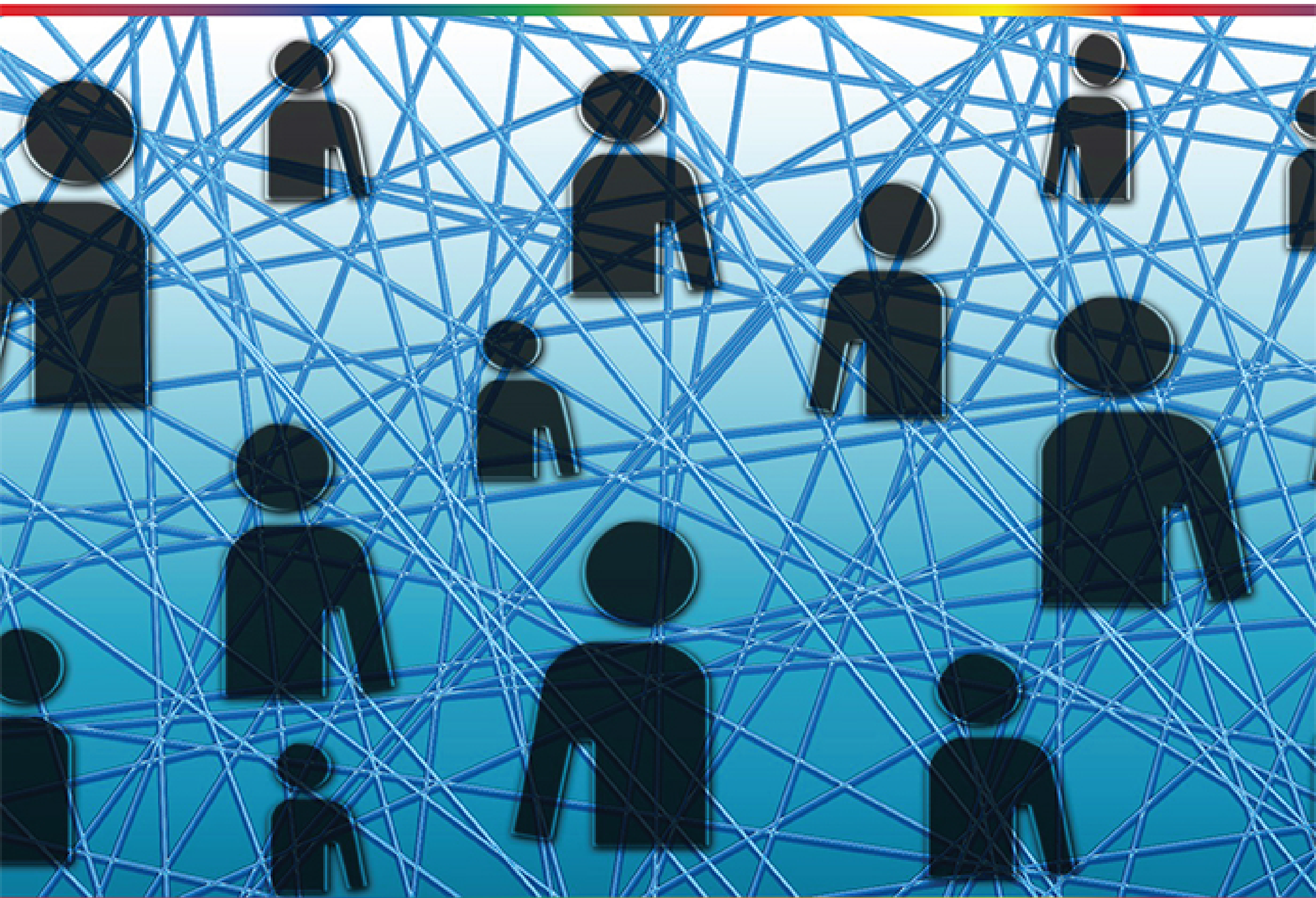
Stephen Rutherford
Editor



Collaborative Learning

Theory, Strategies and Educational Benefits

Education in a Competitive and Globalizing World

NOVA

COLLABORATIVE LEARNING

THEORY, STRATEGIES AND EDUCATIONAL BENEFITS

EDUCATION IN A COMPETITIVE AND GLOBALIZING WORLD

Additional books in this series can be found on Nova's website under the Series tab.

Additional e-books in this series can be found on Nova's website under the e-book tab.

EDUCATION IN A COMPETITIVE AND GLOBALIZING WORLD

COLLABORATIVE LEARNING

THEORY, STRATEGIES AND EDUCATIONAL BENEFITS

STEPHEN RUTHERFORD
EDITOR

nova publishers
New York

Library of Congress Cataloging-in-Publication Data

ISBN: 978-1-63321-790-4 (eBook)

Published by Nova Science Publishers, Inc. † New York

CONTENTS

PREFACE

In his introduction to the edited volume, “Collaborative learning: Cognitive and computational approaches” Pierre Dillenbourg describes the outputs of a series of workshops on collaborative learning, undertaken between several academics across a variety of disciplines. Dillenbourg states specifically that:

> "The reader will not be surprised to learn that our group did not agree on any definition of collaborative learning. We did not even try. There is such a wide variety of uses of this term inside each academic field and a fortiori, across the fields.”
>
> Dillenbourg (1999), p1

It is in this vein, recognising the vast diversity of collaborative learning as a pedagogic approach, that this volume entitled, "Collaborative Learning: Theory, Strategies and Educational Benefits" has been compiled.

Collaborative learning has risen in its significance in recent decades, largely through the recognition of its value by numerous key theorists of social-constructivism and situated learning. There are numerous treatises on collaborative learning and a myriad of subtle variants of definitions around a central theme for this pedagogic methodology. As Dillenbourg noted, it is not possible (or indeed wise) to provide a single clear definition of collaborative learning as a pedagogic concept. This lack of a definition is, in fact, quite comforting, as it reflects the complexity and richness of collaborative activity and collaborative inquiry. The closest some authors have come to a definition has been to highlight differences between co-operative learning (the allocation of tasks between group members within a learning activity) and collaborative learning (the combined focus of all group members on the same tasks simultaneously), but still this is a vague definition. This current edited volume revels in that lack of definition and seeks instead to highlight the diversity of approaches to collaborative learning by presenting a series of examples, case studies, evaluations and discussions of approaches to learning and teaching that have collaborative learning at their core. In presenting a collection of varied approaches we hope to emphasise that collaborative learning as a pedagogic tool is exciting in its diversity and its adaptability.

Cornerstones for collaborative learning are the importance of dialogue and interaction between learners, and the sense of a shared responsibility towards meaning-making or problem-solving. Dialogue is particularly important, as it is essential to the process that learners share their experiences, their expertise and their thoughts or feelings. This makes for a rich and diverse environment of skills, perspectives and experiences. By utilising the assets of the group collectively, the whole performs to a greater capacity the sum of its parts. There are many ways in which to achieve this interactivity, and not all of the collaborative interactions need to be face-to-face to be effective and empowering. The earlier chapters in this volume focus on experiences of collaborative activities, and highlight some of the benefits, insights and challenges these involve.

The role of the teacher, or more-expert other, in scaffolding the collaborative activity is a key and recurring consideration. Some authors refer rather to the "teacher-tutor", as in collaborative learning situations the teacher is required to be an organiser, a facilitator and (not insignificantly) a partner in the overall collaborative activity. The fundamental nature of collaborative learning is that the direct hierarchy of a didactic learning structure is diminished (though not always completely absent). This change in the hierarchical structure of the learning environment may be as challenging for the teacher-tutor as for the learners. Indeed, in the richest collaborative learning environments, the teacher-tutor will be a learner as well. There are several chapters in this volume which focus on the roles and requirements of the teacher-tutor in scaffolding the collaborative activity so that it achieves its maximum impact.

The latter portion of the volume focuses more on the role of technology in collaborative learning, and how the learning experience may be enhanced by its use. In recent years, with the advent of collaborative and Web 2.0 technologies, the potential for technology to increase the scope or impact of collaborative learning has been revealed. Computer-supported collaborative learning (CSCL) is a topic of some considerable interest to theorists and practitioners alike. With any technology comes potential danger; the balance between the technology and the pedagogy in terms of which is the driving force for new and innovative approaches to learning and teaching, is something that needs careful consideration. Yet technology has great potential for collaborative learning in particular and several of the chapters in this volume focus on the use and impact of technology in facilitating the collaborative approach. The chapters in the latter half of this volume illustrate innovative and powerful ways in which technology may be used to support and enhance learning, dialogue and collaboration, without losing the focus of the overall pedagogic requirements of the learning activities themselves.

Chapter 1, by Soraya García-Sánchez, discusses a collaborative methodology whereby students use the production of videos, presentations and other resources to support the learning of English as a second language. This blended learning approach supports the development of mobile learning (m-learning) and ubiquitous learning (u-learning) approaches. These methodologies ensure that learning is not just restricted to the classroom, but becomes part of the participants' overall personal development. With the increasing importance of digital literacy in the internet-empowered society of the 21st century, these lifelong learning skills are especially important.

The chapter also focuses on the importance of role-play and communication in developing confidence and creativity in young people. These forms of collaborative activities are key in promoting the dialogue that is required for collaborative learning to be effective and productive. These methodologies also facilitate the emotional development of learners, as is also seen in Jakubik and Hmelo-Silver, by providing a mutual approach to scaffolding emotive responses to difficult issues. The challenging issues dealt with in the classes described by Garcia-Sanchez are mediated by the opportunity for the group to come to a collective view of the situations.

The approach described by Garcia-Sanchez, of producing digital resources, means that the outputs of the learning session may be shared more-widely with the class as a whole. This is an interesting suspect of the study, and is in accord with the chapter of Scott et al., in providing a mechanism whereby the impact of the collaborative activity may become wider than the immediate group of collaborating learners.

Another key aspect that Garcia-Sanchez highlights is the importance of the teacher-tutor in devising the learning environment and shaping the outline of the collaborative tasks in which the students are engaged. This is both in terms of the design of learning activities and the technology used to support the interactions. When properly scaffolded, the collaborative activity is immensely powerful as a learning tool.

Chapter 2, by Ai-Ling Wang, compares several case studies of cross-cultural collaboration. This chapter highlights the challenges faced by developing collaborative activities between students of different cultures, different language proficiencies and different world views. Many of the case studies highlighted in the chapter focus on interactions involving learners for whom English is not their first language collaborating with learners who are native English speakers. By understanding the aims and goals of each group, it is possible to develop fruitful and effective collaborations that support the learning of all parties.

Of particular interest in this chapter is the subtle difference on collaborative activity that is caused by neither parties being native English speakers, despite using English as the common language medium. The chapter highlights how when collaboration is mutually beneficial, then it is extremely powerful as a learning tool. As is also seen in the later chapters by Gillies and by Simões and Pinheiro, provided that there is sufficient scaffolding for the activities to be beneficial, all parties will work towards a shared goal. However, where the goals of the participants are different, or there is, perhaps, a different perspective of the motives of different participant groups, there is the potential for conflict and a reduction in the efficacy of the learning. Teacher-tutors, therefore, need to be careful in planning the collaborative activity such that these concerns are addressed ahead of them arising. Even so, this chapter highlights clearly that collaborative activity (as is seen in the chapter by Lambropoulos and Romero) does not need to take place within a confined geographical location, but can be of benefit between countries and across cultural and language divides.

In *Chapter 3*, Tara Jakubik and Cindy Hmelo-Silver have presented an interesting study of the interactions between learners whilst mastering an unfamiliar and potentially-confusing literary medium – graphic novels. The authors follow a group of students who are engaged in ‘reading circles’ whereby they jointly read a graphic novel. They identify that there are key roles that individuals variously undertake within the collaborative group. In some cases students worked co-operatively, sharing the reading between them. In others there were students who naturally assumed key roles within the groups. However, these active students were still impacted-upon by the collaborative process. All of the participants within the group had valuable contributions to make, and together the students developed a common understanding of the process.

Jakubik and Hmelo-Silver note that the collaborative activity assists the students not only in meaning-making, but also in reflecting upon themselves and their situation relative to their peers. Collaborative activity enabled students to turn to each other for answers and support, as well as relying on their own efforts to understand the medium, in a manner which is also paralleled in the chapters by Garcia-Sanchez and Scott *et al.*. Collaborative activity also empowered the participants to reflect on their personal and emotive reactions to situations, relative to their peers.

While considering the impact and challenges of collaborative learning for students, it is also essential to consider the essential role that the teacher-tutor plays in this process. *Chapter 4* by Robyn Gillies reviews the research into the role of the teacher in collaborative activities, and identifies the areas for consideration by the teacher-tutor in their role as organiser, facilitator and supporter of collaborative work. Collaborative activity requires dialogue by some means, and this is not always an easy activity for students to undertake. The role of the teacher as a facilitator do dialogue also includes their role in setting the ground-rules and leading by example. The importance of teacher-talk and the dialogue between teachers and learners, as well as between learners themselves, is emphasised. Different models for how this support of the collaborative activity is best achieved are discussed in this chapter. Gillies focuses on key concepts of dialogue talk, exploratory talk, accountable talk and dialogic teaching. The teacher-tutor has a key role to play in scaffolding all of these activities, to a greater or lesser extent, dependent on the situation. Without some form of guidance, however, the potential for the collaborative learning activity to either fail, or be severely limited, is considerable. Gillies's observations are borne out in most of the chapters in this volume, which emphasise the considerations required by the teacher-tutor, as much as those of the students themselves.

One of the cornerstones of collaborative inquiry is the development of meaning-making through discussion and debate. *Chapter 5* by Darinka Sikosek and Davorin Horvat presents a case study of how this verbal interaction can be developed in a specific learning situation. The authors use structured educational debates as a learning activity, to drive the discursive process and collaborative meaning-making. An educational debate is an excellent way to encourage reflexivity and critical thinking in learners, by requiring them to articulate and receive contrasting points of view. The discussion that this generates enables learners to see connections and make value judgements on their own opinions.

Sikosek and Horvat’s chapter outlines many of the considerations that a teacher-tutor should be mindful of during the development process of a learning activity such as this, and the authors share the materials they have designed and used to provide the required scaffolding of the collaborative process. Through this approach, the students were not only able to debate successfully, but also able to critically appraise their peers in a manner which was not too dissimilar to that of the teachers. The success of this scaffolding process reflects the concepts discussed by Gillies and by Wang in this volume, whereby the teacher-tutor has a key role to play in the structuring of the collaborative activity, if that activity is to be successful in a classroom environment. By placing learners in a challenging situation, where they are required to work with each other to derive an answer or to make meanings and understand complex concepts, the teacher-tutor actively encourages a collaborative approach. An educational debate formalises this shared meaning-making as a structured and open discourse, as opposed to the unstructured private discourses that occur during group-based collaborative inquiry.

Chapter 6, by Norman Kee and Noel Chia, takes a slightly different view of collaborative learning to the rest of this book, focusing on the benefits of collaborative activity for the professional development of teachers, rather than for students. By looking at the process of ‘Lesson Study’ as a tool for new or inexperienced teachers to learn the nuances of their profession, the authors emphasise the fact the collaborative learning is not just beneficial to younger learners, but is part of the lifelong learning experience of us all.

Lesson study is centred around the premise that through discussing and critically-assessing one's own practice (in collaboration with one's peers), it is possible to identify less-effective practice that otherwise would go unnoticed and therefore unchallenged. The mindfulness required to be genuinely reflective and self-improving is best generated by collaborative discussions of experiences of individual professional situations. These discussions facilitate more-experienced practitioners highlighting nuances of practise that more-naive individuals might not yet have observed. Conversely, equitable discussions, free of social and professional hierarchies, can lead to the less-experienced practitioner's naïveté questioning existing practices, and revealing flaws in approaches to practice that have previously not been questioned. This approach mirrors the findings of Jakubik and Hmelo-Silver in this volume, who also identify the impact of the collaborative group on revealing misguided practice and understanding. Whether dealing with younger learners or professional practitioners, it is clear that collaborative activity is a powerful tool. By discussing and sharing experiences, all learners of any age or educational level can benefit from developing a shared understanding.

Chapter 7, by Dora Simões and Margarida Pinheiro ,addresses the important question of the role of technology in collaborative learning. The rise in communication technologies over the past decade has revolutionised learning in all levels of education and collaborative activities have benefitted from these technologies considerably. Simões and Pinheiro emphasise the importance of selecting the appropriate technology to support the learning and collaborative experiences. The authors highlight that both pedagogy and technology are subtly changing higher education, emphasising more the benefits of active learning over didactic approaches. As a result, academics are often being seen more as facilitators than teachers, and collaborative learning is one methodology that benefits greatly from this change in emphasis.

Simões and Pinheiro describe an approach whereby information and communication technologies were used to support a collaborative project. The technology facilitated the co-ordination of the group and the authors observe that the collaborative groups functioned well using these media to communicate. As with the chapters by Talon *et al.,* Wang, Scott *et al.* and by Lambroupoulos and Romero, it is clear from this work that technology can be greatly beneficial in supporting collaborative activity. Simões and Pinheiro show that students' outcomes from the learning activities benefit from the collaborative experience.

Chapter 8, by Jonathan Scott, Sumit Mistry, Bernard Moxham and Stephen Rutherford, takes a slightly different direction from the other chapters by focusing on collaborative learning outside of taught or scheduled class activities. The authors investigate the degree to which students create their own collaborative groups to support their learning. From this analysis, it is suggested that students naturally form small partnerships, but rarely engage in larger group collaborative activities of their own accord. However, the authors also show that when given a modicum of scaffolding by teacher-tutors, larger collaborative groups can form, and are significantly beneficial to the learning experience of the participants. As also emphasised by Gillies in her chapter, the scaffolding provided by the teacher-tutor is necessary, even to a modest extent. Therefore even though collaborative activity is extremely useful at supporting meaning-making and understanding, it is not an activity that students normally undertake outside of small social-based groups.

Scott et al. also investigate the potential impact that technology may play in supporting collaborative activities – most significantly in sharing the outputs of those activities with a wider peer group. This ability to broaden the impact of the collaborative activity is reflected in the chapter by Sanchez-García-Sánchez, which also emphasises the benefits of collaborative outputs that are long-lived and shareable. The work presented in this chapter highlights that students do not necessarily need to work within the defined boundaries of the classroom to benefit from collaborative activities.

Interest in the role of technology in collaborative learning is growing, and especially regarding online media and uses electronic tools. *Chapter 9*, by Maria Rangel-S, Jane Guimarães, Ana de Oliveira Barbosa, Nícia, Riccio and Adroaldo Belens undertakes a literature analysis of the footprint of collaborative learning as a subject. In particular the authors focus on the prevalence of collaborative learning via online or web-based strategies. In an analysis of the literature as a whole, the authors note that publications on collaborative learning are increasing in frequency, suggesting that the subject in general is gaining interest and exposure. For the authors the increase was particularly noticeable in the area of health education. Many of these publications were empirical-based research studies of the impact of collaborative learning.

The authors identify some interesting trends in how the notion of collaborative learning is described in abstracts, being variously a pedagogic tool or a pedagogic model. What is interesting to note from this analysis is the variety of ways in with collaborative learning is viewed and approached - very much in-keeping with the ethos of this volume.

Continuing the thread of the role of technology in collaborative learning, *Chapter 10* by Dragan Markovic, Irina Branovic and Ranko Popovic, describes the use of a 3-D virtual reality simulation to promote and support collaboration between learners. One of the challenges faced by any collaborative activity - especially an online or distance-based approach - is encouraging students to engage with the process. By embedding the collaborative activity within a virtual reality learning environment, the authors aimed to address this concern. It is encouraging that one of the key outcomes of using a virtual approach to collaborative activity is not just the degree of engagement with the learning activity, but also the degree of interest that this format engenders in the participants. A novel approach, such as a 3-D virtual environment, already places the learner in an unfamiliar space, and potentially means that he/she is more-open to accepting other concepts, such as the ideas and opinions of others. Being willing to accept change and alternate points of view are key requirements for any collaborative activity.

The authors here are keen to stress that the virtual reality world they describe is not sufficient as an alternative to face-to-face collaboration, but is a useful addition to it. Virtual and online collaboration may be seen as being less-rich than direct personal contact. However, there are significant benefits offered by virtual collaboration for some learners, especially amongst young people. Learners who are less-confident, socially or academically, can be comforted and buffered by virtual environments, and they allow less-articulate individuals to consider their responses rather than feeling pressured to respond immediately. As a collaborative tool, virtual environments bridge the gap between face-to-face and online collaborations nicely, providing elements of both in an engaging and unusual setting.

Chapter 11, by Niki Lambropoulos and Margarida Romero, is a detailed and extensive study of a technology-enhanced collaborative approach which compares the impact on collaborative activity of two contrasting technologies. These technologies are used to facilitate collaborative activity between individual distance learners who are dispersed between different geographical locations and time zones. The traditional face-to-face collaborative activities are therefore not an option for these learners. The authors observe that the technology used has the potential to be a significant benefit to the collaborative process, but also make some keen observations about student behaviour within these different arenas, with their different capacities for supporting collaborative activity between individuals at a distance.

An important aspect of these authors' findings is their observations on the dynamics of the students within the group, and how students perceive themselves and their peers in relation to their input and their validity within the collaborative experience. This observation parallels those of Wang in this volume, highlighting that collaborative activity heightens participants' self-awareness and reflective ability - both in relation to their own situation and their position within a working group.

Lambropoulos and Romero also highlight an important observation, that learners require real-time tool in order to interact and collaborate for effective knowledge-building. So while forums and chat-tools are effective tools in collaborative activity for distance learners, they lack the dynamic quality that face-to-face or real-time discussions possess. Whilst this does not mean that under these circumstances collaborative learning is not possible, there are nevertheless issues that must be borne-in-mind by the teacher-tutor when designing collaborative activities for learners who are dispersed geographically.

The authors also highlight the importance of development of the collaborative group, from discussion that is related to the organisation of the group, to discussion that are aimed at knowledge-building. Both of these activities are key aspects of a collaborative format, and it is difficult for the latter to develop without some attention to the former. The most successful collaborative approach in this study was the one where participants were facilitated in their awareness of the group structure as a whole. Thus possibly the more-aware group began to operate more collaboratively than cooperatively. The dynamics of collaborative learning are similar whether the groups are face-to-face or interacting remotely. However, teachers and tutors need to be mindful of the subtle eccentricities of each of these situations, and adapt the learning activities (especially CSCL activities) accordingly.

Last, but by no means least, the final chapter, *Chapter 12*, by Bénédicte Talon, Henda Belaid and Insaf Kerkeni, offers a detailed descriptive analysis of a blended learning technology and how it may be used as a tool to support collaborative work. The activities undertaken by students, which the authors describe, are both collaborative and cooperative, and require a degree of discussion and interaction. The tool that the authors describe has the potential to track and catalogue this collaborative interaction. This methodology of tracking the activity of participants in a collaborative or cooperative activity is interesting, as it can potentially reveal insights into the dynamics of the activity. While the authors of this chapter have focused on the structure and use of the tool itself, it will be interesting to see what patterns are formed by students who use this tool for collaborative activities.

Talon and colleagues also emphasises how technology can be used to support and monitor collaborative inquiry and cooperative work. This is an excellent example of how a pedagogic tool can be adapted to support collaborative activity. One of the key concerns with any technology-enhanced educational approach is the risk that the technology becomes the driving force rather than the pedagogy. In the example in this chapter, the technology is designed to provide an authentic analogue to the real-life work situation (the authors discuss the deficiencies of higher education in terms of training students for authentic transferable skills). By using technology in this way, as is also shown in the chapter by Markovic *et al*. in this volume, it provides learners with a means to bridge the gap between theoretical knowledge and real-life practice. By using collaborative activity to support this bridging process, the experience is improved for the learners, as they are supported, driven and encouraged by their peers.

Overall, the contributors to this volume show that collaborative learning has many facets and can be undertaken in a myriad of ways. It is hoped that this collection of studies may offer insights into the way in which collaborative learning approaches are being used across the globe and for learners of all ages and educational backgrounds. The contributors to this volume show that collaborative learning is equally valid and useful to learners who are just beginning their education, as well as those who are more experienced or already working as professionals. With the advent of collaborative technologies, face-to-face communication tools and social media, the scope of the collaboration can now extend far beyond the classroom, and be no less effective despite the challenges of distance, culture or even language. The benefits of collaborative learning are there for all of us, learners and teachers alike, to utilise.

Stephen Rutherford
Deputy Director of Undergraduate Education
School of Biosciences
Cardiff University
Museum Avenue
Cardiff, CF10 3AX
Tel: 029 208 70251
E-mail: RutherfordS@cf.ac.uk
May, 2014

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 1

KNOWLEDGE CREATION AND DIGITAL COLLABORATION IN HIGHER EDUCATION

Soraya García-Sánchez*
Department of Modern Languages, Universidad de Las Palmas de Gran Canaria

ABSTRACT

This chapter establishes a debate about the concepts of creativity and collaboration with regards to learning English as a Second Language in Higher Education. The chapter focuses on a heuristic, mindful learning method set in a blended learning environment of English for Specific Purposes (ESP) at the Universidad de Las Palmas de Gran Canaria, Spain. Various task-based examples are provided to demonstrate that a mindful, collaborative and creative learning approach that allows for reflection, participation and autonomy can contribute to enhance ESP competences effectively. On the one hand, this chapter analyses the different communicative tasks that enabled learners to be collaborative and creative in class and online. On the other hand, the results will corroborate that active participants of their learning process create knowledge that is closed to their own spaces. Creation and collaboration for ESP students have benefits that contribute to a successful communicative approach of foreign language and ITC competences.

INTRODUCTION

Learning English for Specific Purposes (ESP) in a non-native environment and engaging students to be active participants in the classroom are not always easy objectives to reach. Without a communicative approach, learners hardly ever feel that they are improving their language skills. Some students start their university degrees at the Universidad de Las Palmas de Gran Canaria (ULPGC), in Spain, with the feeling that their competences in the English language are still quite basic. Their confidence in public speaking, especially if they have to use the English language, is often low. Some are influenced by negative experiences when

* soraya.garcia@ulpgc.es

they studied the foreign language at school or high school. Others have experienced traditional teaching methods that do not contribute to active participation, decision-making and questioning by learners. Nevertheless, students at ULPGC need to be recognized at level B1 when finishing their degree, whichever specialty they are enrolled in. Consequently, English is often the most common first foreign language of the Canarian population.

There are a variety of modes and strategies to allow learners to be immersed in an English speaking context, especially when we can mention mobile learning and ubiquitous learning (*m-learning* and *u-learning*) approaches. Accessing digital material anywhere and at any time (*u-learning*), and by using any mobile device, allows to extend the classroom scenario to other spatial or temporal contexts (Darias Marrero et al., 2013). The classroom is not just a rectangular place for sixty or eighty students who are sat for hours, but the learning space is moved outside the classroom. In this line, *u-learning* contributes in planning autonomous, collaborative and interactive tasks in the educational community. This promotes not only digital, social and collaborative competences in adult learners but it also focuses on autonomous learning and digital competences among the students who are completing bachelor's degrees recognised by the European Higher Education Area.

The potential of online videos in Higher Education is considerable since they serve various purposes to the educational community. One example is the flipped class, in which students watch the clips outside the classroom so that the contact sessions are used for other participative purposes that enhance, for example, communicative tasks, critical thinking exercises or debates. Flipped classes encourage the reflective actions of learners. Another example of using videos at university is as a communicative tool between the teacher and the students. One common practice is for providing feedback to the class members, as can be observed in Figure 1.

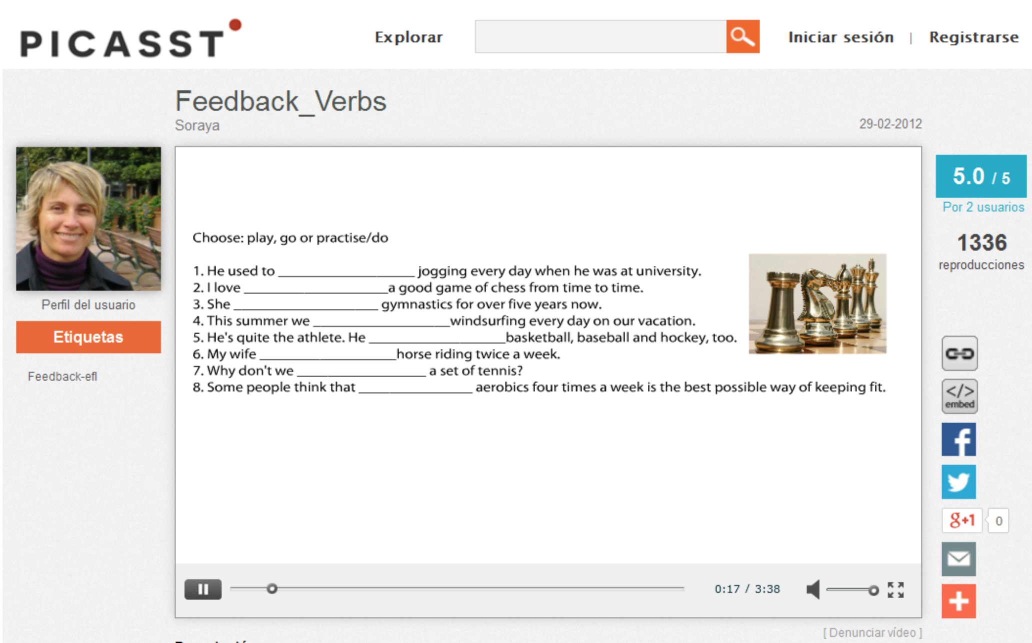


Figure 1. Example of video use as a communication tool between teacher and students.

Finally, video creation has become more and more common among students, who use *YouTube* or *Present.me*, among other tools, to create presentations that could quite possibly be assessed by the teacher. As Curtis (2014) highlights, the use of mobile devices that have internet connection allow participants to open new windows for knowledge: *"[S]martphones put microlearning right in learner's pockets, so it can be done while waiting for the train, hanging out at home or while on a lunch break"*. Moreover, there is no doubt that instructional videos of short length and specific content have become essential teaching-learning resources in the increasingly-prevalent MOOCs: Massive Open Online Courses (Santos-Espino et al., 2013).

A MOOC is intertwined to ubiquitous learning since instructors create a learning environment that addresses different worldwide learners who are beyond the traditional classroom. Interactive discussions, self-assessment quizzes and peer-to-peer evaluation exercises are some of the tasks a MOOC includes in order to make learners participate in the ubiquitous course. Students are working with each other to discover and share knowledge, while the instructor guides them in order to address their needs (Burbules, 2012). In this manner, *u-learning* contributes to collaborative learning methodologies that allow students to adapt their learning time to their needs whichever the place or the time (Yang, 2006).

With technology, the development of autonomy and more social interactions take place in any second language practice (Benson, 2001; Healey, 2007; Schwienhorst, 2003; Kessler and Bikowski, 2010). Collaborative learning requires the careful planning of teachers who may know the group characteristics, the goal setting, the structure to achieve those set goals, the glance of the process and a backwards/forwards reflection of what has been done and how it can be improved (Tschannen-Moran and Woolfolk Hoy, 2000). Collaborative learning strategies often produce a positive answer in ESP learners who become more and more open to diversity when working in collaborative groups (Summers et al., 2005). Collaborative Learning is significantly productive and effective for L2 students who develop their communicative and social competences in a constructivist learning environment (Dewey, 1966 and Vygostky, 1978).

With this entire environment in mind, this study argues that a communicative learning approach that combines face-to-face exercises with online tasks can enhance the language competences of students. Furthermore, if a collaborative learning approach is added, with social, linguistic, communicative and digital competences in mind, the goals can be extended to a higher level since learners gain an enhanced confidence in the foreign language. Collaborative learning implies a better productivity of each member of the group compared to an individualistic or competitive approach (Johnson and Johnson, 1989). Since the class is structured into different groups who are assigned specific interdependent roles, social skills are also expanded when students share their individual cognitive skills with the group in order to formulate a conclusion or solution to the initial task (Summers et al., 2005).

Equally, a task-based approach allows participants to become active learners not only in class but in any virtual learning platform they can access anywhere and at any time. When learners participate in group tasks, they are not only working on the mentioned skills that are applied to collaborative learning, but when dealing with tasks, the following considerations take place:

- Meaning is primary.
- There is a goal which needs to be worked towards.

- The activity is outcome-evaluated.
- There is a real-world relationship (Skehan, 1998).

Collaborative online tasks allow current learners of English not only to share their work but to create knowledge that can benefit other peers inside and outside the classroom. This study suggests how some collaborative learning tasks would make students to engage fully in their ESP communicative competences by participating collaboratively in a blended learning approach that facilitates creativity and reflection. As suggested by the European Higher Education Area, the philosophy of lifelong learning that creates full European citizens corresponds with students' abilities to be autonomous, when making their learning context, and interpersonal, when working with others. In either way, the access to u-learning resources cannot be omitted in this study.

METHODOLOGY

The Learning Process and the Students

This study was undertaken in a blended learning environment that combined face-to-face lessons with different u-tools and tasks posted on the course page in the virtual learning platform, *Moodle*. Students accessed digital content anywhere and at anytime, so the ubiquitous learning approach was also behind this Higher Education setting at the Universidad de Las Palmas de Gran Canaria, Spain. *English Applied to Social Work* was the compulsory subject of English for Specific Purposes for these learners who were in their third year of their degree in Social Work. Two groups of about 80 students between 20 and 60 years old participated in this learning experience during two consecutive years (2012-2013; 2013-2014). This subject programme had 6 ECTS (European Credit Transfer and Accumulation System), which implied that learners had 60 contact hours combined with 90 hours of online and independent or group learning work.

The students of *English Applied to Social Work* had to, individually and co-operatively, perform various tasks, either in class or online, in order to fulfil the goals required for their evaluation of the course. Although some students were reluctant to interact actively with others using the English language in class, the use of technology combined with a communicative learning approach invited learners to cooperate with each other and be active participants of their learning process. The frequent access to the Internet by means of mobile devices was, on the contrary, an additional benefit for this learning environment. As a result *u-learning* was taken into consideration at the time of planning the communicative, collaborative, and e-learning tasks that will be mentioned in the following section.

Data collection included both quantitative and qualitative methods. A full evaluation using this experimental approach focused on communication, creativity and collaboration in the learning of English for Specific Purposes. Students were given instructions, the u-tools, lectures and the evaluation criteria to complete two oral tasks. The instruments for this analysis were an anonymous online survey, students' videos and *PowerPoint* presentations, together with the discussion forums where they posted their work and where they provided and received feedback from their peers. At the end of the semester, an online survey was posted on the course platform to collect their feedback. 71% of students completed the survey.

In order to initiate the collaborative learning atmosphere, the teacher allowed learners to construct their own groups, so that they felt comfortable with their peers. It happened during the 7th-8th week of the semester. In the instructions for both the oral presentation and the video-recording of a role-play, however, it was clearly stated that each member of the group had to participate in these communicative oral tasks. The evaluation criteria for the oral presentation and for the video role-playing were posted on the virtual platform for students to print out on the day of their presentations for peer to peer assessment.

		P2P Group (20%)	T (80%)
VISUALS &Ppt/Prezi FORMAT	1	_____	_____
BODY LANGUAGE	1	_____	_____
ORGANISATION & DELIVERY	1	_____	_____
FLUENCY & INTERACTION	1.5	_____	_____
VOCABULARY	1.5	_____	_____
GRAMMAR & USE OF ENGLISH	2	_____	_____
PRONUNCIATION, INTONATION	2	_____	_____
FINAL GRADE	TOTAL		

Figure 2. Evaluation criteria for the oral presentation.

		P2P Group (20%)	T (80%)
ROLEPLAY SITUATION/ORIGINALITY	2.5	_____	_____
GROUP WORK	1	_____	_____
FLUENCY & PRONUNCIATION	1	_____	_____
VOCABULARY & CONTENT	2	_____	_____
GRAMMAR & USE OF ENGLISH	2	_____	_____
LINK BETWEEN PRESENTATION & ROLEPLAY	1.5	_____	_____
FINAL GRADE	TOTAL		

Figure 3. Evaluation criteria for the role-play.

The Oral Tasks and the Evaluation

Since the preparation of *English Applied to Social Work* included some writing and reading comprehension skills together with lexicon and the use of functional language for the context of Social Work, the collaborative learning tasks were planned to perform oral skills in the specific language of social work. These two oral tasks were delivered in groups of 4 – 5 active members. Both collaborative learning tasks were linked to communicative language competences and ITC, since students had to do some previous research, planned their topic and role-play for a later presentation and video-recording. The context for the presentations and the forthcoming role-plays had to correspond with one of the topics studied in the course:

1. Communication
2. Communication skills in human services
3. Family communication
4. Child protection
5. Communication and elderly people
6. Managing communication in prisons

The oral presentation was created using some visuals in a presentation format, usually *PowerPoint* or *Prezi*. It had to correspond with one of the topics undertaken in class but students needed to add some new information so that their cognitive skills were assessed. The delivery of each presentation was done in front on the whole class (between 80-90 students).

Each day, there were two groups presenting and each member of each group had to assess each other and give a general mark following the evaluation criteria posted on the virtual campus. This peer-to-peer evaluation only implied a 20% of the oral tasks but it provided learners with the possibility of contributing to each other's evaluation. The remaining 80% of the evaluation was assigned by the teacher, as it can be seen below. The rubric designed for the oral presentation assessed the use of visuals to support the work, and the appropriate use of foreign language skills related to Grammar, Use of English and Vocabulary. The interaction students maintained as a group was also considered, together with the organisation of the group and delivery of outputs.

Finally, the body language was also assessed in this first communicative task. When delivering their oral presentation, students had to also include their situation in context, which was often played after the presentation was concluded. The majority of students used the following order: they gave the oral presentation first, then they continued introducing their video, then they concluded by thanking the audience and asking for any questions or comments. The evaluation criteria for the role-play included the originality to create an appropriate context for the role-play, the group work, the use of correct vocabulary and grammatical structures together with some oral abilities in the foreign language such as fluency and pronunciation. Finally, the connection between the group oral presentation and the role-play video was also included in this assessment. Both evaluation criteria have been designed to form a unit with the intention of assessing collaboration, communication in ESP and creativity using a b-learning (blended learning) environment. Blended learning approaches often combine face-to-face activities with e-learning.

In order to complement these collaborative learning skills, two discussion forums were opened on the course virtual platform (based on *Moodle*), with the intention of allowing students to complete two online activities. One was to post both the link of their video role-playing and their *PowerPoint*/*Prezi* presentation on the right forum designed for it. Two was to provide constructive feedback on the work the other groups had created.

The instructions published on each forum required that everyone received and gave feedback, with the intention of constructing a comfortable educational atmosphere for sharing knowledge, experiences and opinions. Finally, all these tasks were always done in the foreign language, so students kept the communication flowing in English.

RESULTS AND DISCUSSION

Oral Communicative Competences: Role-playing and Presentations with ITC

During the two years of this study, each group of about 80 students was given the course assessment and the evaluation criteria in the first week of the course. Details were posted on the course platform for them to consult and print out on the day of their delivery. Students knew what they had to do and which competences they had to perform successfully in order to pass this subject. As a result, the students understood that the traditional final test to assess vocabulary, use of English and writing comprehension skills only comprised 50% of the summative assessment. The other remaining 50%, centred on the continuous assessment, required their active participation in class and online, and the accomplishment of two oral communicative tasks: the oral presentation and the role-play video recording in a context particular for social workers.

These two oral tasks required some research and collaborative decision making among the four members of each group. Instead of implementing solo performances of competition, the collaborative learning approach was designed in order to highlight social and affective skills that would improve students' confidence in the foreign language and the performance of various language skills together with other affective challenges.

Once the groups were organised according to the students' criteria, the topic of their presentations and role-plays were chosen with the aim of having all the areas of the course discussion covered. In order to facilitate undertaking some group discussion, planning and research for the students' oral tasks, two sessions of 50 minutes were offered in the IT room.

The IT Tools

In order to assess the digital competences promoted by the European Higher Education Area (EHEA), the following u-tools were proposed for students to elaborate their communicative collaborative tasks. For the oral presentations on one of the topics delivered during the course, students were suggested to use various visuals on a *PowerPoint* or *Prezi* format. A previous twenty-minute session was also delivered in class by the teacher in order to explain the steps students should follow when doing an oral presentation using visuals. This presentation was also recorded and posted on the course platform, with the intention of allowing students to revisit it when preparing their speeches. Not only was the structure of an oral presentation was introduced, but the use of visuals was explained with examples during that lecture. Also some tips to control their nerves, to communicate effectively and to make correct postures in order to successfully communicate with their body language were also provided. This latter support was necessary since the course of *English Applied to Social Work* devoted two topics to communicative skills in a professional environment.

For the creation of videos, students used either the cameras of their smart phones or their tablet PCs. Then they uploaded and edited their videos on *YouTube*. As part of the instructions, students were suggested to register on *YouTube* so that they could upload and edit their videos. Students were also advised to save videos as "hidden" instead of "public" or "private" (the latter would mean that a password was required to see the digital document). The "hidden" version would imply that only the students of the course, who had access to the links posted on the forums, could see each other's videos. Although the large number of learners used the physical scenarios of the ULPGC campus to record their videos, some moved their role-plays to other external spaces such as their houses and cars. Most videos included the credits of the authors, soundtrack, the role-play itself and some outtakes. Also, some groups used make-up and some fancy costumes to positively contribute in the performance of their role-plays.

Figure 4. "Communication in a TV show".

Three examples of innovative videos are presented in the following snapshots. The first one (Figure 4) is about "Effective Communication" and it uses the scenario of a popular TV show, "Divinity", to establish the situation. There is a TV presenter and two invited speakers that start the video with wrong forms of acting and talking in public places in order to continue with the correct forms of talking and behaving in public spaces.

The second example (Figure 5) is set in the context of social workers and prisoners. The protagonists are a social worker, a prisoner, a psychologist and a policewoman (figure 5(b)). The scenarios are various: in prison; in the street robbing a car; in prison again; in the office with the psychologist and the social workers; at work once the prisoner is successfully re-integrated into society.

Finally, the last picture (Figure 5(c)) illustrates some snapshots devoted to a role-play in the context of "Child Abuse", and how the school finds a solution to that problem at home. These three videos also used credits and soundtrack in their edition, and they were some of the favourite recordings for the class members.

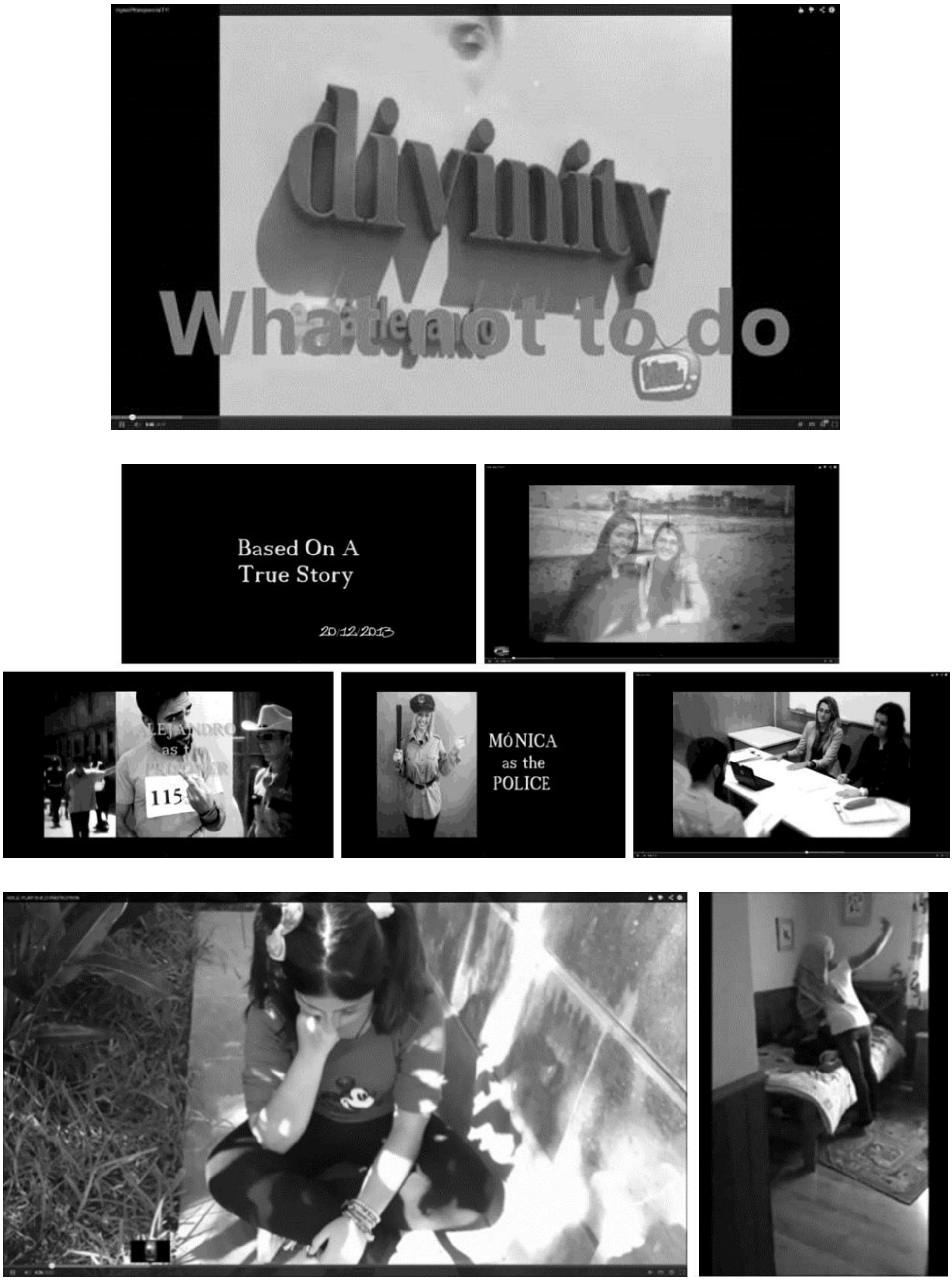


Figure 5. Screen captures from “Divinity”. (a) Welcome message, (b) “Working with a prisoner”, (c) “Child Protection”.

The Communicative Competences for Creation and Collaboration

The competences intended for *English Applied to Social Work* are various (summarised in table 1). They are categorised according to general, specific and nuclear, according to what learners have to perform.

In table 1, only the tasks and competences that correspond with communicative language skills are included. The left column summarises the communicative competences whereas the right column describes the various exercises and tasks students did in order to successfully perform in this basic learning (*b-learning*) environment at ULPGC.

Table 1.Communicative Competences and tasks for *English Applied to Social Work*

English Applied to Social Work	
Communicative Competences	**Collaborative Tasks in a b-learning environment**
GENERAL	
Ability to communicate in the English language at level B1.	Debates in class, group oral presentations in class, discussion forums, pair work, role-plays, students' interaction, video recording, peer to peer feedback on forums.
SPECIFIC	
Ability to understand, speak and write in English at an intermediate level.	Debates in class, group oral presentations in class, discussion forums, pair work, role-plays, students interaction, video recording, peer to peer feedback on forum, reading exercises, summaries, word guessing, word definition, written test.
Capacity to elaborate reports and transmit ideas about any topic but with especial focus on the area of social work.	Peer to peer feedback on forum, summaries, assignments, role-plays, group oral presentations, written test.
NUCLEAR	
Capability to communicate in an appropriate and respectful way with different audiences (clients, collaborators, promoters, social agents, etc.), using the most appropriate resources and ways of communication (especially, ICT), in a way that can understand the interests, needs and worries of people and organisations, and that can express clearly the meaning of the task set.	Role-plays, discussion forums, video recording and video posting, oral presentations.
Ability to actively participate in multicultural integration that favours human development, living together and social justice.	Debates, discussion forums, role-plays.

The Creative Goals

Maurice Sendak, an American writer who focused on the artistic competences of children, created stories for children and with children as protagonists. Bodmer (2014) makes a contribution to Sendak's work and highlights that children are born free with the abilities of creation, interpretation and interaction, and only when they become adults, these artistic competences seem to disappear. The two oral communicative tasks designed for *English Applied to Social Work* have aimed to add this component of freedom for creation and collaboration in the ESP learners. Although the six topics of the course limit the freedom of students somehow, the possibilities for originality and creation are still extensive.

The oral presentation and the role-play were planned, bearing in mind the instructions and the topics of the course but not without allowing some space for group research, critical thinking, interaction and knowledge acquisition. The creation of these two tasks implied that the students were working together with digital texts and were using the foreign language. Their subsequent plan to choose the topic, establish different group actions, choose the most appropriate subtopic, design the presentation and create a situation-solution for the role-play was the scenario that contributed to innovate and be creative to perform these collaborative, communicative tasks. The observation of the students' performance of these two tasks emphasises that students enjoyed elaborating these two creative tasks that required some human skills social workers should have such as empathy and group work. As stated by Murdock (2003): "Humanising creativity emphasises that creativity happens individually, collaboratively and communally. Communal creativity is particularly important to the humanising process and encourages a strong focus on empathy, shared ownership and group identity".

Anonymous Feedback

According to the anonymous survey, the data collected to answer three specific questions are of interest in this study (summarised in figure 6). The two favourite tasks students enjoyed in the course, being the role-plays (35%) and the video creation (25%) and posting in the course platform. The third favourite task was the discussion forum (18%), rather than the oral presentations (10%) that were the fifth favourite task after the debates (12%). Interestingly, from a selection of six different tasks, the fifth preferred activities correspond with communicative and collaborative competences among the group members.

What are the best aspects of the course? Please, number your two favourite from the options.

- ✓ class oral presentations (**5th favourite**)
- ✓ role-plays (**1st favourite**)
- ✓ discussion forums (**3rd favourite**)
- ✓ video creation & posting in the course platform (**2nd favourite**)
- ✓ peer to peer exercises
- ✓ debates (**4th favourite**)
- ✓ videos watched before the face-to-face class (**6th favourite**)
- ✓ Other:______________________

Figure 6. Anonymous survey data regarding the best aspects of the course.

The second question in the survey was also interesting for this analysis because it provided information about the type of device these learners used to use when accessing the u-learning resources posted on the course platform. It is suggested that the Personal Computer is still the most common machine used by these learners (58%) followed by the laptop and their smart phones. The tablet PC was also used, but by only 7% of learners. Although it is more common to see students with mobile devices in the ESP classroom, it seems that they still prefer using the traditional PC to fulfilled different u-learning tasks and sessions.

Finally, the third question in the survey was about the effective learning use of open learning spaces such as *OCW*, *Picasst* or *YouTube*, to mention some of them. It was investigated whether or not these ESP learners would continue accessing open learning spaces to continue enhancing their communicative competences in English. The numbers collected indicate that 92% of students answered positively to continue improving their English language skills, so that the lifelong learning competence was also promoted.

CONCLUSION

Built upon innovative strategies for learning foreign languages in Higher Education, this chapter provided some examples of oral tasks that contributed to a collaborative learning approach combined with creativity in the English for Specific Purposes classroom. The main objective was to improve communicative language skills that built some confidence in ESP learners when talking in public. Secondly, the development of the students' digital competences by means of creating a community for learning was the consequent goal. The data collected suggest that a task-based approach that provides space for collaboration and creation among students of ESP can enhance their communicative and social competences effectively. The creation and delivery of an oral presentation in the physical class combined with the making of the video role-playing using the context of Social Work provided these active learners to form a learning context closer to their needs.

The combination of formative and summative assessments has also been considered in this course, giving especial emphasis to constructive suggestions. There is no doubt that the participation in the creation of these two collaborative tasks was compulsory as they were included in the continuous assessment of the subject *English Applied to Social Work*. Most students were extrinsically motivated to complete these tasks since they were given a 20% mark if they successfully completed these two oral exercises. It is suggested, however, that because participants actively engaged in the elaboration of their oral presentation and the context creation of their role-play, that although compulsory, students seemed to have especially enjoyed the elaboration of their work and presentation with the rest of the community. Intrinsic motivational attitudes were also appreciated during and at the end of this course.

The interdependent competence seemed to have worked quite well considering the different steps learners had to face. First, they were aware of the necessity of doing these two communicative collaborative tasks if they wanted to pass this subject. Second, they chose their group members to start the creation process and the collaborative abilities. Third, active participants of ESL shaped both their oral presentations and their video recording of a role-play assigning different roles to the group members.

Finally, the educational products were successfully delivered and shared with the rest of the ESP community of this course. The main intention was, on the one hand, to allow learners to freely create their own work in order to reflect on their own learning and that of others. On the other hand, the subsequent result was the extrinsic motivation of positively being assessed by the teacher, and therefore has passed this subject. However, the instructions established an active critical participation of the students who gave and received feedback of some groups.

The observation of the teacher during the class sessions, the tutorials requested, and especially the two IT sessions given for students to plan and organise their work, confirm that the majority of students, even the less confident ones and the shy minority, were working in a constructive learning environment that allowed them to "reflect on what they [were] doing, so that they learn[t] from their experiences" (Kinniburg, 2010, p. 77). The input and output given and received by this learning community of ESP was established on a constructivist learning environment with real goals for them to fulfil.

All in all, this case study has demonstrated that learners of the international language can benefit from collaborative task-based activities that enhance not only their linguistic competences but also their social and creative abilities in a scenario that combines face-to-face discussions with digital creative work and collaboration. Along these lines, the learning environment is not only blended but ubiquitous, happening anywhere and at any time, outside the limits of the classroom. It goes beyond the university campus in order to effectively contribute in shaping autonomous, ubiquitous and life-long learners of ESP.

REFERENCES

Benson, P. (2001). *Teaching and researching autonomy in language learning*. Harlow, England: Pearson.

Bodmer, G.R. (2014). Maurice Sendak: The Child as Artist. *PMLA. 129*, 101-103.

Burbules, N.C. (2012). El aprendizaje ubicuo y el futuro de la enseñanza. *Encounters. 13*, 2-14.

Curtis, J. (2014). Microlearning: Turning Smartphones into Textbooks. *eLearning Mind*. From:http://elearningmind.com/microlearning-turning-smartphones-into-textbooks/?goback=.gde_1881768_member_5829611628227760131#! Accessed 6/1/14.

Darias Marrero, A., García-Sánchez, S., and Vidal Luengo, A.R. (2013) Aprendizaje móvil, ubicuo y autónomo de lenguas extranjeras en la ULPC. *Cuadernos de Innovación educative. 1*, 11-35.

Dewey, J. (1966). *Democracy and Education*. New York: Free Press.

Healey, D. (2007). Theory and research: Autonomy and language learning. In: J. Egbert and E. Hanson-Smith (Eds.), *CALL environments: Research, practice and critical issues*, TESOL Alexandria, VA. pp. 377–389.

Johnson, D., and Johnson, R. T. (1989). *Cooperative and Competition: Theory and Research*. Edina, Minnesota: Interaction Book Company.

Kessler, G., and Bikowski, D. (2010). Developing collaborative autonomous learning abilities in computer mediated language learning: attention to meaning among students in wiki space. *Computer Assisted Language Learning. 23*, 41-58.

Kinniburg, J. (2010). A constructivist approach to using GIS in the New Zealand classroom. *New Zealand Geographer*. *66*,74-84.

Murdock, M.C. (2003). The Effects of Teaching Programmes Intended to Stimulate Creativity: A disciplinary view. *Scandinavian Journal of Educational Research. 47*, 339-357.

Santos-Espino, J.M., Afonso Suárez, M.D., Guerra Artal, C., and García-Sánchez, S. (2013). Measuring the Quality of Instructional Videos for Higher Education. *ICERI Proceedings: 6th International Conference of Education, Research and Innovation*. pp. 1053-1060.

Schwienhorst, K. (2003). Neither here nor there? Learner autonomy and intercultural factors in CALL environments. In D. Palfreyman and R.C. Smith (Eds.), *Learner autonomy across cultures: Language education perspectives*. Palgrave Macmillan, New York. USA. pp. 164–180.

Tschannen-Moran, M., and Woolfolk Hoy, A. (2000). Collaborative learning: A memorable model. *The Teacher Educator*. *36*, 148-165.

Skehan, P. (1998). Task-Based Instruction. *Annual Review of Applied Linguistics*. *18*, 268-286.

Summers, J.J., Gorin, J.S., Beretvas S.N., and Svinicki, M.D. (2005). Evaluating Collaborative Learning and Community. *The Journal of Experimental Education*. *73*, 165-188.

Vygotsky, L.S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Yang, S.J.H. (2006). Context aware ubiquitous learning environment for peer-to-peer collaborative learning. *Educational Technology and Society*. *9*, 188-201.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 2

KEY TO DEVELOPING CROSS-CULTURAL COLLABORATION: THREE CASES OF COLLABORATIVE PROJECTS

Ai-Ling Wang*
Tamkang University, New Taipei City, Taiwan

ABSTRACT

Research studies have shown that not all cross-cultural collaborative projects can really benefit their participants. This chapter aims at illustrating how a collaborative project between two culturally different groups of students can be developed to ensure that both groups can benefit from the collaboration.

In this chapter, three research studies on cross-cultural collablration reported by different researchers are reviewed. The author then presents three cases of cross-cultural collaborative projects in which she was personally involved. The first case was a collaborative project with Taiwanese students and American students as participants; the second case was joined by Taiwanese and American TESOL majors; and the third case was the collaboration between Taiwanese and French business majors. The three projects were different in terms of the objectives of the project: the nature of the students, how the project was conducted, and findings of the study.

The author applies the grounded theory method to compare and analyze her three cases of cross-cultural collaborative projects along with existing research studies on cross-cultural collaboration, and to look for important issues and patterns emerging from the data. Findings of the comparison and analysis showed that, despite the differences mentioned above, cross-cultural collaborations did share something in common and this is actually key to successful cross-cultural collaboration. The author finally suggests some important issues for practitioners to keep in mind while developing a cross-cultural collaborative project.

Keywords: Cross-cultural collaboration, cross-cultural collaborative projects, grounded theory method, collaboration and cooperation, cooperative learning

---

* Email: wanga@mail.tku.edu.tw.

INTRODUCTION

Cross-cultural collaborations are very popular in modern society. In the educational arena, educators develop cross-cultural projects to help students with learning a language, culture, and professional subjects. Compared with traditional learning, learning from people of a different culture can have added value in terms of language skills, cultural awareness, and professional growth.

There are two issues involved in cross-cultural collaborations: collaboration and cross-cultural communication. It is not uncommon that a learning activity requires students to work together. Cooperative learning activities or different types of group work can easily be found in an educational setting. Some issues of cooperative learning have been raised by researchers, such as the way to group participants, unequal contribution to a group project, and assessment of group work (Olsen and Kagan, 1992). In this chapter, the author does not treat the two terms *cooperation* and *collaboration* equally and will stick to the sense and merits of collaboration throughout the chapter. In some sense, collaborative projects may help solve some problems of cooperative learning mentioned above. In a collaborative project, participants do not just work on their assigned part alone and put each participant's work together as the final product of the group. A collaborative project features its interdependence among participants and different contributions to the project. Chances are that a collaborative group needs to find another group member specialized in a particular skill to fill the role of a member who is leaving the group. For example, publication of a campus newspaper requires collaboration among writers, editors, proofreaders, art designers, etc. An individual can hardly fulfill all the tasks. That is to say, the performance or accomplishment of a collaborative project should be more than the sum of each individual work.

Another underlying issue in cross-cultural collaboration is cross-cultural communication. Generally speaking, cross-cultural communication is much more complicated than traditional classroom communication. Partner groups' being geographically apart may require a virtual environment for cross-cultural communication. As modern technologies develop, cross-cultural collaborations have become more and more popular and much easier to organize. Different modes of communication and different learning environments of cross-cultural collaboration can be developed for students to learn. However, not all cross-cultural exchange activities are seen to be successful in terms of how students can benefit from these activities. Technologies used for cross-cultural communication may not be the sole problem cross-cultural collaboration practitioners experience. As Egea (2007) pointed out, in cross-cultural collaboration, in addition to technological skills, partner students need to develop communicative and collaborative skills. These skills are particularly important in cross-cultural collaborations because they involve participants from different cultures and different modes of collaboration may be significantly different from that of traditional face-to-face classroom teamwork.

Several research studies have shown that there are challenges existing in cross-cultural collaboration in the educational arena (Magnier-Watanabe *et al.*, 2011; Ellenwood and Synders, 2010; Yogman and Kaylani, 1996; Wilkinson and Wang, 2007). This chapter aims to review cases of cross-cultural collaboration in terms of their degree of communication and collaboration between or among groups of participants and how participants may learn and extend their discipline and knowledge through communication and collaboration. In this chapter, the author will first define *collaboration* and *cooperation* and explain, based on the principles and merits of collaboration, and compare differences between *collaboration* and *cooperation* in the literature review section. Also in this section, the author will review existing research studies reported by practitioners of cross-cultural collaboration to illustrate how cross-cultural collaboration can be practiced. Also, these research reports may serve as additional information or evidence to support the author's own research and personal explanation. In the methodology section, the author will present three cases of cross-cultural collaborative projects experienced by the author herself, and then the author will follow the principles of the grounded theory method to analyze the data to look for important points that may be crucial to the development of cross-cultural collaborative projects. Finally, the author will present findings of the analysis and discuss their significance in the course of developing cross-cultural collaboration.

LITERATURE REVIEW

In this section, the author will first define the word *collaboration* and *cooperation* and explain what may differentiate them in the educational arena, and then the author will review three research reports on cross-cultural collaboration. These cases are different in their research design, background of participants, and purposes of collaboration. By doing so, the author intends to provide readers with a broader sense of cross-cultural collaboration and to urge readers to look at cross-cultural collaboration from different perspectives.

Definition of Collaboration and Cooperation

At first glance, the word *collaboration* seems easy to understand. However, *collaboration* is often misinterpreted as *cooperation* and the two words are sometimes used interchangeably. There is a subtle difference between *collaboration* and *cooperation*. Specifically speaking, *collaboration* is a higher level of *cooperation*. Cooperation between or among partners is more informal, and there is no need to define each partner's mission or role. Little or no planning effort is needed in a cooperative task, and there is no hierarchical power structure in the task. Each individual shares information with others and retains his or her authority. Compared with *cooperation*, *collaboration* is more a long-term project than a smaller-scaled cooperation. Collaboration between partners needs to be well planned in advance and each individual has his or her mission to accomplish and a role to play. The power structure in a collaborative team is hierarchical, and the entire team must work together toward a shared goal. Speaking specifically of the nature of *collaboration* and *cooperation*, people "collaborate" to "collect" different pieces of information needed for a joint task to be fulfilled. Unlike *collaboration*, people get "connected" to "cooperate" in sharing information and helping each other to pursue their own goals (Winer and Ray, 1994).

There are both merits and drawbacks of collaboration and cooperation. In a collaborative work, each individual member of the team needs to contribute his or her part in order for the project to be complete and, by contributing to the common project, each member can feel a sense of participation and accomplishment. However, the credit for the completion of the project is shared by all team members and is considered a team effort. In a cooperative learning environment, members help each other and learn whatever is needed for them in their hope to achieve their personal goal. In this cooperative context, members have loosely connected relations and they feel free and comfortable to work with each other and to enjoy their own achievement.

Another issue relevant to collaboration is the context of collaboration. Egea (2007) pointed out that working in a virtual team is quite different from working in a traditional face-to-face group team. The chances are that cross-cultural collaboration needs to work with partner groups in a virtual environment. Egea argued that there are at least three types of social behavior particularly relevant to virtual teamwork and communication: conversation, awareness, and coordination. In virtual conversations, participants need to communicate based on the rules of interaction, the implicit or explicit cues, formal or informal language, whether the communication is synchronous or asynchronous, number of participants, etc. On the other hand, participants of a cross-cultural collaborative team must have both cultural and audience awareness. Finally, participants of culturally different groups need to coordinate with each other for shared understandings, schedules, social norms and rules. The three types of social behavior may not be so apparent in traditional face-to-face communications. In virtual communications, these types of social behavior may be crucial to the success of a cross-cultural collaborative project.

In the *methods* section to come, the author will present three cases of cross-cultural collaboration experienced by the author herself and these cases are collaborations between Taiwanese students and their international partners. However, based on the definition mentioned above that requires participants of each part to contribute in a certain degree to the joint projects to entitle the projects to be called *collaboration*, the three cases are not necessarily collaborative projects. The author attempts to review and reflect on the three cases of cross-cultural collaboration and explores how cooperative or collaborative projects may affect students' learning and how they may differentiate from each other.

Studies on Cross-cultural Collaboration

In this section, the author will review three research studies on cross-cultural collaboration. These research studies may show that different research designs and different collaborative activities may create different types of contribution to the collaboration. These studies will serve as supporting information or evidence to be compared with the studies done by the author that will be described later. The first study to be described below was about blended learning in MBA education and was done by Magnier-Watanabe *et al.* (2011); the second study done by Ellenwood and Synders (2010) was a cross-cultural project combining a virtual journey with face-to-face exchange; and the third study was an ESP program, done by Yogman and Kaylani (1996), involving college business majors from different cultures to work together in the same classroom.

Blended Learning in MBA Education

The study by Magnier-Watanabe *et al.* (2011) involved MBA students from Japan and from France. In their case study, the authors first raised two issues relevant to cross-cultural collaboration between two groups of students from different cultures: experiential learning and cross-cultural understanding and language proficiency. The authors argued that hands-on experiential learning is key to developing cross-cultural understanding and it is particularly important for MBA students who need to develop cultural adaptability and flexible management to respond to different cultures. In addition to cultural learning, another issue, language proficiency, should also concern practitioners of cross-cultural collaboration, especially if the collaboration involves non-English speaking groups. In addition to the proficiency level of the lingua franca, English in this case, students from different cultures also exhibit different attitudes toward using the language. For example, as Magnier-Watanabe *et al.* pointed out, "students from Asian countries were much less comfortable in challenging or criticizing others' ideas, and may not know how to express disagreement appropriately in English" (p. 255).

The Magnier-Watanabe *et al.* (2011) study included Japanese participants who were business executives in Tokyo, while the French participants were young full-time graduate students. This type of collaboration allowed bridging the gap between academic and business practices and bringing value to both sides. On the other hand, the researchers claimed that the collaborative project is one kind of blended learning. As described by the researchers, the class

> "…incorporated both interactive lectures and class discussions, using several case studies of international alliances and the participation of a senior manager with a long international experience as guest speaker. Assignments for this class were a combination of individual papers and group projects with students from both sides working together in cross-national teams." (p. 256).

In the process of designing the course, the authors particularly described different profiles and a wide gap existing between the two groups of participants, including age, level of English proficiency, academic background, professional experience, school calendar, and familiarity with the Moodle platform. These differences required a lot of coordinating work for faculty from both sides to reach consensus.

Participants of the cross-cultural MBA course included 10 students from each side. Generally speaking, the Japanese participants were older and had more professional experiences, better English proficiency, and felt more comfortable with the use of technological tools than French participants did. The Japanese participants were working professionals attending classes after work, while French participants were first-year M.A. students in their early 20s.

In activities practiced during the 10-week course, aside from lectures delivered by faculty members from the two sides, students presented and discussed cultural issues and business cases in mixed teams with two members from the Japanese side and two members from the French side. In general, findings of Magnier-Watanabe *et al.* (2011) showed that students held positive attitudes toward the course, including distance-learning environment, faculty exchange, and even imbalance of students' background. Their study presents a good example of how a cross-cultural distance course can be organized. This research report may benefit practitioners of cross-cultural collaboration more if the authors can present the added value of the collaboration for both groups and report specifically as to how students' group presentations and discussions show cross-cultural contacts in action.

Virtual Journey Coupled with Face-to-face Exchange

It may benefit participants more if cross-cultural collaborations can provide partner groups with both virtual learning and face-to-face contact experiences. The second case to be introduced in this section was done by Ellenwood and Synders (2010). Ellenwood and Synders's study involved graduate students from an American and a South African University. The activities organized for the cross-cultural collaboration included a six-week virtual exchange and a two-week face-to-face contact. In their study, the authors particularly focused their attention on the investigation of cultural competency and intercultural sensitivity.

Ellenwood and Synders (2010) argued that both genetics and environment are responsible for the development of one's personality and that one's negative attitude toward the perception of a person from a different culture may be changed through involvement in an issue together. The purpose for having online activities prior to face-to-face contacts abroad was that, according to the authors, online activities may develop students' cultural sensitivity and cultural competence and students' anxiety for the forthcoming trip abroad may be allayed.

Ellenwood and Synders (2010) carefully designed the course to reflect the developmental stages of intercultural sensitivity, with the last stage being the ethnorelative stage that required American students to visit students at University of South Africa. There were basically two parts of the project: web-based instruction and face-to-face education abroad. In the first part, students were required to interact on online List Serv. Students first introduced themselves to their partner peers and then they discussed online particular cultural issues and commented on each other's postings. In the second part, a 10-day face-to-face education abroad, American students flew to South Africa to have field trips to schools there and to have real cultural experiences. At first glance, it seemed that the two groups of students were not "collaborating". They were not working together to achieve a common goal. They just provided their own ideas and cultural messages and interacted with their partner students online. However, cultural competency and intercultural sensitivity could not be developed without either student group. They were actually working together to achieve a common goal: enhancing the cultural sensitivity and competence.

Ellenwood and Synders (2010) concluded that the "six-week online List Serv and 10-day face-to-face experience positively impacted the group's cognition, attitudes, and behavior toward people of difference" (p. 559). On the other hand, a lot of participants' worldview had been moving from "all people are alike physically, psychologically, and spiritually" to "acknowledging differences among people in the world," another merit worth mentioning as to how the project was organized. An educational abroad experience can be more exciting, comfortable, valuable and less stressful and uncertain after the experience of online interaction and after getting familiar with each other's culture.

ESP Program for Mixed Level Students

The third case of cross-cultural collaboration discussed here is an ESP program designed for business majors. In this case, the researchers provided a very thoughtful post-program evaluation and observations and suggestions for future improvement. Yogman and Kaylani (1996) described a four-week Business English program conducted in Pittsburgh, USA with 10 students from a post-secondary business college in the Baltic state. The American students and the Baltic students worked and learned together in the same classroom, focusing on management information systems experience and lectures on US and Japanese management practices. There were two mini-projects assigned for students to accomplish: a brochure describing the department of the American university and start-up plans for potential new businesses in the Baltic state. The researchers did not really explain the course in detail. However, their post-program evaluation and analysis of observations and how the second-year program was improved were based on the lessons learned from the previous program, which were perfect examples of cross-cultural collaboration. After all, cross-cultural collaboration requires constant evaluation and improvement.

Basically, Yogman and Kaylani (1996) raised some issues they experienced in their first-year cross-cultural collaboration. These issues included an imbalanced level of English proficiency, a mismatch between teachers and students in expectations relating to classroom culture, and a mismatch of objectives between partner instructors. It can be expected that groups of cross-cultural collaboration may include learners of English and native English speakers. The authors pointed out that students at the beginning level of English proficiency could hardly participate in classroom activities and what they cared about most were their grammar and accuracy of sentences and their scores on English proficiency tests. Another issue relevant to classroom culture was that different teachers, especially teachers from different cultures, might practice different class structures and value a classroom activity differently. In a cross-cultural setting, students may encounter unfamiliar learning activities and may have expectations different from those of the teacher; for example, the Baltic students valued the achievement on English proficiency tests a lot. Finally, gaps may exist between partner teachers in terms of objectives of the programs, the length of collaboration, and students' linguistic, cultural, and academic ability. For the teacher of the English-speaking group, academic skill building may be the priority. However, for the teacher of the non-English-speaking group, it is possible that learning English for specific purposes is the most important thing.

On the other hand, Yogman and Kaylani (1996) argued that cultural learning and preparation and mini project assignments are useful and advantageous in cross-cultural collaboration. According to the authors, different cultures may hinder collaboration. Familiarizing groups of students with each other's culture may ease students' anxiety and uncertainty for the forthcoming collaboration and the unfamiliar learning activities. On the other hand, mini project assignments may also facilitate collaboration. In the project, the students were assigned to perform two mini projects: a brochure describing the departments of the American university and startup plans for potential new businesses in the Baltic state. To design the brochure to be used in the orientation of future collaborative projects and to design startup plans, the two groups of students had to work together to interview people, write reports, and make video advertisements. According to the authors, the two mini projects worked well in the cross-cultural collaboration.

ANALYSIS OF THREE CASES OF CROSS-CULTURAL COLLABORATION

In this section, the author will first present three cases of cross-cultural collaboration in which she is personally involved. In each case, the author will first introduce the participants of the project and the project itself. At the end of each case, the author will provide analytical findings and comment on each case in a reflective manner. At the end of the section, the author will introduce the tool and grounded theory method, which she used to analyze the entire qualitative data.

Three Cases of Cross-cultural Collaboration

There were three cases of cross-cultural collaboration investigated in the research study: the TESOL-Jouralism case, the TESOL case, and the Taiwan-Frence Business case. Details of the three cases are described respectively below.

Case One: TESOL-Journalism Case

Participants

Participants in the TESOL-Journalism case included 27 English majors (EFL learners) in Taiwan and 16 M.A. Journalism majors in the U.S. The Taiwanese students were night school students and they were learning English as a foreign language. Although they were English majors, they were considered low English proficient students. In Taiwan, night schools are always students' last choice. These students were taking *English Conversation* with the author at the time of the study and none of the participants passed the required English proficiency test. They might work during the day and attend school in the evening.

The participants in the U.S. were M.A. journalism majors. They were taking journalism with the partner teacher of the project. Mostly the American students were native English speakers or at least they were in an English-speaking country. They signed up voluntarily to attend the video conference.

The Project

Both the teachers of the two classes were interested in cross-cultural collaboration. They met at a conference in Hong Kong. In an informal conversation, they decided to collaborate via video-conferencing. Problems to be solved at the very beginning of the collaboration were issues such as different time zones, different school calendars, different levels of English proficiency, and different fields of study. Having all the problems solved, the author reached a consensus with the American teacher to have the two groups of students meet with each other at the video-conference 9 times at 8:00 p.m. (Taiwan time) in the whole semester to talk on desiginated topics of students' interest, and American students might interview Taiwanese students and report the story on their campus newspaper.

First, to solve the problems of different time zones and different school calendars and to meet the nature of the class, the author decided to choose the *English Conversation* night class to participate. American students had to come to the video-conference early in the morning at 8:00 a.m. Generally speaking, American schools start and end the semester earlier than schools in Taiwan; also Taiwan and the U.S. have different national holidays. The author first listed the dates of the class meeting in the whole semester, excluding holidays and official exam days, and provided the information to the American teacher. The American teacher then crossed out those days that they would not have class meetings. Finally, the two teachers came up with 9 dates that students can meet at videoconferences.

Other issues were differences in students' levels of English proficiency and in their fields of study. Theoretically, Taiwanese EFL learners could learn English from English-speaking American students. However, there was no reason for American students to waste their time teaching Taiwanese students English at the video conference if they could not benefit from the collaboration. As mentioned earlier, the American students were journalism majors and they were assigned to interview people and publish their reports on their campus newspapers. They might take the opportunity to interview Taiwanese students on a particular issue and write a news report. For example, two American students, after interviewing Taiwanese students, wrote articles about how hospitals in Taiwan reacted during the time when Bird Flu threatened Taiwan and about the traditional ghost story prevailing among Chinese people.

Finally, the two partner teachers and students came up with nine topics to be discussed at the video conferences: friends and family, education and learning, food and city, East/West holidays, most unforgettable experience, working experiences, childhood and toys, Chinese and Hollywood films, and travel and vacation. Both groups of students prepared for the discussion and met at the conference on the designated days. As an extended activity, two students from each partner class and the two partner teachers attended a world-wide video-conference, Megaconference VI, hosted by the Ohio State University. The students and the teachers shared their their experiences of cross-cultural video-conferencing.

Analytical Findings and Reflective Comments

Findings of the study showed that Taiwanese students benefited a lot from live interactions with native English speakers and they were strongly motivated to learn English. In an EFL environment, generally speaking, learners of English have little chance to practice English with native English speakers. At video-conferences, Taiwanese students could not wait to answer questions relevant to Chinese culture and the situation in Taiwan. One of the Taiwanese students responded in an interview:

> "I really enjoyed the video-conferences we had with our American partners. It is really impossible for me to think of skipping the class. My friends in another class envied me a lot and asked why they cannot have this kind of experience."

On the other hand, American students have expanded their worldviews and have put what they have learned in the classroom into practice and practiced their interview skills and skills of news report writing. As noted by Wilkinson and Wang (2007), American students are often under-informed about other cultures. This cross-cultural videoconferencing project has aroused their curiosity, and they even asked sensitive political and religious questions.

This project was mainly a cooperative one and was mediated exclusively by video-conferencing. Students shared information and cultural messages with each other, but they did not collaborate to achieve a common goal. Students commented at the end of the project that they did not feel pressured at the conference because they were not forced to say anything if they did not want to, and they could practice their English if they felt comfortable in doing so. Being less formal and less structured can be seen as being typical of a cooperative project.

Another salient feature found in the project was the dissimilarity of students' professional studies. Taiwanese students were English majors and they studied foreign languages, linguistics and literature, while their American partners focused their study on mass media and journalism. As pointed out by Wilkinson and Wang (2007), in choosing video-conferencing partners, teachers may consider two approaches for students' learning: a complementary approach in which students of the same field of study work together to "complement" each others' professional knowledge and a supplementary approach in which students from different fields of study work together to "supplement" or "enrich" each others' knowledge. This TESOL-Journalism case was typically a supplementary one. In this case, in addition to Chinese culture, American students learned the way a second language is acquired and how language and literature majors may be sensitive to the use of language. On the other hand, Taiwanese students got a rough idea of how an interview can be conducted and how a news report can be presented.

Case Two: The TESOL Case

The second case of cross-cultural collaboration, the TESOL case, involved Taiwanese students who were studying to teach English to speakers of other languages (TESOL) and American TESOL majors in Maryland, USA. The Taiwanese students were college seniors and were taking *TESOL Methodology* with the author and the American students were also taking *TESOL methodology* with their American professor. This project was termed the TESOL project.

Participants

As mentioned above, the Taiwanese students were taking *TESOL Methodology* with the author. There were 26 students in the class. They were college seniors and voluntarily chose the course because they were interested in teaching non-English speaking students English in their future careers.

The 13 American students were also taking *TESOL Methodologies* with the American professor. Some of them were international students from different countries, such as China, Morocco, and Malaysia. Because the number of Taiwanese students was twice the number of American students, one American student was then paired with two Taiwanese students.

The Project

In the cross-cultural collaboration, because both of the two groups of students were TESOL majors, the project focused on methods of teaching English to non-English speaking students. Basically, there were two parts of the project: video-conferencing and social websites. The two groups of students, in addition to interacting on the Facebook and Moodle websites designed exclusively for the project, met at the video-conference five times in the period of the entire project with different topics to focus on: introduction of your partners, teaching levels, educational systems forum, holidays/festivals forum (USA), and holidays/festivals forum (Taiwan). Before the first conference meeting, students from both sides were required to fill out a 14-question survey, including participants' background regarding their experience of distance learning, teaching experience, expectation about this project and what kind of tasks they think would beneficial both Taiwanese and American participants in the project.

The first conference meeting was termed *Introduction of your partner*. Students were required to interview their partner or partners before the meeting to get information on their background, such as their favorite activities, food, traveling experience, teaching experience or teaching level of interest. At the videoconference, students were required to introduce their partners, instead of introducing themselves. This activity initiated the interaction between the two groups of partners.

In the second conference meeting, focusing on teaching levels, students were assigned a specific stage of education, e.g. elementary school, secondary school, higher education, and adult education, and introduced the stage of education to the class. The third conference meeting was termed *Educational Systems Forum*. Students took turns to do a short slide presentation to compare and contrast both educational systems and current English teaching and learning phenomena in Taiwan and in the U.S. Finally, the forth and the fifth conference meetings were devoted to the presentation of lesson plans. Students of the same group, i.e. two Taiwanese students and an American student, might work together to design a holiday/festival lesson plan to introduce one holiday/festival that they think might be new to students from the other university. At the fifth conference meeting, students were asked to choose two of their partners' presentations and comment on the lesson plans, share their ideas, ask questions that they might have, and make suggestions for further improvement.

In addition to meeting at videoconferences, there were two social and instructional websites organized especially for the two groups of students: Facebook and Moodle. The students had to register as project participants before they could use the websites. The Moodle instructional website was developed for students to read announcements, post assignments, fill out surveys, etc., while the Facebook website was developed for students to first introduce themselves and to get to know each other. Students may make use of the website to develop their friendship, share common interests, and do some informal conversations.

Analytical Findings and Reflective Comments

Because the two groups of students shared the same field of study: TESOL, their interests and topics of discussion mainly focused on the educational system, teaching and learning of English as a foreign or second language, and cultural learning in cross-cultural communications. Students are especially interested in comparing and contrasting teaching of English in the US and in Taiwan. In answering the question: *What do you like to learn from your counterparts in this cross-cultural project?* An American student wrote:

> "What teaching methods they commonly use. What age students they will be teaching, and how their methods of teaching EFL compares and contrasts with our methods of teaching an ESOL class. Also, how old they were when they first studied English and how they were taught."

Another American student wrote:

> "I am really interested in learning about the tangible differences between EFL and ESL, as well as the differences between English teachers whose L1 is not English. I am always impressed by non-native English speakers' knowledge of grammatical forms and structures while most non-native English teachers I have met admire the native speaking teacher's intuition in delivering communicative-driven activities and tasks."

In answering the same question, Taiwanese students showed concerns similar to those of American students. One Taiwanese student wrote:

> "I'd like to know everything about TESOL in the US, such as the way English is taught to non-native English speakers, research relevant to TESOL, experiences of TESOL our American partners have had."

Another Taiwanese student wrote:

> "I hope I can know more about the teaching experience from my American counterparts, especially the way they deal with students' learning problems and how they overcome the stress of being a teacher."

At a video-conference focusing on the discussion of Taiwanese and American educational systems, a Taiwanese student happened to mention that corporal punishment is not allowed in schools in Taiwan. Taiwanese students were curious about the situation in American schools. American students responded that corporal punishment is not allowed in American schools, either. This issue led to the discussion and comparison of different educational systems, ways of dealing with students with different problems, students' right to learn, etc.

Generally speaking, the TESOL case did not really include collaborative activities in the cross-cultural project. That is, there was no task assigned for mixed groups to achieve together, for example, a joint task requiring Taiwanese students and American students to work together to design an ESL lesson plan. This cross-cultural project is more cooperative than collaborative. In the cooperative learning setting, students from two different cultures share information and learn from each other in terms of culture, ESL and EFL teaching methodology, and educational system. For Taiwanese students, having an opportunity to practice English with native English speakers was another gain. In a non-English speaking environment like Taiwan, it is not always easy to get a chance to communicate with native English speakers. In future cross-cultural collaborations similar to this case, students from different cultures may be paired or grouped together to work on a lesson plan or other tasks to have the collaborative work more culturally diverse. Also, a post-project survey may be conducted to explore students' perception of the cross-cultural project.

Case Three: The Taiwan-France Business Case

Case Three was a collaboration between Taiwanese college business majors and French business people attending an institution dedicated to life-long education. The author would like to term it the Taiwan-France Business case. The author met the French teacher at an academic conference, and it happened that both her and the French teacher's presentations dealt with cross-cultural collaboration. After several exchanges of ideas, the two teachers started planning a cross-cultural project because of their shared interests in cross-cultural collaboration.

Participants

Taiwanese participants in this case were 20 college sophomores in the second year of a business management course. They voluntarily participated in the project because of their interests in international communication and their awareness of future careers. The French participants were 16 students taking classes with the French teacher in a program dedicated to life-long higher education. Generally speaking, the French students were older than their Taiwanese counterparts, and, unlike their Taiwanese counterparts, they had a certain degree of career experience in business.

The two groups of students were paired into teams, with one or more Taiwanese students and one or more French students in a team. Each team was given a team name. There were 13 teams in the project.

The Project

In order to make the cross-cultural collaboration more interesting and more challenging, the project was defined as an international collaborative contest. Each participant had to discuss and work with his or her culturally mixed team members via video-conferencing or e-mailing and come up with a final version of a business scenario, such as development of products or services, negotiations, interviews, meetings, etc. At the end of the contest, the best three teams were chosen at the end of the project and were awarded with gifts.

Analytical Findings and Reflective Comments

Strictly speaking, among the three cases of cross-cultural collaboration described here, this was the only case that required collaborative work between two culturally different groups of students. It could be observed that because of the different time zones and school calendars, different cultures, and technical problems that the students encountered, it required a lot of coordination to complete the assignment. As mentioned earlier, coordination is particularly important in a virtual collaborative environment. Some participants experienced a long wait for their counterparts to respond.

Unlike the other cases mentioned above, participants of the two partner groups were non-native English speakers. Theoretically, they might not learn English from each other. However, in order to achieve their common goal, they would use English as the lingua franca to communicate. They might struggle to express themselves. However, being in the same field of study and having a common goal to achieve might ease their tension and anxiety and might encourage them to focus their attention on the project itself.

Analytical Tool and Data Analysis

In the process of collecting data and analyzing all the data collected for the present study, the author applied the grounded theory method to look for shared characteristics or factors that could be critical to the development of a cross-cultural collaborative project. In this section, the author will first explain the grounded theory method, and then the author will demonstrate how all the data was analyzed.

Grounded Theory Method

Bryant and Charmaz (2007) stated that the grounded theory method comprises a systematic, inductive, and comparative approach to conducting research. Being systematic, inductive, and comparative can be regarded as key characteristics of the grounded theory method. Being systematic refers to grounded theorists' persistent interaction with their data, and, at the same time, they look for emerging patterns or theories. They do not have a predetermined judgement or stand in mind. Rather, they interact with their data and let the data reveal the truth. Sometimes grounded theorists do not even have predetermined research questions to explore. Rather, they let the data speak for itself and remind the researcher to note some important messages that are worth exploring further. Another feature of the grounded theory method is that it is inductive. Unlike common research methods that test the researcher's hypothesis, grounded theorists tend to induce patterns from the mass of data. That is, grounded theorists categorize pieces of existing data from different sources and look for important attributes or components that these pieces of data share. These attributes or components may later be considered as theories found in the study. Still another feature key to grounded theory is that, in the process of working with the data, researchers keep comparing the existing data with the emerging data and comparing among codes or categories. In this way, patterns can eventually emerge. The point here is that, in the process of conducting research, researchers do not cease collecting at an early point of time. Rather, they keep collecting data while they are in the process of coding the data. Emerging data may be assigned to an existing category or a new category may be created for a piece of data.

Roughly speaking, after collecting the data, grounded theorists start going over the data and code the data. They start with open coding by reading the data line-by-line and comparing incidents in the data to each other. As researchers code the data, categories emerge. Researchers may need to create new categories or they assign new incidents to existing categories as mentioned earlier. After the open coding stage, researchers continue to do axial coding. In this stage, researchers work on one category a time and do in-depth analysis. As researchers working at this stage, they may find an "axis" for further coding, and category building may be done around this axis, which may become the so-called "core category."

While doing coding, at the same time, researchers may write memos about the conceptual connections between categories. Memos writing may help develop the properties of each category and may serve as a guide for further data collection, coding, and analysis. Having all the memos, researchers then sort them to generate theories and write up the entire research report. In sum, grounded theorists do not take an existing theory and use the data they collect to verify the theory or to endorse their assumptions. Rather, they take relevant existing data and analyze the data and look for a fact or truth that they can eventually present as a theory (Borgatti, 1995; Corbin and Strauss, 2008; Dick, 2005).

Data Analysis

Based on the principles of ground theory method, the author analyzed the data she collected and tried to come up with important elements or points that practitioners of cross-cultural collaboration need to take into account. In this section, the author will demonstrate how the grounded theory method can be applied to research on cross-cultural collaboration.

At the beginning of the research, the author first decided on the data to be collected. The author chose three cases of cross-cultural collaboration she personally experienced. Along with the three cases, the author chose another three cases reported by other researchers and presented in the literature review section. The author first looked over all the data and found that objectives, participants, project design, the learning environment, advantages and advantages of cross-cultural collaboration were all key to successful cross-cultural collaboration, and were necessarily described in these research reports. The author then developed these categories. In each category, the author looked for important messages and looked for attributes or patterns that different categories might share. For example, different researchers might have used different cross-cultural activities in different learning environments and might claim that their collaborations were successful. The author would look for attributes these cases shared in terms of the design of activities and the development of the learning environment. Finally, the author focused on important issues that practitioners of cross-cultural collaboration should take into consideration in the course of developing a cross-cultural activity.

FINDINGS AND DISCUSSION

As mentioned earlier, this chapter incorporates both existing research reports from researchers of cross-cultural collaboration and the authors' personal experiences of conducting cross-cultural collaborative projects. By doing so, the author may look at cross-cultural collaboration in the educational arena from different perspectives and may discuss relevant issues and recommend educational applications in a more useful way. In this section, the author will provide crucial points in the course of developing cross-cultural collaborations that she found from analyzing the data she collected.

Choosing Collaborative Partners

Some novice teachers of cross-cultural collaboration may feel it difficult to find an international collaborative partner. Actually, it may not be as difficult as they thought. Teachers may get collaborative partners from a variety of sources. In Case One, the author met the American Professor at an e-learning conference held in Hong Kong. The American teacher was the moderator in the section when the author was presenting. The American teacher expressed his interest in cross-cultural collaboration and he exchanged e-mail addresses with the author. They started planning cross-cultural video-conferencing after the conference.

In Case Two, the author was assigned to teach *TESOL Methodologies*. It happened that her university had a long-term relationship with one of its sister universities in Maryland, U.S.A., the partner school in the study. The American teacher, who was also teaching *TESOL Methodologies* related courses, got a research grant and invited the author to work on a collaborative project.

Case Three is the collaboration between Taiwanese students and French students. The author met the French teacher at a conference dedicated to the discussion of computer-mediated language learning held in Scotland, U.K. Both teachers presented research studies relevant to cross-cultural collaboration. They exchanged some ideas via e-mail and soon reached a consensus for a cross-cultural collaborative project.

In addition to ways to look for project partners mentioned above, there are still a lot of ways that organizers of cross-cultural collaboration can find partners. For example, as the author's search has shown, teachers may post their request for collaborative partners on professional discussion forums, such as the TESOL list, Technology-Using professors, LinkedIn or they may read professional journals or books to find authors who share the same research interests and contact them directly.

Consensus among Partners

Just take the two examples of cross-cultural collaboration illustrated in this chapter, not necessarily project partners who have consensus on each detail of the project. In Case one, the author suggested at the very beginning that we might consider a pen-pal mode of collaboration. However the American teacher would like to have an entire class participating in the class discussion. One of the advantages of this type of discussion is that students may work together to brainstorm new information or ideas, and a clear picture of a different culture may be easily shown. However, this type of discussion may lead to unequal class participation. Some more articulate students may dominate the talk. In this case, a consensus between partner classes must be reached to smooth out some potential problems. Fortunately, the facilities and the nature of the two classes allowed them to have class-to-class interactions.

Another example is that, in case two, one of the Taiwanese students mentioned to the author that he felt that the American partners dominated the entire project and that the American teacher organized the entire project. He suggested that next time, to organize a cross-cultural collaboration, it might be better to involve students in the developing process and take students' ideas or suggestions into consideration. Cross-cultural collaboration needs to be student-centered anyway. Surveys or interviews may be conducted before starting a project or after a project is finished. For example, Brown and Aktas (2012) created a very thoughtful survey to investigate Turkish university students' hopes and fears before they travel to the United Kingdom as exchange students. Findings of the survey showed that Turkish university students hoped that their sojourn in a European country might help broaden their horizons and learn new cultures. On the other hand, Turkish students were afraid that their developing world status would be attacked and their Muslim religion would be stigmatized. In this case, knowing the political and religious issues that students might encounter, Turkish teachers could provide psychological support before students headed for the host country.

An Enjoyable and Optimal Learning Environment

A learning environment should be educational. That is, participants should be able to learn something from the learning environment. However, if the learning environment creates too much pressure for the students, students may unconsciously feel resistant to engage in the activity. How to balance between being educational and being entertaining may be a great challenge for an organizer of cross-cultural collaboration. On the other hand, the learning environment should be attractive and should be able to engage students in their learning to an extent that they are actively involved in the environment. Chuah (2007) urged practitioners of online learning to redesign students' online learning experience and provide students with an educational, entertaining, esthetic, and escapist learning environment. Wang (2013), on the other hand, focused the cross-cultural learning environment on video-conferencing. Wang echoed Chuah's ideas of four realms of e-learning experience and argued that an e-learning environment should be attractive and students should be willing to join the conference.

In the cases of cross-cultural collaboration mentioned in this chapter, it seemed that researchers did not really assess the online learning environment from the four perspectives Chuah (2007) proposed. Generally speaking, researchers focused on one thing other than the online learning experience to explore, for example, cultural learning (e.g. Ellenwood and Synders, 2010), language learning (e.g. Case Two the TESOL case), and professional learning (e.g. Magnier-Watanabe *et al.*, 2011 and Case Three the Taiwan-France Business Case). Some cases may be considered successful (e.g. Case One). Students feel excited at first but the novelty soon wears off. However, when looked at from the four domains of designing a virtual environment, there must be a lot of room for improvement.

Being Mutually Beneficial

Organizers of cross-cultural collaboration must have a purpose in mind in the course of developing relevant activities. Sometimes, organizers may ignore the fact that their collaborative partners also have their own purposes in mind. When developing a collaborative project, partner teachers should first identify their objectives for the collaboration and make sure the project follows through the principles of their objectives and that the needs of the students can be met. Cross-cultural collaboration cannot be successful if only one part of the partner classes will benefit from the collaboration.

To be mutually beneficial to both groups of students may be seen as the most essential element that organizers of cultural exchange programs should take into consideration while developing a project. In the TESOL-Journalism case, theoretically, Taiwanese EFL learners could learn English from their American partners and they would love an English-speaking environment, which cannot be easily found in an EFL setting. However, it seemed that there was no reason for American students to spend their time teaching Taiwanese students English, especially since these students were considered low-achieving in their English proficiency. The fact was that American MA students were journalism majors; they were learning to interview people and to write news reports. This experience was an excellent opportunity for them to interview people from a different culture and the messages they got from the interview were authentic and valuable.

In the TESOL case, both of the two groups of students were in the same field of study. They were concerned about teaching English to speakers of other languages. In a traditional classroom, they can only learn from their peer students and get second-hand information from a textbook or a research report. Through communicating with people from different cultures via video-conferencing, students can expand their professional knowledge and get authentic information relevant to their field of study. That is, they complement each other's professional knowledge as to how English can be taught to non-English speakers.

Collaborative Projects to Activate Students' Participation and Online Interaction

In the Taiwan-France case, the two partner teachers provided students with opportunities to collaborate. They were required to work through video conferences to come up with a final business scenario. Competition among teams and selection of winning teams had even made the cross-cultural collaboration more exciting and rewarding. By doing so, interactivity and dynamism increased, and the relationship between partner students was collective. That is, each participant's contribution was required and did count. In Case One and Case Two, there was no collaborative project assigned to students. Students just met at the video conference and posted their ideas or comments on the Web to share with their partner students. The relationship between them was kind of connective and participants might maintain their friendship with their partner students and provide whatever information their partners might need. One of the drawbacks of these types of cross-cultural projects is that some students may dominate the talking at the video conference and some may remain as silent readers on the online discussion forum. To encourage participation, collaborative projects may be a better approach.

Diversified Curriculum Design

Curricula of cross-cultural collaboration should be developed based on participants' fields of study, professional experiences, purposes for participation, levels of language proficiency, and availability of and familiarity with modern technologies. Differences in these aspects may result in different modes of course delivery, learning contexts, collaborative activities, and assignments. Chances are the diversity of partner groups can serve as complementary sources to facilitate each group's learning. For example, in the first case, partner groups were quite different in their levels of English proficiency and fields of study. It turned out that American students helped Taiwanese students with their English, and Taiwanese students provided American students with the information on Chinese culture they needed.

It is always necessary that teachers survey students' level of satisfaction and collect students' feedback to make improvements for future designs of cross-cultural collaboration. The more diversified the curriculum design, the better the chances that students may learn. Teachers who are developing cross-cultural projects need to design pedagogical richness and provide students with diversified learning opportunities. As the virtual journey coupled with face-to-face exchange described in the literature review section has shown, students could not really develop their cultural competence and intercultural sensitivity without having a chance to meet with each other face to face.

CONCLUSION

In this chapter, the author reviews three cases of cross-cultural collaboration and presents another three cases of collaboration in which the author was personally involved. One of the purposes of this chapter is to provide practitioners of cross-cultural collaboration a guide as to what may be the important factors that can affect the success of a cross-cultural project and what should be considered in the course of developing the project. Based on the analysis of all the qualitative data, the author would like to conclude that choosing collaborative partners, level of language proficiency, the learning environment, objectives of the collaboration, chances of students' participation, and richness and diversity of the curriculum design should be taken into consideration in the process of designing a cross-cultural collaborative project. In the decade to come, because of the advancement of technologies and the tendency for globalization, cross-cultural collaborations are seeing an increasingly growing popularity. Hopefully, researchers' tangible experiences and analyses may help educators who intend to integrate cross-cultural collaboration into their curricula.

REFERENCES

Borgatti, S. (1995) Introduction to grounded theory. From: *http://www.analytictech.com/mb870/introGT.htm.* Accessed 29/1/10.

Brown, L and Aktas, G. (2012) Turkish university students' hopes and fears about travel to the West. Journal of Research in International Education. 45: 3-18.

Bryant, A. and Charmaz, K. (Eds.) (2007) *The Sage handbook of grounded theory.* Los Angeles, USA: Sage.

Chuah, P.C.K. (2007) Experience redesign: A conceptual framework for moving teaching and learning into a flexible e-learning. In P. Tseng, R. Kwang, and R. Fox (Eds), *Enhancing learning through technology,* World Scientific Publishing, Singapore. pp 37-50.

Corbin, J. and Strauss, A. (2008) *Basics of qualitative research: Techniques and procedures for developing grounded theory,* (3rd ed.). California, USA: Sage.

Dick. B (2005) Grounded theory: A thumbnail sketch, from *http://www.scu.edu.au/schools/gcm/ar/grounded.html*. Accessed 29/1/10.

Egea, K. (2007) Guided reflective practice for communication and collaboration: A tool for successful virtual teamwork. In P. Tseng, R. Kwang, and R. Fox (Eds), *Enhancing learning through technology*, World Scientific Publishing, Singapore. pp 82-95.

Ellenwood, A.E., and Synders, F.J.A. (2010) Virtual journey coupled with face-to-face exchange: Enhancing the cultural sensitivity and competence of graduate students. *International Education*. 21: 549-566.

Magnier-Watanabe, R., Benton, C., Herrig, H., and Aba, O. (2011) Blended Learning in MBA education: A cross-cultural experiment. *Opening learning.* 26: 253-263.

Olsen, E.W-B. and Kagan, S. (1992) About cooperative learning. In C. Kessler (Ed.), *Cooperative language learning: A teacher's resource book*, Prentice Hall, New Jersey, USA. pp 1-30.

Wang, A-L. (2013) Engaging students in language learning via successful cross-cultural video-conferencing. In M. Hamada (Ed.), *E-learning: New technology, applications and future trends, Nova*, New York, USA. pp 241-256.

Wilkinson, J.S. and Wang, A-L., (2007) Crossing borders: How cross-cultural videoconferencing can satisfy course goals in dissimilar subjects. In P. Tseng, R. Kwang, and R. Fox (Eds), *Enhancing learning through technology,* World Scientific Publishing, Singapore. pp 37-50.

Winer, M. and Ray, K. (1994) *Collaboration handbook: Creating, sustaining and enjoying the journey*. (ERIC Document Reproduction Service No. ED390759).

Wu, W.V. and Marek, M. (2010) Making English a "habit": Increasing confidence, motivation, and ability of EFL students through cross-cultural, computer assisted interaction. *Turkish Online Journal of Education Technology*. 9: 101-112.

Yogman, J. and Kaylani, C.T. (1996) ESP program design for mixed level students. *English for Specific Purposes*, 15:: 311-324.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 3

COLLABORATION AND COMICS: USING LITERATURE CIRCLES FOR GRAPHIC NOVEL INSTRUCTION

Tara L. Jakubik[1,*] and Cindy E. Hmelo-Silver[2]
[1]Hackensack High School, Hackensack, NJ, US
[2]Indiana University, Bloomington, IN, US

ABSTRACT

Multimodal texts, such as graphic novels, require readers to adapt reading strategies beyond those used to read traditional texts. These pose challenges even for high school students. One way to support students in dealing with these challenges is through the use of collaborative literature circles. The goal of this study was to look at how groups of 17-18 year old secondary school students of mixed achievement levels read graphic novels in literature circles. Data sources included video recordings of the literature circles.

The literature circles were coded for Common Core reading strategies and collaborative student behavior and allowed for reflective analysis. Findings suggested that students, of varying Language Arts proficiency levels, supported one another in reading comprehension in small group settings. The literature circles enabled students, who are considered to be "low-achievers" academically, the opportunity to provide reading scaffolds for students who are considered to be "high-achievers." In comparison to individual reading, students were able to correct reading errors with the support of classmates during literature circle reading. When reading independently, high-achieving students exhibited more of a range of reading comprehension strategies; however, in the small groups, low-achieving students were able to help higher-achieving students understand the forms and features of the text. This study provided insight for reframing the curriculum for graphic novel instruction in the classroom. This chapter will examine how students interact collaboratively with graphic novels in the classroom setting.

[*] Corresponding author: Tara L. Jakubik. Hackensack High School, Hackensack, NJ 07601. E-mail: TaraJakubik@yahoo.com.

INTRODUCTION

Multimodal texts, such as graphic novels, require readers to adapt reading strategies beyond those used to read traditional texts. These pose challenges even for high school students. One way to support students in dealing with these challenges is through the use of collaborative literature circles. The goal of this study was to look at how groups of students of mixed achievement levels read graphic novels in literature circles. Using graphic novels as literacy tools in the high school language arts classroom is a novel way to teach literature and support reading comprehension. Graphic novels replace the traditional literary canon with rich text, supported by the juxtaposition of words and pictures, which provides students with additional opportunities to make textual inferences.

Although some researchers argued that pictures in graphic novels support reading comprehension (Hughes et al., 2011; Rowsell and Burke, 2009), others found that the pictures presented a unique challenge to readers (Hatfield, 2005; Krinsky, 2012). In an earlier iteration of a Creative Writing: Genre Studies course, it was clear that we needed to better understand how students read graphic novels. In the earlier iteration of the course, Krinsky (2012) found that graphic novels are complex texts and that there is a need for explicit reading strategy instruction. Krinsky argued that the pictures are narrative, and contrary to previous research, suggested that the pictures are not illustrative, which may make the texts more difficult to understand. In response to this need, the study explored how students attempted to make meaning of the text in a small group activity. Elsewhere, we demonstrated that individual students face challenges in understanding graphic novels (Jakubik, 2014).

The results of individual think-alouds demonstrated that students (1) tended to summarize the page rather than read all of the text on the page; (2) read pages incorrectly or out of order; and (3) followed expected reading patterns of traditional texts instead of adapting their reading to the format of the graphic novel. Despite these challenges, Jakubik (2014) also demonstrated that graphic novels support addressing the new common core standards (Common Core Standards Initiative, 2010).

Comics are only one of many genres of multi-modal texts. In addition, other 21st Century texts are multimodal, using a combination of words and images to convey messages. Using multimedia pedagogy with comics is one way to prepare students to engage in a world full of multimodal literacy, thus easing the transition toward 21st Century texts.

It is important for educators to understand what students do when they read complex texts, especially when assuming students will naturally connect to the content. It is also important to study how textual features affect reading comprehension. In a case study analyzing students' interaction with multimodal digital texts, Rowsell and Burke (2009) concluded that the images provided additional reading comprehension support and gave students the opportunities to connect to the context of the characters' world. Since graphic novels include various textual layers, and students need to learn how to connect to the text, it was essential to explore the steps students take while reading graphic novels so that educators can provide text-specific instruction (Krinsky, 2012).

One strategy to support learners in comprehending these multimodal texts is collaborative reading activities such as literature circles (Mills and Jennings, 2011). Collaborative reading activities are not new. In seminal work, Brown and Palincsar (1989; Palincsar and Brown, 1984), developed reciprocal teaching to aid struggling readers. This successful collaborative approach explicitly modeled the strategies that expert readers use. A recent review has noted the “dialogic turn” taken in research on reading comprehension (Wilkinson and Son, 2011). This dialogic turn is increasingly to encourage student agency, joint construction of understanding and to support the multiple voices (“heteroglossia”) that are so important in reading literature. Literature circles provide the students with an opportunity to develop an expressive stance toward the texts they are engaged with. High-quality discussion around literature is associated with improved comprehension.

Features of high quality discussion include open-ended questions and exchange of ideas in both whole class and small group discussions. Wilkinson and Son (2011) argue that dialogic approaches to comprehension provide a way to sustain the use of strategies. We also argue here that the multiple perspectives and distributed cognition allow joint construction of meaning as students engage with complex texts of graphic novels.

In this chapter, we examine explore how students work collaboratively in an in-class literature circle activity. We explore students’ metacognitive thinking and use of reading strategies while reading graphic novels to make meaning of the text (i.e. the words and pictures). Other studies have explored students’ use of reading comprehension strategies when reading graphic novels in small group settings. The findings suggest that peer support helps students overcome the challenges of reading graphic novels.

COMICS

For the purposes of this discussion, the terms “graphic novel” and “comic” are interchangeable. McCloud (1993) defined graphic novels (i.e. comic books) as “juxtaposed pictorial and other images in deliberate sequence, intended to convey information and/or produce an aesthetic response in the reader” (p. 9). Graphic novels have been integrated slowly into high school English/Language Arts curricula. For example, Bitz (2004) started an after-school comic book program entitled the Comic Book Project, and Ranker (2007) explored how a teacher incorporated graphic novels into her classroom to increase student engagement and motivation in the English classroom. The teacher focused on the textual features of the text, which Ranker (2007) stated allowed students to engage fully in the text through the exploration of the reading process. In contrast with Ranker’s strategy, the study explored how students interacted with the graphic novel in a small group setting (i.e. literature circle), and later investigated how students interacted with the textual features of the text.

Students choose to read graphic novels in their personal time and space; therefore, it may be practical to bring graphic novels into schools. An example of texts students read at home is comics (graphic novels) and educators have found that children and adolescents find comic books enjoyable (Dorrell et al., 1995; Morrison et al., 2002), and as a result, are more likely to sustain interest in a discussion about it. It is evident that students may be motivated to read graphic novels, but Morrison et al. detailed how students may “engage in greater literacy exploration than they otherwise would, due to the comics’ popular and easily accessible format” when creating their own graphic novels (p. 579).

The accessible format identified by Morrison et al. (2002) refers to the juxtaposition of words and pictures, which enhance understanding most of the time, but at the same time, can hinder understanding when students do not know how to read the two simultaneously.

The problematic text features include panel design and layout, dialogue balloons and designs, and narration. Graphic novels are slowly being introduced into classrooms. Bitz (2004) explored the use of graphic novels in the classroom through The Comic Book Project, which was an after school program he created in alignment with the New York State learning standards. Bitz studied the development of reading skills among students through an exploration of the social contexts of literacy. However, because of the complex textual features, collaborative reading activity is one approach to enhance students' comprehension.

STUDYING COLLABORATION IN LITERATURE CIRCLES

During literature circle activities, students engage with the forms and features of the graphic novels. The objective of the learning activity is for students to scaffold one another when reading graphic novels. Prior to working in literature circles, students read the text independently and therefore, brought in their own experiences reading the graphic novel. The literature circle groups worked together reading the graphic novel. Groups were given suggestions for reading the graphic novel in the literature circle but the task remained open-ended. The students were asked to read six pages of the graphic novel aloud in their literature circle. The research presented here focuses one literature circle of four participants.

The literature circle was heterogeneous to reflect the cultural diversity of the school as well as a range of reading abilities. The video of small group activities (i.e. the literature circle) was used as an observation tool.

Research Design

The educational focus was based on the premise that due to the multiple layers of text associated with graphic novels, students have to employ various reading strategies to make meaning of the text. Therefore, the purpose of the research design was to examine what reading strategies students used to make meaning when reading graphic novels in small groups. We explored the various strategies students implicitly and explicitly used while reading. Having an understanding of how students read graphic novels will allow teachers to present a new reading genre in a meaningful way. According to Krinsky (2012), "if teachers want to use [graphic novels] in their classrooms, they may need to prepare to present the material within an appropriate instructional framework and provide their students with text-specific strategies for meaning making" (p. 134).

Therefore, this research sought to capture the text-specific strategies students made use of, and therefore, the instruction varied to meet these students' needs.

The students who were asked to participate in the study were enrolled in a grade 12 English course in a diverse urban secondary school in the northeastern United States. The students were between the ages of 17 and 18. The participants in this analysis included a group of four students who worked together in the literature circle activity. The group was part of a larger Creative Writing: Genre Studies class that included 28 students of the same age. The class took place at a large suburban high school in Northern New Jersey in the winter of 2013.

The study focused on how students read graphic novels in small groups. To meet the research objective, students read a short selection of the graphic novel during class time or after school in small groups. All meetings were video recorded. The video data was used to capture the actions of students as they read the graphic novels in small groups. In particular, we wanted to understand the extent to which students were able to draw inferences to and make connections beyond the text, addressing important Common Core standards.

Research Procedures

Phase I of the research was the explicit instruction of reading comprehension strategies, which were documented throughout the study. Instruction included a reading of McCloud's (1993) *Understanding Comics*. McCloud's text provides readers with explanations for understanding comics. Following this reading, students discussed their knowledge of the events of the terrorist attacks on September 11th, 2001 ('9/11').

Due to the sensitive nature of the material covered by the graphic novel and student proximity to New York City, students had the opportunity to read an alternative graphic novel. None of the students opted out of reading *The 9/11 Report*. During Phase II, the data collection phase, students read a short excerpt from the graphic novel, *The 9/11 Report*, in a small literature circle. We focus here on the Phase II activities.

Phase II included each student participating in one literature circle activity during the graphic novel unit. Each student participated in one literature circle activity during the graphic novel unit. There were three literature circle groups consisting of 4 students each. The students read sections of the text that were new to them (Fox et al., 2011).

The camera was directed on the small group activities to capture student conversations as well as the page of the text students were reading. Each section chosen from the text included various forms and features of the text. The purpose of the video recording was to support the coding of the reading comprehension strategies students used while reading the text with others. In such cases, students may become more thoughtful and reflective readers while paying attention to their social interactions with others (Mills and Jennings, 2011).

Each literature circle group met individually and were read the following same directions: The literature circle may be organized by having students lead discussion by using different roles: (a) discussion leader, (b) picture reader, (d) travel tracker, (d) gist expert, (e) predictor. If you are confused say, "I'm confused" or "I don't get it." Use question stems like "I predict…" "I can connect to my own experience…," "I am just skimming…," "I'm going to read the pictures first…," "I am going to read the words first," etc. Make sure you establish your group roles. Please read pages 10-17 in your literature circle. I will begin recording now.

Data Analysis Procedures

Table 1 shows the relationship between the research questions, data sources, and data analysis. The table lists the reading question, the data sources to answer the research question, and the method of data analysis.

There were three research questions:

1. What reading strategies do students use to make meaning when reading graphic novels?
2. Based on the forms and features of the text, when do students use each of the reading comprehension strategies?
3. How does students' use of instructed reading strategies relate to their comprehension?

Data sources included literature circle video data and state High School Proficiency Assessment (HSPA) test scores. The data was coded for reading comprehension strategies used, student behavior while reading, and text features. The HSPA scores were compared to the reading comprehension strategies and student behavior.

CODING AND ANALYSIS OF ACTIVITY

Coding involved both inductive and deductive strategies. The first pass through the video focused on identification of emergent themes, particularly those related to forms and features of text. The second viewing was deductive and included coding reading strategies that have been identified in the literature as well as any new strategies identified. The coded reading strategies were placed into frequency tables and written into descriptive case studies (Pressley and Gaskins, 2006). The constructs of the research were examined through forms of behavior such as student performance during the literature circle.

The literature circles uncovered socio-cultural factors of reading graphic novels. The HSPA scores revealed student comprehension skills (Gall et al., 2010). The HSPA scores, according to the New Jersey Department of Education Open-ended Response Rubric, were linked to student reading strategies (table 2).

The quantitative data were categorized by type of reading comprehension strategy used, based on the particular forms and features of the text and the data was placed into a frequency table. Following a narrative research approach, the qualitative analysis was told by the "interpretation of stories" (Gall et al., 2010).

A guided framework for analyzing the literature circles was developed to include student behavior and reading comprehension strategies.

Table 1. Research Questions, Data Sources, and Data Analysis

Research Question	Data Source	Data Analysis
What reading strategies do students use to make meaning when reading graphic novels?	Literature circle video	Code for reading comprehension strategies used, behaviors, and text features (frequency tables) Descriptive case study
Based on the different forms and features of the text, when do students use each of the reading comprehension strategies?	Literature circle video data	Code for reading comprehension strategies used, behaviors, and text features (frequency table) Descriptive case study

Table 2. New Jersey Department of Education Open-ended Scoring Rubric

Points	Criteria
4	The response clearly demonstrates understanding of the task, completes all requirements, and provides an insightful explanation/opinion that links to or extends aspects of the text.
3	The response demonstrates an understanding of the task, completes all requirements, and provides some explanation/opinion using situations or ideas from the text as support.
2	The response may address all of the requirements, but demonstrates a partial understanding of the task, and uses text incorrectly or with limited success resulting in an inconsistent or flawed explanation.
1	The response demonstrates minimal understanding of the task, does not complete the requirements, and provides only a vague reference to or no use of the text.
0	The response is irrelevant or off-topic.

Reading comprehension strategies and behaviors related to text features were coded by text feature. The coding system allowed for the comparison of the forms and features of the text with student behavior and reading comprehension strategies used.

Codes. The guiding framework for analyzing the literature circles was used to develop the codebook. The codes evolved into three categories: (a) Common Core reading strategies (table 3), (b) behaviors (table 4), and (c) text features. The tables contain an operational definition of the code and illustrative data.

Common Core reading strategies. The Common Core reading standards (2010) were used to define the reading strategies shown in Table 3. Each code was aligned with a standard and was used to identify reading behaviors.

Behaviors. Behaviors were defined as actions performed by a student while reading that were not directly tied to a Common Core standard. These behaviors included actions such as redirection or finger pointing.

Most behaviors involved a physical movement while reading, while other behaviors referred to student comments. Gesture-related behaviors referred to the actions of the students; whereas, the other behaviors referred to spoken words of the students. Table 3 contains a detailed description of the behaviors.

The three gesture-related strategies were finger tracing, finger pointing, and finger pointing in discussion. There was a clear distinction among the three strategies that involved a reader's index finger. Finger tracing referred to a student using the index finger to follow along with the words/pictures read aloud individually or in the literature circle. Evidence of finger tracing was important because finger tracing showed where the student was reading on the page. Finger pointing referred to the process in which a student specifically points to the page, and is always used in connection with one of the verbal reading strategies which provides an explanation for the pointing (table 3). Independent finger pointing helped students manage all the words and images on a page. Finger pointing occurred when students attempted to make sense of the text (Chi, 1996). In addition, finger pointing evolved into a communicative act in peer discussions.

Table 3. Common Core Reading Strategies and Codes

Reading Strategy	Common Core Standard (2010)	Example
Direct Text Reference	Cite specific textual evidence when writing or speaking to support conclusions drawn from the text.	The student flips between the two pages again and says, "Let's go back to flight 11," when he sees that pages 8-9 match the format of pages 6-7.
Inference	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.	The student notices that some of the pictures on page 3 match the pictures of the people on page 4 to draw the conclusion that these are the terrorists who were on the planes.
Evaluation	Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence	"I don't know if that is accurate"; "Oh well, that's great!" "I don't get it because I always thought that the messages were typed" (in regards to the pilot not hearing the message, "We have some planes.")
Character Voices	Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.	The stewardess says, "Pillow anyone?" and the student reads this in a female high-pitched tone.
Text Structure Questions	Analyze and evaluate the effectiveness of the structure an author uses in his or her exposition or argument, including whether the structure makes points clear, convincing, and engaging.	"Why did the author use these sound words?" "Do I even need to read this…?"
Content Questions	Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective, analyzing how style and content contribute to the power, persuasiveness, or beauty of the text.	"Wait? Is that even his name?"
Fluency	Read and comprehend complex literary and informational texts independently and proficiently.	The student reads the page seamlessly without pausing, questioning, or adding any additional comments and/or questions.

Text features. The text feature codes shown in table 5 were used any time a student commented on the structure of the text or when the features of the text complemented the students' ability to read the page. For example, a student may have noticed the colors, font size, and sound words of the text. The text feature codes also were used when describing how students interacted with a particular type of text. The text feature codes were important because the codes captured when students changed how they read when interacting with the variety of textual features.

The data were cross-tabulated with the type of reading comprehension strategy students most frequently while reading graphic novels. The students had ample opportunity to demonstrate their ability to make real-world connections and make inferences as they participated in the literature circle. Their conversations within the literature circle allowed students to demonstrate their mastery of reading comprehension skills.

Table 4. Student Reading Behavior Codes

Student Behavior	Definition	Example
Finger Tracing	The student read with a finger on the page and pointed to the page being read. The student used a finger to point to the words that a peer was reading aloud.	The student used a finger to point to the text on the page being read. The student used the index finger to trace the direction of reading.
Finger Pointing	The student reading stopped to point to a specific panel of the text and discussed that particular component of the text.	The student says, “I don’t like this quote here” while pointing to the text.
Finger pointing in peer discussion	Finger pointing in peer discussion referred to peer-monitoring when a student pointed to a piece to describe what is happening to another student in the literature circle. A peer re-directed the reader by describing the format of the page. The student either described the words or may also have pointed to the panel when describing the set-up.	On page 11, a student said, “You have to read this way” and points along the lines of the books. The student reading said, “Ohhhh… It’s like a timeline. Now you tell me.”
Redirection/ Self-Monitoring	A student recognized a mistake being made in the reading and redirected the reading. Self-monitoring behavior occurred when students mispronounced a word or skipped a word or number. Redirecting/self-monitoring behavior also occurred when students read the page incorrectly.	The student noticed that pages 6 and 7 were read horizontally across the two pages and not singularly.)
Description	The student explained what was on the page. Instead of reading the words, the students described what they saw on the page.	On page 4, the student said, “There are 5 men on each plane” but did not read the name of each man.
Connections to Prior Knowledge	A student talked about the text and connected to prior knowledge. The prior knowledge was either from the student’s past learning or something that learned earlier in the text.	In the literature circle the students thought the use of the sound word “BLAM” was to be like “Batman.”

Based on these codes, case study narratives were constructed to tell a story of the collaborative experiences in the classroom. Gall et al. (2010) defined case studies as “representations of phenomenon on which data collection and analysis will concentrate” (p. 338). The narratives that follow are organized by the phenomenon of page/features of the page. They are framed by the phenomenon of each page, and are organized in sequential reading order.

All 12 students who participated in the study had equal opportunities to read the same pages of the graphic novel for the literature circles. Each small group received the same instructions, and was offered the same opportunities bounded in time and place. Interpretation was used in analyzing the phenomena of each case study. “Patterns represent systematic relationships between two or more phenomena within a case or across cases” (Gall et al., 2010, p. 350).

The patterns of students across HSPA score ranges, and the patterns among all students drove the analysis of each narrative. In addition, reflective analysis, which “requires case study researchers to rely mainly on their own intuition and personal judgment to analyze the data,” was used to analyze the findings (p. 351).

Literature Circle Case Study

Comics are challenging texts for learners to engage with. Here we present a narrative of how students interacted with the particular forms and features of the text in a small group setting. The small group setting allows students to be mutually supportive and provides a context for elaboration, inference, and joint meaning making. The focal students include a range of achievement level based on state standardized assessments. This section first addresses the forms and features of some of the key passages students read.

Then, it includes a description of the strategies the students used to interact with the page. Specifically, the reading comprehension strategies they used and which behaviors they enacted are described. Finally, we explore how students engaged in deeper levels of thinking when working in small groups than when reading individually.

Even though the groups used structured literature circles in class, and even though the directions offered suggestions on how to organize a literature circle, students formed group roles and norms naturally in their literature circles. One of three groups naturally took turns reading by page, and two groups had a single reader for the duration of the session. The case study that follows is an example of a literature circle in which one student predominately read the text while all students engaged with the graphic novel independently and expressed their thoughts verbally in the small group. The students represented in the following narrative were chosen because they offered a large amount of interpretation and analysis of each page as they read. Thus the group offered substantial data for the analysis. Furthermore, the students represented the range of reading abilities from low, middle, and high groups.

Although students were not asked specifically, this group of students, Literature Circle 3, included some students with prior experience reading graphic novels. However, all students had recently read *The 9/11 Report* to page 9 individually during their think-aloud (see Jakubik, 2014 for details). The literature circle groups were asked to continue reading the text, starting with page 10 and ending with page 17.

Students read pages 10-11. Pages 10 and 11 were to be read horizontally from left to right starting with page 10. This format was the same as pages 6-7 and pages 8-9 that had been read individually. The features of the pages (see figure 1) included a black background, horizontal white lines above and below, panels to designate a timeline, a vertical white line with titles of flight numbers of the hijacked planes, times, text boxes with narration, narration outside panels of pictures, and word bubbles. Similar to pages 6-7, there was a text box with the words to introduce the page. The text box was important because pages 10-11 included a "special note" about the timeline of events. The thick white lines on the page took the form of a table with the events of each flight across each of the four rows.

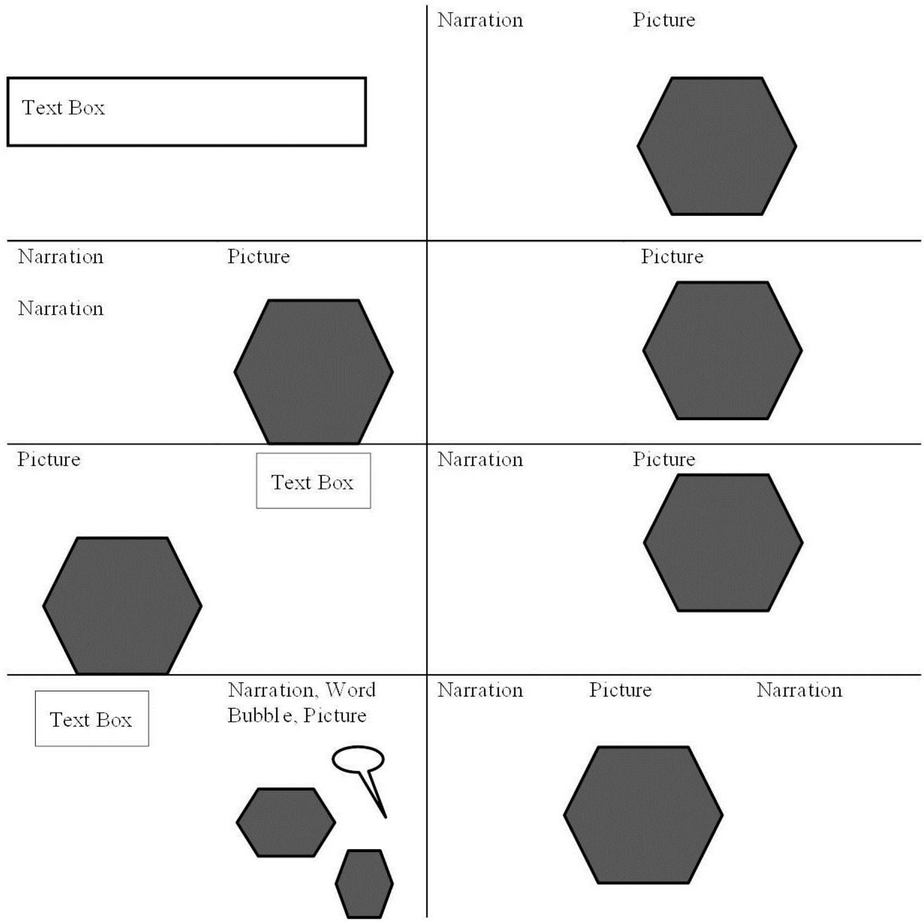
Unlike pages 6-9, the four flight titles "Flight 11," "Flight 175," "Flight 77," and "Flight 93" were not present on the pages. The absence of the flight numbers with the replicated format of the pages suggested that these four segments followed the same timeline. Pages 13-17 had all the same features as the previous pages except with one distinctive difference; the stories of each plane were not told in linear timelines. The story of each plane was told within a quadrant on the page. Table 5 summarizes the text features and reading strategies afforded by these pages and figure 1 shows a schematic representation of pages 10-11.

The four participants, Brett, Taylor, Melissa, and Parker sat in a circle. Each student held a copy of the text. Parker, who scored the highest on the standardized assessment in this group, started the conversation by saying, "I'll read," and essentially became the leader of the group. The other participants were Brett, who represents the low achievement group; Taylor, who represented the upper-middle achievement group, and Melissa who also represented the high achievement score group.

The findings indicated that students, of varying Language Arts proficiency levels, supported one another in reading comprehension in small group settings. For example, each time a student made a reading error, another student corrected the error until the student read again with fluency. One instance was when Melissa pointed and suggested that Parker was reading "out of order," but Parker replied, "It's okay, because they are separate stories." Each time a student commented about the text (this is usually an opinion), another student would add to that opinion in support of what was said.

Table 5. Pages 10-17 Summary of Text Features and Affordances for Reading Strategies

Page(s)	Text Features	Reading Strategies
10-11; 12-13; 14-15; 16-17	Double page Horizontal white lines (pages 10-11 only) Quadrant lines (pages 11-17) Time of events Narration Text boxes with narration Narration outside picture panels Word bubbles Different colored shading	Sound word Opinion Character Voice Inference Prior Knowledge Text reference Text Features (Format) Explanation Character voice Questioning about the text feature Questioning about the content Finger pointing



Hexagon = Picture, Word balloon = spoken text, Narration = Storyline text, Text Box = Commentary text.

Figure 1. The Schematics of Doubled Pages 10-11.

Parker began reading page 10 with fluency. There was a pivotal moment in Parker's reading and understanding of graphic novels. He started to read the page incorrectly, in the same manner that many students read pages 6-7 and 8-9, but when he jumped to the next panel on page 10 instead of reading across to page 11, Parker managed to only say the first word of the panel, "Minutes," before two of his peers, Melissa and Brett, offered assistance.

What follows is an analysis of student behaviors when reading graphic novels. The behaviors, which three of the four students used, were being taught to the reader, Parker. Melissa used "finger pointing in peer discussion" while saying, "Don't you read it across?" Melissa took her index finger and pointed to the beginning of page 10 and then traced her finger across the two pages to show Parker how to read the text. As she did this, Brett reaffirmed Melissa's statement, and used "finger pointing in peer discussion" in the same way. Brett said, "Yeah. In this book, you have to read it across." Parker responded, "Oh" and heeded their advice. In this case, Melissa's use of gestures enhanced Parker's ability to read correctly.

The gestures aided reading comprehension in connection with navigating the challenging textual features of the page. Parker did not hesitate to begin reading again without even reflecting on how he must have read the previous 4 pages incorrectly.

Brett, who scored significantly lower on the HSPA than the other students, understood how to read the comic well. This may be attributed to his prior experience reading graphic novels; however, his experience reading graphic novels was comparable to Melissa's, both of whom are avid comic book readers.

Parker continued reading the second line. At this time, the students confronted the sound word, "Whoom." Taylor casually stated, "I think a most effective sound word would be people screaming." Here, students engaged with an important reading strategy—providing an opinion about the text. However, what this group started to do and continued to do throughout the reading was comment on the author's purpose and author's choice. This higher-order thinking engaged the students not only in the content, but also in the context in which the story was written. The ability to not only understand the content, but to extend from the content is required of students by the Common Core Standards and is assessed on the HSPA. Parker added to Taylor's comment by providing the group with a sound of a cry, "Wahhh," which elicited smiles among the group.

In a similar manner, Parker used character voices when reading the dialogue. Again, he made inferences about the characters. Parker read the words in the word bubbles. The word bubble was an additional layer to the features of the text.

Furthermore, Parker was inclined to read the word bubbles because the reading of each page was driven by the images. In these cases, the word bubbles were in direct connection with the images of the characters, and therefore, it would have been impossible to overlook the words. He used a female voice when reading the woman's word bubble, similar to the voice he, and many other students, used when voicing the female flight attendant. As in the think-alouds, the use of character voices was an inferencing reading strategy.

Parker read the text, which stated the pilots had an error in communication. Melissa stated, "You know, they are kind of bad at their job," to which Parker replied, "Yeah. They all suck." This was a case of the students adding their opinion. At this point in the text, the students were learning that the country was not prepared for the attacks on September 11. The text then read, "The hijackers attacked flight 93 at 9:28 while traveling 35,000 feet above eastern Ohio. There were four of them. While the other hijacked planes had five".

The probably fifth would-be hijacker had been denied entry by a suspicious immigration official in Florida." Melissa replied, "Well, we finally got one out of like how many?" Taylor and Parker chuckled. The students clearly knew this was not funny, but their sarcastic comments and chuckles implied that they were well aware that security needed to be tightened.

The students read page 12. This was where the format of the text changed from four horizontal segments to quadrants across the two pages. The students also came across the next large sound word, "BLAMM!" Parker repeated the word, BLAMM," and said "BLAMM is the sound effect of choice" for emphasis, with his tone insinuating that there was something wrong with this. Taylor stated, "This is sort of insulting." Parker replied, "It's almost like they are so insulting that they are trying not to be insulting to the people. It's like not make a 9/11 joke, but it's a giant 9/11 joke." Taylor said, "I am picturing the hokey Batman song" to which Parker sang, "Da Na Nana Na Na Batman!" Taylor replied, "That's exactly what I was thinking."

The sarcasm was evident in the room among Melissa, Taylor, and Parker, but seemed lost on Brett who did not add much to the conversation. The students were aware that their jokes may have been inappropriate because the text was of somber events. Parker looked around and said, “We are all horrible.” However, the students were making meaning, connecting to prior knowledge, adding opinion, and engaging in conversations around the text, thus demonstrating the type of reading comprehension that is necessary to meet the state standards. In this way, the HSPA scoring rubric (Table 2), which requires students to make “insightful connections” and the standards (Table 3), which states students should “make a judgment or form a conclusion,” were discussed in the literature circle.

Parker was again confronted with a name of a person in the reading. He slowed down his normal pace of reading with fluency when approaching the word. At this time, Melissa pronounced the word for him, and he repeated it after her. Parker continued to repeat the same reading behavior when he saw dialogue balloons. This time, the dialogue was attached to a male with a serious look on his face. Therefore, Parker spoke in a deeper, more serious tone when reading his words. The students then looked closely at the picture and noticed the expression on a woman’s face. This was one of the first times the students commented on the pictures. Melissa said, “Look at this girl’s face.” Brett and Parker mimicked this face while Melissa and Taylor laughed.

The students turned to pages 16-17. They were now familiar with the format, so the reading procedures changed slightly. For example, instead of simply reading the narration, Parker started explaining what he saw on the page. He said, “There is a picture of the tower burning. You see it right there.” He used finger pointing to point to the image to which he was referring. He continued reading down page 14 instead of across to page 15, because the upper right quadrant of page 15 was blank. Therefore, he continued to read in the proper order. Even in this short time, students learned enough about each other that they did not need to read everything out loud and seemed to focus on what was between the lines, thus demonstrating an understanding of the format of the text. In this instance, Parker continued to use character voices to represent the characters paired with word bubbles. After the first line, the students commented on the word bubble, “It looks like everyone is running up to first class. I’ve got to go.” They asked a content related question: “Is that a joke?” Then, they start making inferences such as the following: (a) maybe there is a fight breaking out; (b) maybe he is a security person, (c) maybe that is why Sid Jacobson and Ernie Colon wrote it, referring to the cover of the text. Again, the students were questioning the intent of the author.

The artwork clearly showed the sense of urgency on the character’s face who said, “I’ve got to go.” That sense of urgency had the students questioning the shift in content as evidenced by their conversation relating to author’s purpose. Because the students did not know who this character was, they questioned the purpose of the outburst. This contrasted with instances when students clearly knew the purpose of a character and matched the image with a character voice.

The students turned to pages 16 and 17. The large sound word, “R-RRUMBLE…” appeared. Parker read, “Rumble” and followed the reading with, “Rumble. That was the sound effect of choice. These are some horrible onomatopoeias.” Melissa said, “Really?” and Brett said, “Wow,” while Taylor shook her head. Again, the students were commenting on the sound effects and the author’s choice of sound words by adding opinion. The students’ opinions were important because it was their way of connecting to the text.

Again, the students were not discussing the meaning of the text; rather, they were adding their own opinion, which is characteristic of good readers (Wolfe and Goldman, 2010). At the same time, students were demonstrating another facet of what good readers do—they were stopping to think about the ideas and restating the content (Pressley and Gaskins, 2006). The next page contained the sound word, "FLAMM!" Parker said, "FLAMM. And the sound effect of choice was FLAMM." No one commented this time.

Melissa pointed out that Parker skipped a panel. She asked, "10:28 am. Did you read that part?" Parker replied, "No, but that's okay because they are all different flights." Therefore, the quadrants signified the ability to read the contents in any order, whereas the horizontal lines did not offer that same affordance.

The reading ended on page 17. Peter read the line aloud and then pointed to the line saying, "That line really pisses me off. This one right here: "The number of lives lost that day was 2,973, the largest loss of life ever on American social as a result of a hostile attack." He pointed to the line, and stated, "This is the 'white man's' loss of life." Again, offering his opinion, but this time it was more sophisticated. He was upset that the phrase "white man" was used to refer to all those who lost their lives on September 11, 2001. He implied that "this soil" belongs to people of all races, and not only "the white man." The student, critical of the author's word choice, demonstrates the student's ability to critique the text.

DISCUSSION

These findings highlight how students engaged with graphic novels in small group settings. In the literature circles, students tended to evaluate the text more often than engage with other reading strategies or behaviors. According to Pressley and Gaskins (2006), good readers evaluate the text before they read. This was important because the ability to evaluate a text correlates directly to the Common Core Standards (2010), which state students must, "delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiently of the evidence" (Integration of Knowledge and Ideas section, standard RI.11-12.8). The literature circles were guided by peer-monitoring through the reading. Although the student with the highest achievement score initiated the reading, it was the other students in the group, including the student with the lowest achievement score, who helped guide the reader through the process.

One of the most common behaviors was finger-pointing, which allowed students to provide the reader and peers with directions on how to read the page correctly. Finger-pointing behavior was also used to denote a specific text point to discuss, especially with the sound words. On the other hand, finger-tracing, which was often used by students with low HSPA scores, only showed that students followed the pages, but did not show that they understood the pages because they continued to read the double-paged pages in the incorrect order. Students had a unique ability to make inferences in the literature circles. In the literature circle, discussion was possible – something that independent reading would not provide. The literature circles provided the students an opportunity to explore the forms and features of the text, and even create arguments about how to read the page in different orders. In examining the behaviors students enacted while reading graphic novels, the findings suggested that the text features affected the way students read the texts.

The textual features students paid attention to included font size, color, sound words, and format. The findings of the study suggested that students read the large print titles on the page, yet neglected to read smaller simply read the pictures instead of the titles. Color played a factor primarily in reference to the background color of the page. Although students noticed the background color (all black), this did not help students understand that two pages were to be read together. Sound words were read aloud with emphasize demonstrating students understanding of the type of text they were reading. In addition, and most importantly, many students incorrectly read pages 6-7 and 8-9, the two sets of pages that were read together. Students did not notice the features of a double-page reading and subsequently, many students misread the text without making corrections. The layout of the double-paged pages violated the readers' natural inclination to read left to right and top to bottom. Although students noticed they had read the page wrong, they did not go back to re-read the misread pages.

Other student reading behaviors were also pertinent to the research findings. Students frequently described what they saw on the page rather than read word for word. These findings indicated that graphic novels could be read and understood without reading all the words. Furthermore, the findings demonstrated that text features were important cues for students. Even though the students did not read all the names on a particular page of the text, they understood the gist of the story. The findings, therefore, demonstrated the connection of how words and pictures work together when reading graphic novels. Other features of the text, such as character voices, demonstrated that students made use of the pictures, words, and features when reading. The students were able to make inferences about a character's voice based on the paired image. All of these strategies came from students' prior knowledge. Description occurred most frequently when a student was describing a page, but "connections to self" occurred most frequently when a student was referring to the context of the content. These findings again showed that students were proficient in verbalizing their connections to the text and beyond the text, even though this is not shown on state assessments.

Lastly, students "read with fluency" when segments of words were strung together. Students were less likely to read with fluency when the page was filled with more images than words. The greater number of words allowed students to read each page at a quicker pace. Students who slowed their reading and asked themselves questions stopped at multiple segments and provided more insightful commentary. The findings suggest that a range of strategies should be taught prior to reading individual texts. Graphic novels are only one of many genres of multi-modal texts.

In addition, other 21st Century texts are multimodal, using a combination of words and images to convey messages. Using multimedia pedagogy with graphic novels is one way to prepare students to engage in a world full of multimodal literacy, thus easing the transition toward 21st Century texts. Pre-reading strategy instruction was used in the study; however, the findings indicate that students developed their own set of reading procedures in the small group literature circles.

Challenges of Reading Graphic Novels

As evidenced through the literature circles, students only made one major reading error when reading *The 9/11 Repor*t; they did not read the doubled pages correctly (pages 6-7 and 8-9). The errors they made did not seem to interfere with their overall understanding of the text. As suggested, students struggled with the format of the text. Students might find it easier to process information written in a comic format if explicit instruction focused on the forms and features of the text prior to reading the graphic novel. For example, the students could compare page features, such as page numbers, to traditional texts (e.g. books). Here, students would notice how the authors eliminated the page numbers at the bottom of each page; in doing so, students may see both pages as being a cohesive whole. In addition, students could compare text features, such as single and double pages, to traditional texts. For example, traditional texts (e.g. books) are read one page at a time from left to right. However, for the graphic novel, an additional reading cue would be to recognize the images, which might span the course of two pages. In doing so, the reader would naturally read the entire two pages from left to right because their eye would naturally follow the continuation of the image to the next page. This textual feature was evident on pages 8-9. In addition, students stopped after many of the panels to ask questions and make evaluations of the text. The short segments of text may have helped the students navigate the reading more effectively (Crabtree et al., 2010). This may aid in text-readability. Pages 6-7 and 8-9 were problem areas for most students even though most students did not notice the error. The problem arose from the challenge of breaking conventional reading patterns (reading from left to right and up and down). However, finger tracing and reading the titles helped students read these pages correctly. Taking a break and asking questions also seemed to guide readers throughout the reading of these pages (Hagaman et al., 2010).

English readers are conditioned to read from left to right on single-pages. Many students read the way they are used to reading - from left to right and top to bottom of a single page, and therefore, when students read graphic novels, they may read the pages out of order (Jakubik, 2014). Even though some students eventually recognized reading pattern errors during literature circle discussions, the students did not go back to the text to re-read the incorrectly read pages. The authors could have chosen a more direct approach which would be to organize the text by flight. The four stories of the four flights could have been told individually in the text. Since changing the text is not an option, teachers can help prepare their students to read new genres of text in prior to reading. One suggestion would be to teach *Understanding Comics* in small groups. Although *Understanding Comics* is a graphic novel, it does not veer as far from the normal features of traditional texts students are used to reading. In addition, teachers should study the text forms and features of a variety of texts.

In small group discussions, students could have conversations about the form of the text separate from the content. In doing such, students would be able to learn more about the format of the text without worrying about the content. In other words, teachers must prepare students to deal with text features that violate English readers normal systems for reading texts.

IMPLICATIONS FOR PRACTICE

Understanding the reading comprehension strategies and student behaviors activated while reading graphic novels provides educators with a fundamental understanding of how graphic novels can be used in the classroom instruction.

This research explored the cognitive and metacognitive processes of students' understanding of reading a combination of words and pictures. An understanding of how students think while reading enables teachers to provide more thoughtful and purposeful instruction.

Collaborative literature circles were key to helping students manage these complex multimodal texts. The findings of this study suggest that students can support one another in small groups. The support of a classmate is sometimes more effective than the text features that were drawn as the intended support. Scaffolds, including text-specific reading strategy instruction and support provided by student-lead literature circles, may assist in promoting deeper understanding of graphic novels (Blum et al., 2002). For example, in peer groups, students assist one another in understanding the direction of the reading. Another student can teach the features of the text that are confusing to one student. The students should work in mixed-ability groups when reading graphic novels. The mixed ability groups can empower students as they read because each student has the opportunity to make reading decisions (Blum et al., 2002). In addition, students are able to speak freely and comfortably about the content of the text, playing off of individual strengths as readers.

As the results show, students of varying HSPA score ranges engage with different reading comprehension strategies. Students will ultimately benefit from working with students who have a variety of skill levels when reading graphic novels.

Supporting Multiple Literature Circles

This study focused on one literature circle at a time. However, the average sized classroom may have as many as five or six simultaneous literature circles. A teacher can support student learning in multiple literature circles by using student behaviors as teaching tools. The behaviors such as finger pointing, finger pointing in peer discussion, and finger tracing, are cues teachers can follow to make inferences about students' understanding of a text. Teachers can see these gestures from across the room; therefore, while working with one group of students, the teacher can ascertain how students are working in other small groups. When a student uses finger tracing, for example, the teacher can determine if the student is reading the page correctly, and then make a reading repair suggestion. Retracing over and over is an indication of students making connections and having difficulty. However, finger tracing can also indicate that students are reading in the intended pattern of the book. Being able to recognize the behaviors will help teachers assist students in their reading as they attempt to make meaning.

Teachers need to prepare their lessons to ensure all students will be on-task. First, a collaborative culture must be in place. The classroom environment should be inviting and safe for all students to feel comfortable reading texts and discussing ideas with other students. Suggestions for creating collaborative cultures include (1) participating in classroom building activities; (2) arranging student seats in groups of 4; and (3) switching student-seating assignments every few weeks.

Next, students must be accountable for the reading in the literature circle. Although literature circles procedures were explained in this study, students chose to make authentic and productive adaptations to the procedures. Students should explore the text freely in order to make connections beyond the text.

However, teachers need to be sure students do not stray too far off topic when working in small groups. To eliminate the potential of students going “off-task,” teachers should create lessons that hold the students accountable for knowing the reading. Suggestions for creating accountability include structured journal assignments. The structured journal gives students the opportunity to continue to explore their own thoughts and ideas in writing after working in the small group literature circle. We are hesitant to suggest giving students study guide or reading questions because in our experience, we have seen students divvy up the questions. When students divide the questions amongst group members, the focus becomes more on answering the questions rather than engaging with the content beyond the text.

CONCLUSION

The study explored what students do as they read graphic novels. With a foundation of understanding of how students read graphic novels, which text and graphical features are affordances, and which text features are constraints, an extension to the research is to study how a teacher approaches the curriculum. The group setting appeared to support comprehension in two ways: (a) students assisted one another in reading repairs, and (b) students developed deeper inferences. Follow-up research study should explore how to make these literature circles more effective, particularly in a classroom with multiple small groups.

The literature circles offer students opportunities to take ownership in their learning experiences and deepen their thinking in peer discussion. Additionally, the complex nature of the graphic novel offers students more opportunities to discuss text features. The research findings can help future educators connect to the Common Core Standards in a way that motivates students to read in an authentic student-lead learning environment.

REFERENCES

Bitz, M. (2004). The comic book project: Forging alternative pathways to literacy. *Journal of Adolescent and Adult Literacy. 47*, 574-586.

Blum, H. T., Lipsett, L. R. and Vocom, D. J. (2002) Literature circles. *Remedial and Special Education. 23*, 99.

Brown, A. L. and Palincsar, A. S. (1989). Guided, cooperative learning and individual knowledge acquisition. In: L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser*, Erlbaum, Hillsdale, NJ, US. pp. 393-451.

Chi, M. T. H. (1996). Constructing self-explanations and scaffolded explanations in tutoring. *Applied Cognitive Psychology. 10*, 33-49.

Common Core Standards Initiative. (2010). Retrieved from http://www.corestandards.org/ELA-Literacy.

Crabtree, T., Alber-Morgan, S. and Konrad, M. (2010). The effects of self-monitoring of story elements on the reading comprehension of high school seniors with learning disabilities. *Education and Treatment of Children. 33*, 187-203.

Dorrell, L. D., Curtis, D. B. and Rampal, K. R. (1995). Book-worms without books: Students reading comic books in the school house. *Journal of Popular Culture. 29*, 223-234.

Fox, M. C., Ericsson, K. A. and Best, R. (2011). Do procedures for verbal reporting of thinking have to be reactive? A meta-analysis and recommendations for best reporting methods. *Psychological Bulletin. 137,* 316-344.

Gall, M., Gall, J. and Borg, W. (2010). *Applying educational research: A practical guide* (6th ed.). Boston, MA: Pearson.

Hagaman, J. L., Luschen, K. and Reid, R. (2010). The “RAP” on reading comprehension. *Teaching Exceptional Children. 43*, 22-29.

Hatfield, C. (2005). *Alternative comics*. Jackson, MS: University Press of Mississippi.

Hughes, J. M., King, A., Perkins, P., and Fuke, V. (2011). *Adolescents and "autographics": Reading and writing coming-of-age graphic novels.* Newark, DE: International Reading Association.

Jakubik, T. (2014). *Graphic Novels and the Common Core*. Rutgers, the State University of New Jersey, New Brunswick, NJ.

Krinsky, H. (2012). *Reading outside the comfort zone*. (Unpublished doctoral dissertation). Rutgers, the State University of New Jersey, New Brunswick, NJ.

McCloud, S. (1993). *Understanding comics. The invisible art.* New York, NY: Harper Collins.

Mills, H. and Jennings, L. (2011). Talking about talk: Reclaiming the value and power of literature circles. *Reading Teacher. 64,* 590-598.

Morrison, T. I. G., Bryan, G. and Chilcoat, G. W. (2002). Using student-generated comic books in the classroom. *Journal of Adolescent and Adult Literacy. 45,* 758-767.

National Reading Panel (2000). *Report of the National Reading Panel*. Retrieved from http:// www.nationalreadingpanel.org/publications/publications.htm.

New Jersey Department of Education. (2010). Retrieved from www.state.nj.us/education/

Palincsar, A. S. and Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and monitoring activities. *Cognition and Instruction. 1*, 117-175.

Pressley, M. and Gaskins, I. W. (2006). Metacognitively competent reading comprehension is constructively responsive reading: How can such reading be developed in students? *Metacognition and Learning. 1,* 99-113.

Ranker, J. (2007). Using comic books as read-alouds: Insights on reading instruction from an English as a second language classroom. *Reading Teacher*. *61*, 296-305.

Rowsell, J. and Burke, A. (2009). Reading by design: Two case studies of digital reading practices. *Journal of Adolescent and Adult Literacy. 53*, 106-118.

Text Complexity: Qualitative Measures Rubric (2013). Retrieved from achievethecore.org.

Wilkinson, I. A. G. and Son, H. S. E. (2011). A dialogic turn in research on learning and teaching to comprehend. In: M. L. Kamil, P. D. Pearson, E. Moje, and P. Afflerbach (Eds.), *Handbook of reading research*, (Vol. IV), Routledge, NY, US. pp. 359-387.

Wolfe, M. B. W. and Goldman, S. R. (2005) Relations between adolescents' text processing and reasoning. *Cognition and Instruction*. *23,* 467-502.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 4

THE TEACHER'S ROLE IN PROMOTING DIALOGIC TALK IN THE COLLABORATIVE CLASSROOM

Robyn M. Gillies*
University of Queensland, Brisbane, Queensland. Australia

ABSTRACT

Teachers play a key role in introducing children into ways of thinking and learning by making explicit how to express ideas, seek help, contest opposing positions, and reason cogently. Yet, it is only in recent years that research has begun to examine the role that teachers' dialogic talk plays in promoting collaborative dialogue in the classroom. This chapter synthesises research on dialogic talk and the responsibility teachers have for explicitly teaching students how to dialogue together if they, in turn, are to use these dialogic strategies to co-create new understandings and learning as they engage in collaborative small-group activities.

INTRODUCTION

Collaborative learning is a pedagogical practice that has been used extensively in classrooms to promote student engagement and learning. When children collaborate, they learn to listen to what others have to say, give and receive assistance, discuss different opinions and perspectives and, in so doing, develop mutual understandings of the topic that is being discussed (Johnson and Johnson, 1990). In fact, talk is so important that it is now recognised as more than a means of sharing thoughts. It is also regarded as a social mode of thinking and a tool for the joint construction of knowledge and the development of new understandings (Mercer, 1996). Students who collaborate demonstrate increased participation in group discussions, engage in more useful help-giving behaviours, and demonstrate more sophisticated levels of discourse than students who do not have these experiences (Gillies, 2003; Webb, 2009). The result is that children who collaborate on tasks tend to perform better

* Corresponding author: Email: r.gillies@uq.edu.au.

academically and are more motivated to achieve than children who have not had these experiences (Johnson and Johnson, 2002).

However, while collaborative learning provides opportunities for students to dialogue, concern has been expressed about the quality of the discourse that often emerges if students are left to engage in discussions without training in how to interact appropriately. Meloth and Deering (1999) found that task-related talk about facts, concepts, strategies, and thinking only appears irregularly when left to emerge as a by-product of collaborative learning. Similarly, Chinn et al. (2000) found that children only engaged in high quality discussions when they were required to provide reasons for their answers.

However, although children do not initially use talk to explore and investigate issues when they work collaboratively together, Rojas-Drummond and Mercer (2003) found that they can be taught to do so and this has a positive effect on their thinking and reasoning. The authors noted that effective teachers encouraged children to articulate their thoughts, reasons, and knowledge and share them with the class while they modelled useful ways of using language that children can appropriate for themselves during their peer group discussions. Additionally, these teachers provided opportunities for children to engage in sustained interactions where they were able to express their current understandings or articulate their difficulties. Webb and Mastergeorge (2003) noted that teachers have the responsibility for not only modelling appropriate interactional behaviours, but also for providing explicit instruction in how to use them if students, in turn, are to learn from their collaborative experiences.

Training teachers in how to teach appropriate interactional skills appears to be critically important if children are to engage in effective dialogic interactions with their peers. Veenman et al. (2005) reported that when teachers were trained in how to develop students' help-giving behaviour and promote effective small group work, students provided more high-level elaborations and this was positively related to student achievement. Dialoguing with others is critically important because Meloth and Deering (1999), Webb and Mastergeorge (2003) and Veenman et al. (2005) found that the cognitive and metacognitive levels of the groups' discussions are positively correlated with students' cognitive and metacognitive outcomes. Learning to seek and to give high-level elaborations is an important part of learning to dialogue and reason effectively together. Yet research demonstrates that students need to be trained in how to provide such help, if help is to be effective and learning is to occur (Gillies, 2003; King, 2002, Veenman et al., 2005).

Constructing Meaning: Theoretical Perspectives

Students learn new ways of thinking and talking and co-constructing new understandings when they have opportunities to interact with others (Mercer, 1996). This process of constructing meaning from interacting with others can be explained from two theoretical perspectives – personal and social constructivism.

Personal constructivism proposes that individuals are continually engaged in a process of cognitive construction which helps them to order their experiences and develop understandings of their environment (Piaget, 1950). Learning is mediated by interacting with others where individuals are likely to experience differing points of view and perspectives, leading to a state of cognitive conflict. In order to reconcile this conflict, individuals are forced to firstly, reconsider their own position and reassess its validity and secondly, be able to justify and communicate their own understandings if they are to be accepted as valid by their peers. Piaget believed that individuals are strongly motivated to reconcile conflict or contradictions and in so doing are often forced to re-evaluate their own understandings on the basis of the information available to them. In this regard, interaction with others triggers social and cognitive change, although the change itself is achieved by the individual alone. The nature and quality of peer interactions where students learn to challenge others' ideas, ask questions, interrogate responses, and provide explanations and justifications are critically important if students are to experience perturbations that serve to motivate their drive to reconcile anomalous understandings (De Lisi and Golbeck, 1999).

In contrast, social constructivism emphasises the interpersonal dimensions of learning and the importance of adults and more competent peers who help the individual master the cultural tools and signs (i.e., language, memory strategies) that are important to his or her cultural group (Vygotsky, 1978). From this perspective, interaction with others is critically important because adults and more capable peers mediate the child's environment by helping to direct his or her attention to what must be learned and providing the strategies for problem-solving and reasoning. When children interact together they learn the implicit principles of cooperative interaction and procedures for making inferences about what people mean by what they say (Forman, 1992). These interactions become internalised and part of the child's mental repertoire so eventually over time the child becomes capable of reproducing them independently of others (Damon and Phelps, 1989).

Ways in which Teachers Can Promote Collaborative Interactions in Classrooms

Although the benefits children derive from interacting with others in small groups are widely acknowledged (Gillies, 2003; Webb and Mastergeorge, 2003), there is a paucity of research on the role teachers play in promoting constructive interactions among students. This is a concern because there is no doubt that teachers play a critical role in inducting children into ways of thinking by making explicit how to express ideas, seek help, contest opposing positions, and reason cogently. Given the widespread benefits attributed to students working cooperatively with others, neglecting to document the role of the teacher is a concern. This, in part, may have happened because teachers have been encouraged to act as facilitators who encourage students to use each other as a resource rather than rely on outside help so the focus has been on the benefits that children derive from interacting with others rather than the role teachers play in the learning process. Furthermore, much attention has been directed at the conditions under which students learn in groups rather than examining the factors that may affect students' discourse as they interact together.

Teaching children how to ask and answer questions, and to provide elaborated responses that can be used by those requesting assistance, requires a concerted effort on the part of the teacher to model and teach these types of interactions with their students (Webb, 2009). However, while teachers do have the capacity to do this, research shows that it rarely occurs, with many teachers preferring to engage in traditional approaches to teaching where students are passive recipients of knowledge rather than active in their own learning (Galton et al., 2009). In a systematic review of classroom studies across four decades, Howe and Abedin (2013) noted that teachers do find it difficult to promote dialogic talk in classrooms where students are encouraged to explore others' views. At the same time, students also experience difficulties with exploratory talk, especially the requirement to challenge each other's ideas.

While there is no doubt that many teachers do elicit non-elaborated responses from students, Rojas-Drummond and Mercer (2003) found that they also have the potential to encourage students to develop more elaborated responses by making their thoughts, reasoning, and knowledge explicit. They do this when they use question and answer sequences not just to test knowledge but also to guide the development of understanding. These teachers often used questions to determine students' initial levels of understanding so they can adjust their teaching accordingly. They not only taught the specific content knowledge required but also demonstrated the use of problem-solving strategies, explained the meaning and purpose of classroom activities, and used their interactions with students as opportunities for students to be able to make their own thought processes explicit. In so doing, they treated learning as a social, communicative process where they not only interacted with students but encouraged students to interact with each other and become active in their own learning.

In a similar vein, Gillies (2004) found that when teachers had been trained to use specific communication skills designed to promote thinking and scaffold learning in students they used more mediated-learning interactions, asked more thought-provoking questions, and made fewer disciplinary comments than teachers who had not participated in this training. Moreover, the students in the trained teachers' classes provided more detailed explanations and asked more questions during their small group activities than the children in the untrained teachers' classes and this had a positive effect on the learning that occurred. It seems that helping teachers to acquire the specific dialogic skills that foster reciprocal interactions with students is critical for the development of effective small-group discussions and learning.

Dialogic Talk

Interest in the key role that talk plays in the construction of knowledge, understanding, and learning has gathered momentum recently, as various studies have been published that have demonstrated the importance of social collaboration in promoting cognitive development and academic attainment. Two of the first researchers to investigate the powerful effects of dialogic talk on students' thinking and learning were Adey and Shayer (1990, 1993, 2011) with a focus on Cognitive Acceleration (CA) programs. Building on the Paigetian idea that children learn when they are confronted with information that challenges their thinking, Adey and Shayer reported on a series of CA programs that were implemented in science and mathematics classrooms in primary and secondary schools and found that when children are presented with cognitively challenging tasks in socially supported situations where the teacher mediates the learning, they demonstrate significant gains in cognitive development and academic achievements in comparison to matched peers. Moreover, the gains recorded generalised to national public examinations taken up to three years later in science and mathematics, as well as in English, even though this latter subject was not targeted in the original CA intervention.

Adey and Shayer (2011) attributed the success of their CA programs to three core elements that were embedded in each program: Cognitive conflict, social construction, and metacognition. Cognitive conflict, occurs when children are presented with situations that are challenging, which cause them to stop and think, and to reflect on how they must proceed to solve the problem they are confronting. In order to reconcile these conflicts, students need to engage in a process of cognitive reflection to enable them to re-organise and re-construct their understandings in the light of new experiences and cognitions (Piaget, 1950). Gillies (2011) found that teachers promote cognitive growth in children when they use language that challenges their understandings, confronts discrepancies in their thinking and requires them to provide reasons for their solutions.

While CA programs place an emphasis on the role of cognitive conflict, they also recognise the importance of students co-constructing knowledge by interacting with each other. Certainly, Adey and Shayer (2011) believed that intelligence is socially constructed and happens when individuals have opportunities to work with others in a group where they discuss issues, ask questions, interrogate information, and work together to resolve and construct new understandings. In so doing, learners begin to reflect metacognitively on what they are learning and what they may still need to learn. There is a large body of research that indicates that children can be taught to engage in metacognitive processes and that they, in turn, can teach these skills to their peers (Shamir, Zion, and Spector-Levi, 2008; Slavin, 2013). Gillies and Khan (2008, 2009) found that when teachers are taught to use specific questioning strategies that challenge and scaffold children's thinking, this not only leads to the development of higher quality discourse but also better reasoning and problem-solving skills in their students. Reznitskaya et al. (2012) noted that students' thinking is enhanced when teachers engage them in dialogic exchanges where the discourse is shared, questions are open or discovery-based, teachers provide meaningful feedback, students scrutinize both the product and processes of their discussions, and elaborate on their thinking, and, in so doing, engage in the co-construction of new knowledge and understandings. In short, Adey and Shayer, Shamir et al., Slavin et al. and Reznitskaya et al. have demonstrated that children can be taught to engage in higher-level thinking or metacognitive thinking and that this has a positive effect on their interactions, thinking, and learning.

Other researchers who have investigated the powerful effects of dialogic talk on students' thinking and learning include Resnick and colleagues (Michaels et al., 2008; Resnick et al., 2010; Michaels and O'Connor, 2011) with their research on Accountable Talk. Accountable Talk is a way of teaching children how to engage in well-reasoned and logical discourse that involves being accountable to knowledge and accepted standards of reasoning within a given discipline (e.g., science, math etc.). Accountable Talk grew out of a Vygotskian theoretical framework that places an emphasis on the social formation of the mind, and, in particular, the importance of social interaction in the development of individual mental processes.

Accountable Talk

The teacher in the Accountable Talk classroom often initiates discussion by asking thought-provoking questions that challenge students to offer elaborated responses or explanations that can be accepted or challenged by others in the class. During the interaction that occurs children are encouraged to interrogate other's claims, explain and justify their own positions, rebut and reconcile contradictory stances until a resolution is achieved. Because the discourse is deliberative and discursive, it often involves extended exchanges between teacher-and-students, and students-and-students, with the teacher engaging in a number of "talk moves" (Resnick et al., 2010, p. 7). These talk moves are designed to help students to clarify their thoughts by the teacher revoicing or paraphrasing key ideas they have expressed, challenging students to consider the reasoning of others, prompting them to consider additional information, and asking them to explicate their reasoning. When students engage in this type of dialogic exchange, they listen to what others have to say, they learn to agree or disagree in an acceptable manner and offer alternative explanations or reasons when they disagree, and they engage in sustained interactions where they may extend on another's argument or seek further clarification or elaboration on an expressed idea.

In addition, such talk needs to be accountable to standards of reasoning and knowledge. For example, students engaging in discussing phenomena in science would be expected to engage in the process of claim, evidence, and reason, a standard approach to using the genre of argument in scientific discussion. Once this process had been activated, students would be expected to present their facts or knowledge that supports their claim while others would have opportunities to rebut the presented evidence with alternative explanations. While the interaction is essentially dialogical, the skilled teacher will need to provide authoritative knowledge when necessary and guide the conversation towards correct concepts for the discipline. In so doing, students learn that this type of talk requires that they are not only accountable to each other but they must also be prepared to engage in rational and logical reasoning about the presentation of facts and knowledge.

When children engage repetitively in this type of discourse-intensive instruction, Resnick et al. (2010) argues that evidence is beginning to emerge that it does support learning and improved cognitive performance. For example, O'Connor et al. (in press) elaborate further by discussing two studies that provided support for the importance of Accountable Talk in promoting students' classroom discussions and learning. In the first, the authors discuss an intervention called Project Challenge which was designed to provide talented students in low socio-economic schools with a challenging mathematics curriculum. Meanwhile the teachers of these students were taught to use different talk moves from Accountable Talk as ways of helping students to contribute their own ideas, listen to others, focus on reasoning, and work respectively and productively together. When these conditions were created, student discussions were more frequent, elaborate, and sustained and, as a consequence, students who participated in Project Challenge obtained significantly higher standardized test results than, regular education matched peers of their same age. Given that these results were consistent across four cohorts of students for the four years of the intervention, the effect of Accountable Talk on students' results was dramatic. Interestingly, students' standardized English Language Arts scores were also significantly higher than same-age matched peers who had not participated in Project Challenge even though the intervention was limited to mathematics instruction. These results led O'Connor et al. to suggest that improvements in student learning and cognitive performance in both mathematics and English language arts are plausibly related to the intense use of academically productive classroom talk.

In the second study, O'Connor and Michaels (2011) investigated how Accountable Talk supported measurable learning gains through an in-depth, in-vivo efficacy study of classroom talk. Using the same teacher to teach two different classes in order to overcome teacher effects, O'Connor and Michaels used a cross-over design to determine the effects of Accountable Talk versus direct instruction on students' learning outcome scores. The results showed that students obtained significantly higher learning outcome scores when they experienced Accountable Talk than when they experienced direct instruction.

The results obtained from the two studies described above led O'Connor et al. (in press) to conclude that "Through daily use of classroom talk to introduce, rehearse, and practice mathematical ideas and procedures, we might suppose that cognitive, linguistic, and metacognitive skills would improve" (p. 13). Certainly, the effects of Accountable Talk on students' thinking and academic achievements led to significant improvements not only on their standardized test scores in mathematics but also in English, thereby demonstrating that socio-linguistic-cognitive skills learnt in one subject area do transfer to another. Furthermore, the improvements recorded were maintained three years after the students had completed participating in the Project Challenge intervention.

Others who have investigated the powerful effects of classroom talk on students' learning and problem-solving and reasoning include Mercer and colleagues (Mercer, 1996; Mercer et al., 1999; Wegerif et al., 1999; Rojas-Drummond and Mercer, 2003) who used a dialogic tool that they called Exploratory Talk to help children to reason together as they work on collaborative problem-solving activities.

Exploratory Talk

In exploratory talk, students are taught how to engage critically and constructively with the ideas of others by learning how to reason and justify their assertions and opinions while challenging the ideas and opinions of others as the group seeks to resolve the problem they are confronting (Mercer et al., 1999). In order to be able to participate effectively in these types of dialogical exchanges, children are taught specific ground rules for the way they will interact as well as learning that they are accountable to standards of reasoning and knowledge which will be visible in their talk.

The ground rules for exploratory talk during small group discussions include: sharing all information; promoting agreement among group members; accepting responsibility for group decisions; providing reasons for decisions; challenging the ideas and opinions of others; discussing alternative propositions before making a decision; encouraging everyone in the group to contribute their ideas and opinions (Mercer et al., 1999; Wegerif et al., 1999).

While students need to learn how to engage in dialogic discussions with each other through the use of exploratory talk, Rojas-Drummond and Mercer (2003) emphasised the key role that teachers play in creating the classroom conditions that will enable these exchanges to occur. This includes helping students to make explicit their thoughts, reasons and knowledge and share them with the class. It also includes modelling different ways of using language that children can appropriate and use themselves in discussions with their peers or in other settings as well as providing opportunities for children to engage in sustained discussions where they can express their understandings or difficulties. The results from this study on the use of exploratory talk showed that while it enabled students to become more effective in using language as a tool for reasoning and sharing knowledge, it also led to higher levels of individual achievement, and significant improvements in students' capacities to solve reasoning-test problems. These results are consistent with the findings of Mercer et al. (1999) who concluded that "the use of exploratory talk helps to develop children's individual reasoning skills. It appears that even non-verbal reasoning, like that involved in solving problems on the Raven's Progressive Matrices [a test of non-verbal reasoning abilities] may be mediated by language and developed by adult guidance and social interaction amongst peers without the provision of any specific training in solving such problems" (p. 108). Mercer et al. also noted that "…our results support the view that the induction of children into cultural language practices influences their use of language as a cognitive tool" (p. 108).

Similar results were obtained by Rojas-Drummond et al. (2003) who worked with 84 children in grades 5 and 6 (10 - 12 years) in two schools in Mexico City. In the experimental school, students were trained in how to use exploratory talk to enable them to express and share their reasoning as they worked collaborative together on problem-solving tasks while children in the control school received their regular curriculum. Data were collected via videos as the children worked on problem-solving tasks. The results showed that the children in the experimental classes engaged in significantly more exploratory talk where they engaged in more detailed discussion on the problem, considered different alternatives, offered solutions with justifications, challenged ideas, and negotiated different perspectives before reaching consensus for a correct response. In fact, exploratory talk was the most prominent type of talk in the experimental classes for about 75% of all problems whereas, in contrast, in the control classes it was used for about 30% of all problems. Interestingly, this enhanced facility with problem-solving and reasoning appeared to transfer to the Raven's Progressive Matrices of Non-verbal Reasoning Abilities where the children in the experimental classes performed significantly better than their peers in the control classes. The authors argued that the study confirms socio-cultural claims that language functions as a powerful tool to facilitate reasoning and problem-solving in social contexts.

Other studies (Mercer and Sams, 2006; Mercer et al., 2009) have confirmed the value of language as a tool for reasoning. In the first study, Mercer and Sams report on an intervention program called Thinking Together that was implemented in 14 classrooms with 406 Year 5 children (aged 9-10) with the purpose of teaching children the skills they would need to be able to talk and reason effectively together as they engaged in mathematical tasks. The purpose of the program was to make children aware of the use of spoken language as a means for thinking together, to enable children to develop their potentials to use language as a tool for thinking, both collectively and alone, and to enable them to apply this language tool effectively in their science and mathematics curriculum topics. In particular, the children learnt the ground rules of exploratory talk (outlined above) to ensure they had the skills to participate effectively in discussions with their peers.

The results obtained indicate that children can be taught to use talk more effectively as a tool for reasoning and that talk-based group activities can help the development of individuals' mathematical reasoning, understanding and problem-solving. Mercer and Sams (2006) argued that the study provides empirical support for the Vygotskian claim that language-based, social interaction has a developmental influence on individual thinking and attainment.

In the second study, Mercer et al. (2009) investigated how two teachers used talk as a pedagogical tool to guide the development of children's understanding and the extent to which they attempt to guide students own effective use of talk for learning during primary science lessons. The two teachers who participated in this study were part of a larger study involving five primary schools and three secondary schools in two regions in England where data were collected on how teachers taught science. All teachers in this larger study expressed an interest in dialogic teaching, all volunteered to participate, and all were regarded as good practitioners. Information was provided to the teachers on how they could use dialogic teaching strategies to promote discussion in their classrooms.

The results of the Mercer et al. (2009) study showed that while both teachers provided opportunities for students to talk together in pairs or groups, elicited ideas about the topic under discussion from the students, and sometimes made connections between everyday experiences and scientific explanations, only one teacher explicitly focused on the quality of talk of the students in their groups, specifically took time to teach students appropriate ways of taking turns and working together effectively, and regularly emphasised the value of talk for learning. This teacher also took time prior to the commencement of the group activities to establish the tasks the students were to complete. These results led the authors to conclude that even if teachers express an interest in dialogic teaching, they may need re-assurance that that this approach to teaching is an effective way to help students' learning and understanding of science. Furthermore, teachers need to develop an awareness of the importance of the key role they play in promoting and participating in classroom talk.

Dialogic Teaching

Dialogic teaching recognises the power of talk to stimulate and extend students' thinking and advance their learning and understanding (Alexander, 2010a). Dialogic teaching focuses on the teacher's talk as well as the students', it is a comprehensive approach to talk in teaching and learning across the school curriculum, is grounded in research and draws upon a broad repertoire of strategies and practices (Alexander, 2010b). Dialogic teaching, Alexander (2008) argues, is not just any talk, it requires: dialogic interactions which challenge students to think in different ways; questions which probe for more detailed responses; answers that are well reasoned and justified; feedback which is informative as well as encouraging; contributions that elaborate on information or ideas; discussion and argument that probe and challenge accepted positions; professional engagement with discipline knowledge; and a classroom environment that invites open discussion. Participants in a dialogic teaching classroom address learning tasks together, share ideas and consider alternative viewpoints, and, in so doing, learn to engage in logical and rational arguments to co-construct and create new understandings.

Wolfe and Alexander (2008) argue that dialogic teaching occurs when teachers structure learning and facilitate students' active participation in the learning discourses. In order to be able to do this effectively, teachers need to have a sound knowledge of the curriculum and an understanding of the issues likely to confuse students' thinking. Teachers create opportunities that encourage students to respond in extended utterances and they model language that is comprehensible, yet it exceeds what students are able to produce alone. Teachers listen and respond to students' responses by challenging and probing their meanings and they offer constructive and formative feedback to students on their performances. Participants in the discourse understand that ideas are advanced tentatively and with a degree of uncertainty, speaking rights are evenly distributed and they participate in debates in an intelligent and articulate manner, listening to the substance of others' contributions.

Drawing on the principles of dialogic teacher-talk, Lehesvuori et al. (2011) reported on a study where 12 pre-service science teachers were introduced to the Communicative Approach (CA) to teaching science that involved dialogic teaching in addition to authoritative teacher-talk. In response to the socio-cultural view of teaching, where students learn when they interact with more capable others, the concept of dialogic teaching interactions between teacher and students are chained into coherent lines of inquiry as the teacher builds on students ideas and helps to link them to the topic under discussion.

Dialogic teaching in science is supportive and reciprocal with the teacher helping to explore and probe students' views and ideas while simultaneously guiding them to work with scientific ideas and helping them to internalize their understandings. Under these circumstances, the dialogue is discursive as participants engage in discussion which is open to divergent points of view and where the teacher will, periodically, engage in an authoritative intervention to develop the canonical scientific view or establish and consolidate a point of view expressed by students (Scott et al., 2006). The aim of the CA intervention, Lehesvuori et al. (2011) maintain, was to heighten the participants' awareness of these different dialogical practices and to determine if they were able to use these ways of communicating in their pre-service field-practice. The results demonstrated that training in dialogical teaching and authoritative talk did heighten participants' awareness of different dialogical options that were available for communicating with students and that pre-service teachers are capable of challenging traditional forms of classroom interaction during their pre-service field-experience. Lehesvuori et al. also reported that the dialogical approach to teaching created a classroom climate where students had opportunities to discuss and pose questions themselves. When teachers make their classroom interactions more dialogic, they engage students in a collaborative deliberation of complex questions and support the development of students' thinking.

CONCLUSION

There is no doubt that teachers play a key role in promoting dialogic talk in the collaborative classroom. This chapter has synthesised research on dialogic talk and the responsibility teachers have for explicitly teaching students how to dialogue together if they, in turn, are to use these dialogic strategies to co-create new understandings and learning as they engage in collaborative small-group activities. The chapter discussed Adey and Shayer's (2011) research on Cognitive Acceleration programs and the key role social collaboration played in helping students to resolve cognitively challenging tasks. Other researchers who have investigated the powerful effects of dialogic talk on students' thinking and learning include Resnick and colleagues (Resnick et al., 2010) with their research on Accountable Talk and it has been used to teach children how to engage in well-reasoned and logical discourse that has been shown to support learning and improved cognitive performance. Similar results were obtained by Mercer and colleagues (Rojas-Drummond and Mercer, 2003; Mercer, Wegerif and Dawes, 1999; Wegerif et al., 1999) who used a dialogic tool called Exploratory Talk to help children to reason together as they work on collaborative problem-solving activities. The results from a series of studies consistently demonstrated that language-based, social interaction has a developmental influence on individual thinking and attainment.

Finally, the importance of dialogic teaching proposed by Alexander (2010a,b) that recognises the power of talk to stimulate and extend students' thinking and advance their learning was discussed. Dialogic teaching involves the teacher in challenging students to think in different ways, question different positions and views, elaborate on information and ideas, and provide feedback that is informative and encouraging. In the dialogic classroom, participants address learning tasks together, share ideas and consider alternative viewpoints, and, in so doing, learn to engage in logical and rational arguments to co-construct and create new understandings.

ACKNOWLEDGMENT

This work was supported by an Australian Research Council Grant: ARC-SRI: Science of Learning Research Centre (project number SR120300015).

REFERENCES

Adey, P. & Shayer, M. (1990). Accelerating the development of formal thinking in middle and high school students. *Journal of Research in Science Teaching, 27*, 267-285.

Adey, P. & Shayer, M. (1993). An exploration of long-term far-transfer effects following an extended intervention programme in the high school science curriculum. *Cognition and Instruction*, *11*, 1-29.

Adey, P. & Shayer, M. (2011). *The effects of cognitive acceleration – and speculation about causes of these effects.* Paper presented at the AERA Research Conference, Socializing intelligence through academic talk and dialogue. Learning, Research and Development Centre, University of Pittsburgh.

Alexander, R. (2008). Culture, dialogue and learning: Notes on an emerging pedagogy. In: N. Mercer and S. Hodgkinson (Eds.), *Exploring talk in school* Los Angeles: Sage. 91-114.

Alexander, R. (2010a). Speaking but not listening? Accountable talk in an unaccountable context. *Literacy*, *44*, 103-111.

Alexander, R. (2010b). Dialogic teaching essentials. http://www.robinalexander.org.uk/index.php/dialogic-teaching/

Chinn, C., O'Donnell, A. & Jinks, T. (2000). The structure of discourse in collaborative learning. *The Journal of Experimental Education*, *69*, 77-89.

Damon, W. & Phelps, E. (1989). Critical distinctions among three approaches to peer education. *International Journal of Educational Research*, *13*, 9-19.

De Lisi, R. & Golbeck, S. (1999). Implications of Piagetian Theory for peer learning. In: A. O'Donnell and A. King (Eds.), *Cognitive perspectives on peer learning*, Erlbaum, Mahwah, NJ, USA. 3-37.

Forman, E. (1992). Discourse, intersubjectivity, and the development of peer collaboration: A Vygotskian approach. In: L. Winegarand J. Valsiner (Eds.), *Children's development* *within social context: Metatheory and theory*, Lawrence Erlbaum and Associates, Hillsdale, NJ, USA. 143-160.

Galton, M., Hargreaves, L. & Pell, T. (2009). Group work and whole-class teaching with 11-to-14-year-olds compared. *Cambridge Journal of Education, 39*, 119-140.

Gillies, R. (2003). The behaviours, interactions and perceptions of junior high school students during small-group learning. *Journal of Educational Psychology, 95*, 137-147.

Gillies, R. (2004). The effects of communication training on teachers' and students' verbal behaviours during cooperative learning. *International Journal of Educational Research*, *41*, 257-279.

Gillies, R. (2011). Promoting thinking, problem-solving and reasoning during small group discussions. *Teachers and Teaching: Theory and Practice*, *17*, 73-89.

Gillies, R. & Khan, A. (2008). The effects of teacher discourse on students' discourse, problem-solving and reasoning during cooperative learning. *International Journal of Educational Research*, *47*, 323-340.

Gillies, R. & Khan, A. (2009) Promoting reasoned argumentation, problem-solving and learning during small-group work. *Cambridge Journal of Education*, *39*, 7-27.

Howe, C. & Abedin, M. (2013). Classroom dialogue: asystematic review across four decades of research. *Cambridge Journal of Education*, *43*, 325-356.

Johnson, D. & Johnson, R. (1990). Cooperative learning and achievement. In: S. Sharan (Ed.), *Cooperative learning: Theory and research*, Praeger, New York. 23-37

Johnson, D. & Johnson, R. (2002). Learning together and alone: Overview and meta-analysis. *Asia Pacific Journal of Education*, *22*, 95-105.

King, A. (2002). Structuring peer interaction to promote high-level cognitive processing. *Theory into Practice*, *41*, 33-40.

Lehesvuori, S., Viiri, J. & Rasku-Puttonen, H. (2011). Introducing dialogic teaching to science student teachers. *Journal of Science Teacher Education*, *22*, 705-727.

Meloth, M. & Deering, P. (1999). The role of the teacher in promoting cognitive processing during collaborative learning. In A. O'Donnell and A. King (Eds.), *Cognitive perspectives on peer learning*, Lawrence Erlbaum, Mahwah, NJ, USA. 235-255

Mercer, N. (1996). The quality of talk in children 'collaborative activity in the classroom. *Learning and Instruction*, *6*, 359-377.

Mercer, N., Dawes, L. & Staarman, J. (2009). Dialogic teaching in the primary science classroom. *Language and Education*, *23*, 353-369.

Mercer, N. & Sams, C. (2006). Teaching children how to use language to solve maths problems. *Language and Education*, *20*, 507-528.

Mercer, N., Wegerif, R. & Dawes, L. (1999). Children's talk and the development of reasoning in the classroom. *British Educational Research Journal*, *25*, 95-111.

Michaels, S., O'Connor, C. & Resnick, L. (2008). Deliberative discourse idealized and realized: Accountable Talk in the classroom and in civic life. *Studies in Philosophy of Education*, *27*, 283-297.

Michaels, S. & O'Connor, C. (2011). Conceptualizing talk moves as tools. Leveraging professional development work with teachers to advance empirical studies for academically productive talk. Paper presented at the AERA Research Conference, *Socializing intelligence through academic talk and dialogue*. September 22-25, 2011: Pittsburgh, PA.

O'Connor, C., Michaels, S. & Chapin, S. (in press). "Scaling down" to explore the role of talk in learning: From district intervention to controlled classroom study. In: L. Resnick, C. Asterhan and S. Clarke (Eds.), *Socializing Intelligence through Talk and Dialogue*. Washington, DC: American Educational Research Association.

O'Connor, C. & Michaels, S. (2011). *Scaling back to look forward: Exploring the results of an In VivoStudy of Accountable Talk.* Paper presented at the AERA Research Conference, Socializing intelligence through academic talk and dialogue. Learning, Research and Development Centre, University of Pittsburgh, 22-25 September, 2011.

Piaget, J. (1950). *The psychology of intelligence*. London: Routledge and Kegan.

Resnick, L., Michaels, S. & O'Connor, C. (2010). How (well structured) talk builds the mind. In D. Pressis and R. Sternberg (Eds.), *Innovations in educational psychology: Perspectives on learning*, *teaching and human development*. New York: Springer.

Reznitskaya, A., Glina, M., Carolan, B., Michaud, O., Rogers, J. & Sequeira, L. (2012). Examining transfer effects from dialogic discussions to new tasks and contexts. *Contemporary Educational Psychology*, *37*, 288-306.

Rojas-Drummond, S. & Mercer, N. (2003). Scaffolding the development of effective collaboration and learning. *International Journal of Educational Research*, *39,* 99-111.

Rojas-Drummond, Perez, Velez, Gomez & Mendoza. (2003). Talking for reasoning among Mexican primary school students. *Learning and Instruction*, *13*, 653-670

Shamir, A., Zion, M. & Levi, O. (2008). Peer tutoring, metacognitive processes and multimedia problem-based learning: The effect of mediation training on critical thinking. *Journal of Science Education and Technology*, *17*, 384-398.

Slavin, R. (2013). Effective programs in reading and mathematics: lessons from the Best Evidence Encyclopedia, *School Effectiveness and School Improvement*, *24*, 383-391.

Scott, P., Mortimer, E. & Aguiar, O. (2006). The tension between authoritative and dialogic discourse: A fundamental characteristic of meaning making interactions in high school science lessons. *Science Education*, *90*, 605-631.

Veenman, S., Denessen, E., van den Akker, A. & van der Rijt, J. (2005). Effects of a cooperative learning program on the elaboration of students during help seeking and help giving. *American Educational Research Journal*, *42,* 115-149.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Webb, N. (2009). The teacher's role in promoting collaborative dialogue in the classroom. *British Journal of Educational Psychology*, *79*, 1-28.

Webb, N. & Mastergeorge, A. (2003). Promoting effective helping in peer-directed groups. *International Journal of Educational Research*, *39,* 73-97.

Wegerif, R., Mercer, N. & Dawes, L. (1999). From social interaction to individual reasoning: An empirical investigation of a possible socio-cultural model of cognitive development. *Learning and Instruction*, *6,* 493-516.

Wolfe, S. & Alexander, R. (2008). Argumentation and dialogic teaching: Alternative pedagogies for a changing world. http://www.robinalexander.org.uk/index.php/publications/

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 5

HOW TO USE THE EDUCATIONAL DEBATE METHOD AS COLLABORATIVE LEARNING FOR EVALUATING THE CURRICULAR ACHIEVEMENTS

***Darinka Sikosek*[1,•] *and Davorin Horvat*[1]**
[1]Faculty of Sciences and Mathematics, University of Maribor, Slovenia

ABSTRACT

Testing and assessment of knowledge is a key component of the curriculum at all educational levels, starting at elementary education level, where we assess the student's performance in complying with the subject curricular program, which is Science and Chemistry in our case. To illustrate collaborative learning we have chosen an educational debate method for this purpose, supported by a competence list of students who appear in characteristic roles specific to this method.

Educational debate presents, for examination (testing and assessing), an alternative teaching approach in which students experience the experimental and self-initiative debate contents, as well as learning to critique those topics. The competence list covers the operationalized competent sets to the full extent from the key-, generic- and (especially) object-specific- (also known as scientific) competences.

In the debate situation students work as active participants, which means they share their views and knowledge on opposing aspects of educational debate contents. A teacher acts as a preparer of the contents, but a student acts as a moderator and leads this assessment debate situation. Both teacher and student-moderator function as evaluators, wherein the teacher is the authorized assessor (referred to the code of teaching). In our debate situation there are also *active* and *passive* debaters. Using a specialized worksheet, the latter carefully monitor and evaluate the course of the debate.

Our research contribution represents the following didactic material: (1) teacher's preparation on educational debate method for testing and assessing the curricular competences' achievements; (2) instructions to prepare students for the implementation of debate roles; (3) testing sheets given to observing students ("passive-debaters") for their self-reflection of the debate course (active observing and recording); (4) some

---

• E-mail: darinka.sikosek@guest.um.si.

samples of evaluation material for the purpose of evaluating the competence aspects (cognitive, conative, psychomotoric skills).

The strategy of educational debate allows a wide range of competences, promotes self-activity, develops creativity, strengthens the interdisciplinarity and accelerates the development of empathy.

Keywords: collaborative learning, educational debate method, competences, didactic material, Science, Chemistry

INTRODUCTION

Student Evaluation as a Curricular Component of the Educational Process

Effective assessing of quality is a key component of the learning process. In general, testing (Novak, 2005) as a didactic term is defined as the collection of information and data on how the learner acquires and advances in the understanding of the skills covered in the context of a comprehensive set of learning topics. According to the national Regulation on Examination and Evaluation of Knowledge and Progress of Students in Primary School (Official Gazette of RS, No. 73/2008, Article 3) this term is precisely defined as: A didactic collection of information about students' achievement goals or standards of knowledge, as they are defined in the curriculum. The teacher completes a check-list of achieved goals and skills between, before and at the end of the hearing of new content knowledge.

Assessment of knowledge can easily be defined as the systematic determination of the success rate of students' progress of knowledge (Sikošek, 2006; Repp et al., 1999). According to The Regulation on Examination and Evaluation of Knowledge and Progress of Students in Primary School (Official Gazette of RS, No. 73/2008, Article 10) this didactic term is more explicitly defined as the detection and evaluation of students' scope and quality achieved goals or standards of knowledge. Of course, the assessing of knowledge and skills are performed after the testing. Students' learning is evaluated through the necessary aspects of these two categories: contents and skills.

The terms “testing and assessing” may be considered as separate (independent) didactic situations, or singly, using only the term “testing”, which is defined as a didactic situation where the both macro-didactic components take place at the same time (the two “fuse” together) by using specific methods (such as educational debate). This didactic situation can be defined as an innovative form of an evaluation of students' acquired knowledge and skills. Through the current approaches (Novak, 2005; Sikošek, 2006) used in the implementation of assessing by grading, one may observe different meaning and purpose thereof, wherein one can highlight in particular the following primary functions of this didactic situation:

(1) Feedback to student and teacher about their own achievements and approach on the design of further improving the teaching and learning, specific to the type of *formative* (ongoing or continuous) assessment (verification);
(2) Monitoring of the overall achievement of students in a systematic way (trimester and the final score), specific to the type of *summative* (final) testing by assessment;

(3) *Determination of prior knowledge (*the quality of), *learning difficulties and planning an individual curriculum,* specific to the type of *diagnostic* testing by assessment;
(4) *Determining the outcome of an individual against the average, measure the overall performance of students,* characteristic of the type of *normative* assessment (verification);
(5) *Comparing the results of an individual with given criteria (*measurement *of basic skills, stepwise progression*, scheduling *groups*), typical of the type of *criterion* testing by assessing.

CATALOGUES OF EVALUATING (TESTING AND ASSESSING) PRIMARY SCHOOL STUDENTS ACHIEVEMENTS: SLOVENIAN CASE STUDY

As a case study of planning the testing by assessing of curricular goals or standards of knowledge, we selected the following subjects: Natural Sciences (6th grade of primary school education, age 12 years) and Chemistry (8th grade primary school education, age 13 years). For an illustration of assessment contents of Natural Science, an example is "Renewable and Non-renewable Energy Sources", which are broken down into three substantive areas: (1) The environment is derived raw materials, (2) Energy, (3) Effects on the environment.

Regarding the subject of Chemistry, an example of content is "Hydrocarbons Family", which is broken down into four key areas: (1) Hydrocarbons, (2) Oil, (3) Fossil fuels, (4) Alternative energy sources. For each of these topics (using the Bloom and Marzano taxonomy) we constructed specific Catalogues of Testing/Assessing Knowledge (see tables 1 and 2).

KEY POINTS ABOUT COLLABORATIVE LEARNING

Collaborative learning (Tolmie et al., 2009; Johnson et al., 2000) is a reciprocal work with an intention of obtaining a certain common goal: to acquire new learning material through specific problem solving. Collaborative learning represents methods which encourage students to implement tasks mutually. The application of collaborative learning is sensible in small groups (Pisar, 2006; Tolmie et al., 2009) which should enable the best learning efficiency of an individual. Every student has to learn the material, complete the task and consult a classmate regarding this matter. Research studies have shown that collaborative learning can bring better results in all age groups and subject areas (with the implementation of different tasks).

Skills, required for collaborative learning (Peklaj, 2001):

(1) communication,
(2) developing and preserving trust within a group,
(3) solving and overcoming problems, contradictions and conflicts in a group.

Efficient work (Peklaj, 2004) depends on establishing a positive atmosphere and genuine relationships.

Table 1. Catalogue of the target knowledge (taxonomic specified), for assessing (testing) by grading (evaluating) the content section "Renewable and Non-renewable energy sources"

Concepts	Competent learners' knowledge-debaters
Cognitive taxonomic level (current) according to Bloom: Level 1: KNOWLEDGE The levels (current) of complex thinking by Marzano: (1) COMPARING, (2) CLASSIFICATION, (6) ARGUMENTATION AND ARGUING;	
Concepts	**Competent learners' knowledge-debaters**
- Substances, - raw materials, - fossil fuels, - refining of petroleum, - power plants: thermal-, nuclear-, hydro-, wind-power plant; - rocks.	✓ Recognize the properties as a criterion for dividing the substance. ✓ Define the raw materials. ✓ Classify the resources in the classification scheme. ✓ Describe the method of refining oil. ✓ Name the fractions of oil. ✓ Name and describe the different kinds of power plants. ✓ Specify the classification of rocks.
Cognitive taxonomic level (current) according to Bloom, Level 2: UNDERSTANDING The levels (current) of complex thinking by Marzano: (1) COMPARING (7) ABSTRACTING;	
Concepts	**Competent learners' knowledge-debaters**
-Non-renewable sources of energy: fossil fuels, oil, natural gas; - renewable energy sources; - oil (cracking); - natural resources, natural substances, the environment; - packaging, recycling.	✓ Explain and describe the nature of the substance regardless of the source. ✓ Condense knowledge of the oil, describe the process of refining. ✓ Describe the difference between renewable and non-renewable (fossil) energy sources. ✓ Explain cracking process.
Cognitive taxonomic level (current) according to Bloom, Level 3: USE The levels (current) of complex thinking by Marzano: (3,4) CONCLUSION through the induction / deduction, (10) INVESTIGATION;	
Concepts	**Competent learners' knowledge-debaters**
- Alternative sources of energy, - fossil energy sources.	✓ Show how to use alternative sources in practice. ✓ Clarify (in case) the advantages and disadvantages of alternative and fossil fuels.
Cognitive taxonomic level (current) according to Bloom, Level 4: ANALYSIS The levels (current) of complex thinking by Marzano: (11) PROBLEM SOLVING	
Concepts	**Competent learners' knowledge-debaters**
- Protection of the environment, - recycling, - innovative sources of energy, - changed the environment as a result of pollution.	✓ Be aware of the importance of environmental pollution. ✓ Analyze and test alternative energy sources. ✓ Clarify (in case) the advantages and disadvantages of alternative and fossil fuels ✓ Explain (for example) the advantages and disadvantages of alternative and fossil fuels.

Cognitive taxonomic level (current) according to Bloom, Level 5: SYNTHESIS The levels (current) of complex thinking by Marzano: (9) DECISION MAKING, (11) PROBLEM SOLVING;	
Concepts	**Competent learners' knowledge-debaters**
- The environment around us, - problems of environmental pollution, - concern for the preservation of pristine nature	Think about limiting the release of pollutants into the environment. Make self-report and critically evaluated it. Compose (at its discretion) a strategy of separate waste collection.
Cognitive taxonomic level (current) according to Bloom, Level 6: EVALUATION The levels (current) of complex thinking by Marzano: (6) ARGUMENTATION AND REASONING, (13) DISCOVERY / INVENTIONS	
Concepts	**Competent learners' knowledge-moderators**
- Evaluation of the performance (moderator) -argumentation, -independent work (leaving autonomy).	Valued (critical) partial implementation of a classmate and argue their own opinions. Statement of autonomy in designing learning situations. Make meaningful conclusions and possible suggestions.

Table 2. Catalogue of the target knowledge (taxonomic specified), for assessing (testing) by grading (evaluating) the content section "Hydrocarbons Family"

Cognitive taxonomic level (current) according to Bloom: Level 1: KNOWLEDGE The levels (current) of complex thinking by Marzano: (1) COMPARING, (2) CLASSIFICATION, (6) ARGUMENTATION AND ARGUING;	
Concepts	Competent learners' knowledge-debaters
- hydrocarbons: alkanes, alkenes, alkynes; - organic compounds: acyclic compounds, carbonate, heterocyclic compounds; - the circulation of carbon in nature, - oil (fractional distillation).	Know the division of organic compounds. Name the different groups of hydrocarbons. Know the importance of the circulation of carbon in nature. Consolidate their knowledge about oil, list the fractions.
Cognitive taxonomic level (current) according to Bloom: Level 2: UNDERSTANDING The levels (current) of complex thinking by Marzano: (1) COMPARING, (7) ABSTRACTION;	
Concepts	**Competent learners' knowledge-*debaters***
- renewable and non-renewable sources of energy, - oil (cracking).	Tell the difference between the fossil and alternative energy sources. Be described how oil refining process is carried out and explain the cracking process.

Table 2 (Continued).

Cognitive taxonomic level (current) according to Bloom: Level 3: USE; The levels (current) of complex thinking by Marzano: (3,4) CONCLUSION through the induction / deduction, (10) INVESTIGATION;	
Concepts	**Competent learners' knowledge-*debaters***
- alternative sources of energy, - fossil energy sources.	✓ Show you how to use alternative sources in practice. ✓ Clarify (in case) the advantages and disadvantages of alternative and fossil fuels.
Cognitive taxonomic level (current) according to Bloom: Level 4: ANALYSIS; The levels (current) of complex thinking by Marzano: (11) PROBLEM SOLVING;	
Concepts	**Competent learners' knowledge-*debaters***
- alternative sources of energy, - fossil energy sources, - environmental pollution.	✓ Analyze and test alternative energy sources. ✓ Be aware of the importance of environmental pollution.
Cognitive taxonomic level (current) according to Bloom: Level 5: SYNTHESIS; The levels (current) of complex thinking by Marzano: (9) DECISION MAKING, (11) PROBLEM SOLVING;	
Concepts	**Competent learners' knowledge-*debaters***
- the environment around us, - problems of environmental pollution, - concern for the preservation of pristine nature.	✓ Think about limiting the release of pollutants into the environment. ✓ Be prepared self-report problems and critical evaluated. ✓ Composition (at its discretion) its strategy of separate waste collection.
Cognitive taxonomic level (current) according to Bloom: Level 6: EVALUATION; The levels (current) of complex thinking by Marzano: (6) ARGUMENTATION AND ARGUING, (13) DISCOVERY / INVENTIONS;	
Concepts	**Competent learners' knowledge-*debaters***
- evaluation of the performance (moderator), - autonomous operation.	✓ Evaluate (critical) partial implementation of a classmate and argue their own opinions. ✓ Formed (self-) learning situation. ✓ Provides the meaningful conclusions and possible suggestions.

This kind of environment enables students to: (i) open themselves to other classmates and share their knowledge and ideas; (ii) accept and positively evaluate contributions and encouragements of other group members; (iii) assimilate different group roles.

Collaborative Learning in Natural Science Lessons

Recently the strategy of teaching and learning natural sciences has changed gradually (Sikošek and Horvat, 2014). Teachers have to strive toward effective and contemporary methods, forms, and learning styles. We have to realize that merely frontal transfer of knowledge does not bring the desired learning success. A student has to be provided not only with knowledge but also with skills and viewpoints. Therefore, he or she has to be comprehensively qualified for further education and professional work.

Why could natural sciences be defined as unique in a school curriculum? The following reasons should be stressed: cognitive comprehension of these courses, they are interdisciplinary with other subject areas, vital and topical phenomena and concepts. Natural science content can be taught with different approaches or strategies. A natural science teacher should work autonomously but at the same time according to the syllabus. Retention of students will be more effective if the teacher uses various work methods.

Evaluation of Collaborative Learning

The method of an educational debate is one strategy for collaborative learning. Below are the advantages from a direct student's perspective as well as from a wider perspective of a qualitative educational process implementation (Peklaj, 2001; Horvat, 2013).

A student's perspective:

- have more efficient communication (they listen, consider the opinions of others etc.),
- are more motivated, an increased activity of each student,
- accept and respect differences,
- support each other,
- search for contacts with others,
- become more inquisitive and eager to learn,
- strive toward a common objective,
- increase quality and durability of the acquired knowledge,
- become more critical,
- become capable of forming their own evaluation,
- become keen on independent research,
- execute cognitive goals.

A wider educational perspective:

- The increased responsibility – everyone is responsible for oneself as well as others,
- the positive co-dependence among group members is increased (e. g. connections between schoolmates),
- in-class and after-class relations are improved,
- conflict situations are reduced, there is less violence,
- management functions are distributed,
- the emphasis is on social objectives,
- work atmosphere is more relaxed.

Education Debate as Collaborative Learning Approach

For educational debate as alternative accession to educational experiences (testing and assessing) this chapter involved some characteristics: theoretical basis, elements and empirical research experiences from our practice in Slovenia.

Theoretical Basis of the Debate Method

The current methods of cooperative learning support the use of educational debate - defined as a class method talk (conversation) that students are trained in the analysis of different theories, data, strategies and forcing them to connect knowledge from different cognitive (subject) areas. General definition of formal debates (Kennedy, 2007; Driscoll and Zompetti, 2005; Skrt, 2004) can be transformed into meaningful educational debate as an active learning method, namely the debate understood as a balanced structured communication event on the important issue is becoming a learning-themed situation on which confront two (or more) conflicting sides that attempt to convince the audience (classmates) and judges (teachers) (adapted from the source of the Institute of Culture of Dialogue, 2013). Therefore students must develop and acquire a wide range of subject-specific competences. It is important to highlight the motivational impact of the debates on learning, which is reflected in students' more in-depth reading and follow-up of contemporary society (including natural and environmental) events.

Any debating talk (conversation; including also educational-debating) is based on critical thinking that Fisher (2011) identified as one of the core competences (analogous to reading and writing), obtained and supported from teaching. Critical thinking is an essential deviation from normal (“usual”) thinking (summarised in table 3). The teacher is the one that allows efficient implementation of the debating situation in which students in both roles (either debaters or moderators) acquire or develop competency for critical thinking. From a narrow perspective, this competence is interpreted as the ability of analysis and evaluation, and of the creation of arguments (O'Rourke, 2001). Broader aspects of the interpretation of critical thinking is found from authors in the field of education, whose definition of the competences include skills, thought processes, procedures and practice of certain activities (Fisher, 2011; Rupnik, 2006).

Elements of the Educational Debate

When considering essential elements of the education debate, it is important to consider the following two key concepts, namely: the *argument* and *types of conclusions*.

Table 3. Some of the highlights of critical thinking (adapted from Lipman, 1988).
Statements in normal type represent the expectations for Critical thinking.
Statements in italics represent the criteria denoting usual thinking

Critical *(usual)* thinking
Assessment *(Guessing)*
Assumption *(Believing)*
The logical conclusion *(Conclusion)*
Clearly oriented towards the objective (*NOT targeted)*
Self-reflection, meta-cognition *(NO self-reflection / checking of own views)*
Expression of views on the basis of evidence (*without giving any opinions, evidence)*
Judging on the basis of clear criteria *(NO criterion judging)*
Asking questions and problematizes (*NO asking of questions; NO problematization*)

Argument

A statement is supported with reasons given for its acceptance. The reasons in an argument (Šuster, 1998) establish (support, entitle, prove, demonstrate) a conclusion, this support persuades a rational person to accept the decision.

1) *The purpose of an argument* is to influence someone's course (Rupnik, 2006). This course could be devotedness, persuasion or a certain activity.
2) *The structure of an argument,* which is used in a debate, was defined by an English philosopher Astephen Toulmin (1958) and can be written in a following form: SUPPOSITION (statement) ⇔ CONCLUSION (establishing) ⇔ SUPPORT. Supposition is defined as an indisputable statement – a thesis. Conclusion is a concise argumentation of statement correctness and of statement rejection (negation). Support is a proof confirming a certain establishment.

Types of Conclusions

We distinguish (Rupnik, 2006) the following types of conclusions:

1) *Conclusion with an example:* is a conclusion divided into inductive and deductive aspects. This form is frequently used in debates for entitling demands, on the basis of which a specific solution is suggested – a plan, an argument.
2) *Conclusion with an analogy:* is a conclusion trying to prove that what was true in a specific situation will also be true in an analogical situation. Analogy as a comparison of people, places and events.

3) *Conclusion with a causal relation:* is a conclusion on a cause → consequence principle and a conclusion on a consequence → cause principle.
4) *Conclusion with evidence:* is a conclusion providing an actual example, with statistical data, individuals' statements or opinions and witness statements or official documents.

THE DEVELOPMENT AND IMPLEMENTATION OF COMPETENCES IN KNOWLEDGE TESTING AND GRADING AS MACRO-DIDACTIC COMPONENTS OF THE EDUCATIONAL PROCESS

Competences as Elements of Subject Curriculum: Concept Definition

A natural science lesson has to be based on competences and oriented toward developing them. Numerous authors have different interpretations of the concept of 'competence'. Romainville (1996) explains that the word is of French origin and was first used in the field of vocational education. The initial meaning of 'competence' was the ability to execute specific work or tasks. Afterwards, it appeared in the field of general education as an ability to apply specific knowledge. Day (1999) defines competences as abilities to perform roles and tasks required for achieving the expected standards.

Competences help to measure the student's ability to (1) recognize natural science questions, (2) scientifically explain concepts, (3) use natural science data and verified facts (Sikošek, 2010).

For the needs of pedagogic activities, the following competence classification is prevailing: (1) key, (2) generic (not subject dependant), (3) natural scientific, (4) subject-specific competences.

Implementation and Development of Students' Competences through the Educational Debate Method

All categories of competences, especially the subject-specific competences, have different implementations in specific subjects. The most characteristic competences of the chemistry and natural science subject field (Žarić, Sikošek, Golob, 2009), where students develop and gain a palette of skills/competences, are:

(1) demonstration of knowledge and comprehension of the essential chemistry science facts, concepts, theories and principles,
(2) terminology knowledge of the nomenclature, units and agreements,
(3) interpretation – synthesis and evaluation of chemical information/data,
(4) awareness of fundamental questions in chemistry research studies and development,
(5) mastering work safety skills in handling chemical substances and executing laboratory procedures with an ability to estimate the risk factors,
(6) connecting macroscopic perceptions with an explanation of a microscopic level and records on the symbol level,
(7) understanding environmental issue and measures to prevent and reduce pollution.

USAGE OF EDUCATIONAL DEBATE METHOD FOR TESTING AND ASSESSING: SLOVENIAN EMPIRICAL EXPERIENCES

Methodology of Research

How to Adjust the Method of Education Debate for the Implementation of the Evaluation (Testing by Assessing) of Curricular Achievements of Students

Determination of the student's success in meeting the curriculum obligations - the terms ‘testing’ and ‘assessment’ of knowledge - represents a key component of the curriculum from primary level onwards. According to the Regulation on Examination and Evaluation of Knowledge and Progress of Students in Slovenian Primary School (Official Journal RS, No. 52/2013) there is a twofold meaning of this didactic activity, namely: assessment is to collect information about how a student achieves the objectives or standards of knowledge in the curriculum, while the grading of knowledge is detection and evaluation of the extent to which a student achieves these objectives and standards of knowledge. The purpose of both is threefold: (i) the student is enabled critical reflection and insight into the acquired knowledge; (ii) students, teachers and parents give feedback on students' individual progress; (iii) contribute to the democratization of relations between teachers and students.

Under these rules, the teacher is allowed to use different ways of knowledge assessment and grading in relation to the objectives or standards of knowledge for the class. Planning methodology of this teaching situation requires the use of diverse methods and forms of work, which will allow students a high degree of differentiation and individualization as well as constructive team work, critical approach to the problem and develop creativity. The teacher determines and controls the execution of a set of methods that conform to the learning content, objectives, level of development of students and especially their mental activity. As part of this autonomous decision (i.e. the choice of methods), a democratic teacher could “assign” activities to the learners themselves.

In addition to the principles of democracy, the teacher must also take into account a series of didactic principles (Kramar, 2003), guidelines derived from the theoretical and scientific knowledge relating to the educational process.

As a leading method of carrying out testing by assessment of knowledge, one can progress through all the stages of implementing this teaching situation (since the introduction of performance through to evaluation) using the method of education debate. In view of the stage of the target current emphasis is implementing the following forms of two-way verbal communication (dialogue) with questions and answers as basic didactic elements of this method:

(a) *Discussion* → especially cautious in drawing conclusions as evidence of a higher level, in which is placed the processes of convergent and divergent thinking, the flow of ideas and critical judgment;
(b) *The Heuristic talk* → identifying of the necessary information you require to answer the questions placed;
(c) *The Socratic talk* → achieving the objective of responding to alternative and suggestive questions, based on the prior knowledge, in conjunction with subjective knowledge.

A key characteristic of the above mentioned collaborative learning is reflected in the interactive impact of the implemented methods. Thus leading Educational Debate supplements, in its various stages, these accompanying methods: problem solving; many versions of oral explanations; demonstrations method and method of the text. An integrated didactic situation is problem-based and leads to a conflict situation. Each of the typical stages of problem solving methods (PSm) (Sikošek, 2006) requires a lot of creative activity from the students.

Didactic principle activities link the initial design (from the definition of the problem and the collection of information) to the continuation of current learning activities. This leads to the creation of new concepts while developing more complex cognitive operations (logical reasoning), and then to the evaluation of potential solutions - "debate" problems.

The learner's performance in solving "debate" problems, comprising of three factors: (1) *Seeing the problem* (selection, presentation, gradualness, taking into account individuality), (2) *Motivation* (interest, importance, experience dissonance; interaction, competence), (3) *Ability* (difficulty; adaptation of procedures: concretization, parsing, reduction of the problem).

In particular, the debaters are starting (especially in the creative phase of logical reasoning) to establish correlations between either explicitly or implicitly comprehending the "problem concepts”. This leads to the formation of the findings - the creative process of creating the new concepts. An essential contribution to the "debate" performance (in each of the typical roles of this method) represents the student's "situational self- finding his/her way" when he/she learns effective work organization. Through this, the student comes to accept competency of self-organization (which is fully expressed clearly in the phase of data collection) which requires the development of capabilities critical attitude to the data sources used.

In each of these levels of PSm, there is also a need to use the existing forms of explanation as the accompanying method: (1) *The telling* (short voice messaging on the issue), (2) *Describing* (picturesque and analytical), (3) *Clarifying* (interpretation of the concepts, laws, principles), (4) *Evaluation* (invigoration, explanation).

Occasional aspects accompanying this method are also demonstrated when students-debaters show either the phenomena or objects, which takes place in the following stages: (1) *Introduction intention* (motivation, orientation), (2) *Generation of impressions* (the stimuli that affect the observation); (3) *Generation of performance* (mental activity, intentional orientation), (4) *Mental performance* (insights). A permanent accompanying approach is also to present text, comprising work with different sources / databases.

Implementing the planning methods of the educational debate requires the simultaneous examination by assessing knowledge or accomplishing activities: (i) the awakening learners' interest and motivation of the curiosity and the retention of information provided; (ii) specific listening, repetition and reading; (iii) the transition from analytic to the synthetic (an integrated perception), which is mirrored in the asking of questions (moderators and debaters); (iv) experiences of mental restlessness and promote a collaborative engagement. The didactic principles of rationality, appropriateness, gradualness, being systematic and, especially, clarity operate in a complimentary manner in this didactic situation.

A cornerstone of curriculum and didactic materials used in the assessing by grading a teaching situation should be the principle of rationality. Rationality is recognizable from the teacher's definition of a reasonable and prudent debate content that is properly articulated and equipped with optimally compatible didactic resources.

Rationality is important for a teacher, who generates an integrated plan and also acts as a moderator in the effective planning of students-actors debate situations. This last point is particularly important. In particular, ensuring the adequacy of the remaining didactic principles of the development stage; the gradual nature of the content adaptation (in scope and complexity) as well as the systematization of its sequence.

Even in the situation of testing by assessing the debate, it is crucial to create meaningful and understandable lines between the conceptual and the concrete. Therefore, it is necessary to ensure that the teaching principles are obvious for: A cognitive-theoretical aspect (from sensual–concrete to partial abstractions or to see the broader knowledge); a psychological aspect (active perception with all cognitive channels, including students' prior knowledge, attitudes and skills competency); a didactic point of view (diverse needs of stimulating, motivating, information and formation).

The efficiency and effectiveness of the implementation of testing by assessing using the method of debate, is also associated with a range of learning forms, with a distinction being made between sociological and organizational forms of work. The former should be used preferably as individualized teamwork (debaters in the form of a trio, then selected format for the remaining passive debaters) as well as individual work (in implementation of the activities of individual moderators). The organizational form of these didactic situations represents team work, the cooperative strategy (based on the collaborative ethos) provides coordinated (of the moderators responsibility) and associated (with debaters as well as other students-passive debaters) team-implementation of the education debate method used.

Study Goals and Research Questions

The main goal of our empirical research focused on teaching and learning of primary school science education (Natural Science and Chemistry subjects). We hypothesise that it is possible to develop previously acquired competences through testing and assessing, via a method of education debate, whilst also evaluating the curricular achievements of students.

For this purpose we have identified two key research questions, namely:

(1) *What is the quality of newly acquired competences* (general, generic and subject-specific) regarding to: (i) different roles of students carried out during of this method implementation, (ii) age groups, (iii) school location (urban or rural area)?

(2) *What is the motivational aspect of using the debate for the evaluation of students' curricular achievements* (how and to what extent do they use it)?

These two questions are broken down into five questions:

(i) Does a defined specific competence really represent a sufficiently objective, critical and credible criterion for creation of evaluation?

(ii) Does a student (as the teacher’s co-evaluator) demonstrate an sufficient competency in criticism (of self and peers) in order to offer an objective evaluation?

(iii) Does a student (as a moderator) demonstrate a satisfactory competency for leading and organizing the implementation of the education debate?

(iv) Do students in the role of debaters practice a set of competences, current skills and attitudes effectively?

(v) Do student observers (“passive debaters”, “test-takers in benches”) indicate an acceptable competency of active participation?

Instruments

For the effective implementation this empirical research we have produced a different didactic materials as well as evaluation sheets and prepared cases of age-adjusted discussion contents. A detailed illustration of the debate material is represented in later.

Sample

Research Area

Our research was performed from April to June 2013 in NE Slovenia on the Sub-panonian area (Kert, 1991). From an administrative point of view (the Ministry of Education, Science and Sport of the Republic of Slovenia) this part belongs to the Organizational Unit Maribor of the National Education institute of the Republic of Slovenia (NEIRS). Among the 78 primary schools of this area three were chosen from the urban and the same number from rural districts.

Participants

Our case study included 124 primary school students (64 boys and 60 girls) sixth, eighth and ninth grade (ages 12 – 14), as well as six teachers of chemistry or science. From the data in table 4 it can be seen that the difference in gender representation is negligible. In grade 6 classes there were a total of 45 students (36.3% compared to the total sample); the same number of students were in grade 8, while there were slightly fewer students in grade 9 classes, (36, which corresponds to 27.4% of all who participated).

Planned Roles of Students as Participants in the Educational Debate for the Purposes of Testing/Assessing

The roles demonstrated below (see also figure 1) are given to the “actors” in the educational debate implementation.

Moderator (Learning approach: individual work): a student, in a role of a judge and a teacher’s assessor, grading a schoolmate – the debater, with the co-evaluation form (target content competences – knowledge). Teachers are simultaneously grading the moderator with an adapted evaluation form (target skill competences and viewpoints of the debate and internal moderation).

Debater (Learning approach: individualized group work): students organized into two heterogenic (defender – opponent) groups of three. They appear in the role of active speakers for the chosen debate motto topic. Debaters are graded by teachers with an adapted evaluation form (target content competences, skill competences and viewpoints of the debate and internal moderation).

Students – passive debaters (Learning approach: individual work): remaining students in the class. Their role is to observe actively and note the course of a debate, as well as to solve tasks with an adapted debate evaluation form.

Table 4. Frequency (f) and structural percent (f %) students relating to gender and grade

gender \ age		12 years	13 years	14 years	Together
boys	f	21	26	17	64
	f% according to sex	46.7	57.8	50.0	51.6
	f% according to age	32.8	40.6	26.6	100
	f% together	17.0	21.0	13.7	51.7
girls	f	24	19	17	60
	f% according to sex	53.3	42.2	50.0	48.4
	f% according to age	40	31.7	28.3	100
	f% together	19.4	15.3	13.7	48.4
together	f	45	45	36	124
	f% according to age	100	100	100	100
	f% together	36.3	36.3	27.4	100

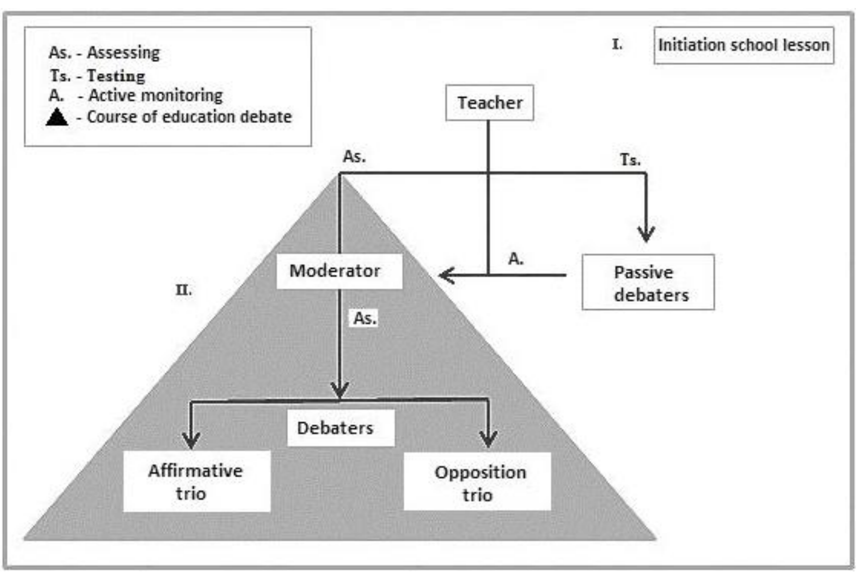


Figure 1. A flowchart of the testing and grading process through the educational debate. Two lessons were required for a constructive implementation; an introduction lesson (I.) and an execution lesson (II.), using an educational debate method.

METHODOLOGY OF PLANNING AND STRATEGY PERFORM OF EDUCATIONAL METHOD FOR THE PURPOSE OF THE TESTING BY ASSESSING DIDACTIC SITUATION

Teacher's Preparation to Testing by Assessing Using the Method of Educational Debate

The wording of the conceptual articulation of a vision of learning units for teaching and learning needs, constitutes the teacher's written preparation. Starting from our well-established articulation methodology (three templates - content, didactical and methodological) and also current attachments. Below we present an example of written preparation materials for debating the motion "Products from plastic materials change the world for the better." In defining this subject, we derived from the Slovenian curriculum for the subject of Chemistry, namely, the core substantive subject area (password) "Hydrocarbons Family: Polymers, broken down by: (i) Reactivity of hydrocarbons - Polymerization (monomers, polymers, synthetic and natural polymers), (ii) Key environmental problems related to the use of hydrocarbons and their derivatives, and alternative or topical content." A narrower subject's didactic layout of this content, set forth as a catalog of testing and assessing (TA) knowledge is presented in table 5a and 5b.

Didactic Planning begins with creating a plan of implementation, the current content is shown in table 6. Implementation steps (IS) of macro-didactic component (MDC) of TA follow the scheme of logical sequence, each of these steps described activity performed by the teacher.

The final product of didactic planning is a didactic proposal (table 7). In terms of the previous content planning we define the so-called "Assessing Passwords" that can be broken down on content password (CPW) and implementing password (IPW). The remaining parameters: teaching methods (with a breakdown in leadership and accompanying methods) and didactic resources (broken down into three sub-parameters: technical resources, teaching materials and teaching aids).

A representative specimen of a didactic proposal, for the needs of TA using the educational debate method, for the subject Chemistry and Natural Science is presented in a structured format (table 7).

The assessment content represents a curricular content section Hydrocarbons Family - Polymers, which is further a substantive-concept articulated as follows: (1) Reactivity of hydrocarbons (carbon and hydrogen), (2) Polymerization, (3) Key environmental problems linked to the use of hydrocarbons and their derivatives.

Necessary information about a specified part of planned and expected behaviour of the students in this teaching situation (debating) are recorded in the methodological proposal.

Table 5a. Subject-Conceptual specified Catalogue of Curricular Knowledge, planned for using the method of educational debate in TA didactic situation

Curriculum subject / sub-entries	**Assessing terms**
POLYMERS Division: ✓ natural, ✓artificial (synthetic);	✓ monomer, polymers (natural, artificial) polymers, polymerization, polymer properties;
USE OF POLYMERS ✓ Getting (production); ✓ properties of polymers;	✓ oil, cracking process, nylon;
PLASTIC ✓ Production; ✓ History; ✓ The most common types of plastic and examples of their use; ✓ The impact of plastics on the environment and humans; ✓ high-tech plastics;	✓ polyvinyl chloride (PVC), polystyrene, teflon; biodegradability, proteins, nucleic acid, chitin; rubber, starch, cellulose;
ENVIRONMENTAL PROTECTION ✓ What is recycling?; Do not dispose of waste!; ✓ From waste to energy.	✓micro-organisms, recycling.

Table 5b. Conceptually-Taxonomic specified Catalogue of Curricular Knowledge, planned for using the method of educational debate in TA didactic situation

Cognitive taxonomic level according to Bloom: 1 level: KNOWLEDGE**;** Cognitive levels of the Marzano taxonomy: (1) COMPARING, (2) SORTING, (6) REASONING (7) ABSTRACTING;	
Concepts	***Competent verb*** **/ Knowledge of students**
monomer, polymer, polymerization, nylon, petroleum, PVC, teflon, polystyrene, nylon, protein;	They ... ✓ *Know* the definition of polymers. ✓ *Define* the concept of polymerization, monomer. ✓ *Classified and designated* the most important articles. of plastics.
Cognitive taxonomic level according to Bloom: 2. level: UNDERSTANDING; Cognitive levels of the Marzano taxonomy: **(**1) COMPARING (6) ARGUMENTATION AND REASONING (7) ABSTRACTING;	
Concepts	***Competent verb*** **/ Knowledge of students**
polymers (natural, artificial), properties of polymers;	They … ✓ *Differ* between artificial and natural polymers. In case *explain* the importance of biodegradation. ✓*Explain* the cracking process.

Table 5b (Continued).

Cognitive taxonomic level according to Bloom: 3. level: USE; Cognitive levels of the Marzano taxonomy: (3.4) THE CONCLUSION OF THE INDUCTION / DEDUCTION	
Concepts	***Competent verb*** **/ Knowledge of students**
polymers, polymerization, hydrocarbons;	They … ✓ *Sketch and explain* the process of polymerization. ✓ At case to *explain* the pros and cons of natural and synthetic polymers.
Cognitive taxonomic level according to Bloom: 4. level: ANALYSIS; Cognitive level of the Marzano taxonomy: (11) PROBLEM SOLVING;	
Concepts	***Competent verb*** **/ Knowledge of students**
The environment and human, polymers, hydrocarbons;	They ✓ *Be aware* of the importance of recycling for environment and spatial planning. ✓ *Analyze and test* alternative energy sources.
Cognitive taxonomic level according to Bloom: 5. level: SYNTHESIS; Cognitive levels of the Marzano taxonomy: (9) DECISION MAKING (11), PROBLEM SOLVING (13) DETECTING / INVENTION;	
Concepts / Facts	***Competent verb*** **/ Knowledge of students**
Synthetic polymers: yes or no? The environment around us. Problems in environmental pollution. Concern for the preservation of intact nature.	They: ✓ *Considering* the limitation of plastic materials and their production alternative, friendly to the environment. ✓ *Considering* limiting the release of pollutants into the environment. ✓ *Draw up* an independent report and critically evaluated. ✓ At their discretion *draw* their own strategy of separate waste collection.
Cognitive taxonomic level according to Bloom: 6. level: EVALUATION Cognitive levels of the Marzano taxonomy: (6) ARGUMENTATION AND REASONING, (13) THE DETECTION / INVENTION	
Concepts / Facts	***Competent verb*** **/ Knowledge of a moderator**
Evaluation of the performance (moderator), argumentation (debaters) independent work (leaving autonomy).	They: ✓ *Evaluated* (critical evaluation) partial implementation of a classmate and argue their own opinions. ✓ *Autonomy* in drawing lessons. ✓ *Ball towards* meaningful conclusions and possible suggestions.

Table 6. Implementation Plan of didactic situation the Testing by Assessing using the method of the education debate

IMPLEMENTING STEP / TIME (min)	ACTIVITIES OF THE ACTORS
MDC: ***Introducing***	
Introductory motivation /5'	Video presentation of current problems.
Preparation for the implementation of /5'	- Organizational instructions for the students - passive debaters. - Organizational and operational instructions for the active participants in methods of education debate.
MDC: **Testing and Assessing**	
Carrying out assessment /30'	- Simultaneous course of the debate appraisal and written recording of the students - passive debaters.
Grading of actors debates /30'	- Grading of students at a pre-adjusted sheet of the evaluation (measurement occurrence of individual competences).
Providing of designed grade and completion /10'	-Individual discussions with students and argumentation grades.

Table 7. Didactic proposal topical for testing by assessing didactic situation using the educational debate

Implementing step	**Guiding / Accompanying teaching and learning METHODS**	**Sociological learning FORMS**
Functional motivation	Video method (observation)	Frontal work
<u>Technical resources</u>: computer, projector, camera <u>Didactic material</u>: video movie ↔ *http://www.youtube.com/watch?v=RVnSilaDCvs*		
Instructions to students who will be assessed and tested.	Problem solving method (1. and 2. steps), structuring the data in the system	Frontal work
<u>Technical resources</u>: whiteboard, camera		
Implementation of students' assessment (simultaneous course of active and passive debate).	Educational debate method /problem solving method (3. and 4. step / heuristic method conversation, explanation method	Individualized group work
<u>Technical resources</u>: the timer, camera; <u>Didactic material</u>: Teacher's evaluation sheets for the active debaters and moderator / Moderator's evaluation sheet for an active debater; Teacher Sheets for checking the passive debaters; <u>Teaching tool</u>: Periodic Table in cubes (PTC);		
Giving feedback to debating and passive actors.	Heuristic method of conversation / explanation method	Frontal work// Individual work
<u>Technical resources</u>: camera; <u>Didactic material</u>: assessing sheets;		

This proposal includes the following didactic parameters: IS / MDC, Objectives (cognitive, psychomotor, conative), Content skeleton, Teacher's work, Students' work (active and passive debaters, moderator). Using the Bloom taxonomy (Bloom, 1956), the aim of each implementing step is defined by aspects of cognitive, psychomotor and conative categories. To methodological proposal for TA didactic situation (table 8) is also attached sheet of tasks (table 9) with the criteria for passive-debaters, who are also involved in assessing by the subjects: Sciences (6th grade) and Chemistry (8th and 9th grades). Of course, the types of questions or tasks are defined and are categorized according to Bloom's taxonomy.

As an illustration of the case debating contents, figure 2 shows a conceptual skeleton for content section "Polymers". From the applied tree's form of this conceptual map is evident the scope of two-level (horizontal and vertical) branching (the hierarchy) the key curricular concepts for debating password "Articles of plastic materials are changing world for the better".

Didactic Material Used in the Implementation of the Education Debate

For the effective implementation of the planned accompanying methods at each stage of the education debate as the leading method adequate didactic materials are required. These materials allow students-debaters (active and passive, as well as moderator) successful acquisition of the target competences. For the realization of the methodological proposal for a didactic situation (table 7), and assessment by grading (using the education debate), the following didactic materials are required:

(1) Topical debate contents;
(2) Instructions to prepare for the implementation of roles: debater, moderator;
(3) Debate Assessment Sheets:
    Be used by the teacher for: (i) debaters, (ii) moderators;
    Be used by moderator for one classmate-debater;
(4) Assessing sheet for students to be tested as passive debaters;
(5) Conceptual map of topical debate subject.

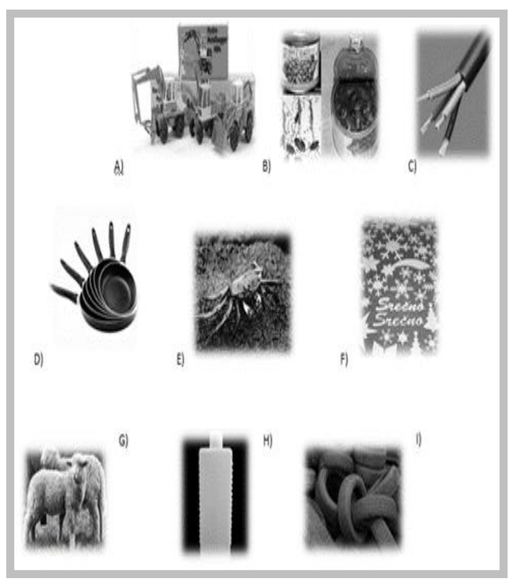
Figure 2. Conceptual map for debating content: "Articles of plastic materials are changing word for better".

Table 8. Methodological proposal (PE curricula (valid in 2011) for subjects Sciences 6 class, Chemistry classes 8, 9.) for testing by assessing using educational debate

IS/ MDC	TEACHER'S activities	COGNITIVE AIMS (Bloom)	CONATIVE AIMS (Bloom)	PSYHOMOTORIC AIMS (Bloom)	STUDENTS' activities (the active and passive debaters, moderator)
1/I	He/She: (1) opens address (2) performs Video Method (the movie playback)	KNOWLEDGE	RESPONDING Trying to connect the content of seeing to chemistry;	IMITATION, MANIPULATION	They: ✓ participate in conversation. ✓ view the video. ✓ follow are course of a lesson.
2/I	He/She: (1) to the students re-explains the course of A & D work; (2) distributes the assessing worksheets to the students who are in assessing then together they discuss the guidance and the potential ambiguities; (3) provides the key guidance to actors in the debate.	KNOWLEDGE (knowledge of workflow)	ACCEPTANCE OF Actively take instructions about the continuing course of; RESPONDING	IMITATION, PRECISIZING Specifying and clarifying	They: ✓ shall actively monitor the instructions. ✓ record important data in notebooks. ✓ take (the debaters, and moderator) their seats.
3/A&G	He/She: (1) active estimates the participants in debates using the modified aluation sheets; (2) assist both actors in debates (these active as well as students--passive performers at any ambiguities	KNOWLEDGE, EVALUATION - look the students' knowledge (catalogues of assessing knowledge)	RESPONDING Recognize where you need help. INTERNALISATION OF VALUES Discovering new knowledge (targeted influencing).	NATURALIZATION ability to lead PRECISIZING Clarifying concepts, phenomena, processes	✓Debaters act as active commentators in the debate implementation. ✓ Moderator act as a strategic debate leader. ✓ Passive debaters solve the assessing sheets.
4/G	(1) Providing a feedback to actors in debate (numeric score); (2) Implementation of a common assessing with passive debaters.	EVALUATION	ACCEPTING	PRECISIZING MANIPULATION	✓ Moderator assess of selected classmate-active debater. ✓ All actors participate in the discussion about design their grades.

Table 9. Sheet of tasks to assess of debate topics: Family hydrocarbons - Polymers

<table>
<tr><td>TASK / INSTRUCTION / QUESTION
Type of question / task
(closed / surrounding / complementary)</td><td>ANSWER/ Solution's CONCEPT /
Cognitive CATEGORY to BLOOM</td></tr>
<tr><td colspan="2">CATALOGUE concepts: natural polymers, synthetic polymers</td></tr>
<tr><td>1.TASK:
Due to the excellent properties and very varied use of polymers (natural and artificial) are indispensable.
<u>Instructions</u>:
Have a good look at the pictures below (in the right column). The information on polymers from 1. to 9. are written to various claims of these polymers.
In spreadsheet (on the right column):
a) Write down the letter before the correct record;
b) Determine their origin (circle the letter N as natural or S as synthetic polymer).

1. PVC used for isolation of wires among others.
2. Sheep's wool is a protein polymer.
3. Phenyletylene or styrene is a monomer for the production of ________.
4. Polythene is also used for a manufacture of packaging for variety of chemicals.
5. The crude rubber obtained from white juice (latex) of rubber trees.
6. Polysaccharide chitin found in the shells of certain animals.
7. Toys are usually made from polyethylene or polypropylene.
8. Pans have a teflon coating.
9. The silk is classified to the protein polymers, since it is composed of amino acid units. Silk thread obtained from the cocoons of silkworm; silk thread in the cocoon is 9000 m long.</td><td>Two examples of tasks
<u>Category</u> : UNDERSTANDING
<table>
<tr><td>Seq. No.</td><td>Write a letter</td><td>Underline</td></tr>
<tr><td>1.</td><td>C</td><td>N <u>S</u></td></tr>
<tr><td>2.</td><td>G</td><td><u>N</u> S</td></tr>
<tr><td>3.</td><td>F</td><td>N <u>S</u></td></tr>
<tr><td>4.</td><td>H</td><td>N <u>S</u></td></tr>
<tr><td>5.</td><td>I</td><td><u>N</u> S</td></tr>
<tr><td>6.</td><td>E</td><td><u>N</u> S</td></tr>
<tr><td>7.</td><td>A</td><td>N <u>S</u></td></tr>
<tr><td>8.</td><td>D</td><td>N <u>S</u></td></tr>
<tr><td>9.</td><td>B</td><td><u>N</u> S</td></tr>
</table>


</td></tr>
</table>

Topical Debate Contents

For students of the sixth, eighth and ninth grade of elementary school, we prepared three various discussion contents, consistent with the current (2011) curriculum subject topics.

These debate passwords are read as follows:

(1) "Energy - production can be cheap or expensive. What about the environment?"
(2) "Alternative energy sources are the domain of the future as they are easily accessible, more efficient - some even cheaper compared to non-renewable energy sources, which are consumed much faster than in nature arise."
(3) "Products of polymeric materials are changing the world for the better."

The guidelines and assessment sheets for these activities are included in appendices A and B, respectively.

How the Progress Is Reflected in Students' Competences Acquired by Educational Debates

The competences achievements of moderators and debaters are assessed with evaluation sheets according to different criteria (see appendix B). These criteria are defined referring to subject-specific competences, especially *content knowledge* as the first competence defined on evaluation debaters' sheets. The same competence groups were prepared on the evaluation sheets for students of the sixth, eighth and ninth grade. We presumed that the *criticalness* competence as well as *the ability to run a debate* would prevail in the moderator's role. The debaters place greater emphasis on knowledge. Due to the small sample size, a reliable statistical analysis cannot be performed. However, there appear to be clear trends within the data that will be described in the following analysis.

Competences Achieved by the Debaters and Moderators

Debaters' Competences

Figure 3 (also summarized in table 10) shows that the debaters generally achieve the competence No. 4 (see appendix B; *understanding the environmental issue and measures to prevent and reduce pollution*). They adequately recognize the environmental issue and responsibly and actively cooperate in solving it. Also, the competence No. 2 (*developing the ability to present and understand the debate content*) was generally adequately realized: the students – debaters defined the problem sensibly, presented it and convincingly argued it. They presented critical and abstract perspectives of the content knowledge, thus we can say that the debaters adequately completed their task.

The competence No. 5 (*following the didactic principles*) was achieved adequately by the debaters since they eagerly and actively explained the debate content. During the entire debate, they were responding to the opponent's arguments trying to refute them (the activity principle). Each debate thesis was formed based on a problem. In arguing the debate content, they adequately connected the actual with the conceptual. The debate content was supported with everyday life examples.

A little less comprehension was demonstrated by the debaters in the competence No. 3 (*evaluation, interpretation and connection of information and data*). This competence requires the ability of logical, creative, self-initiative and divergent thinking.

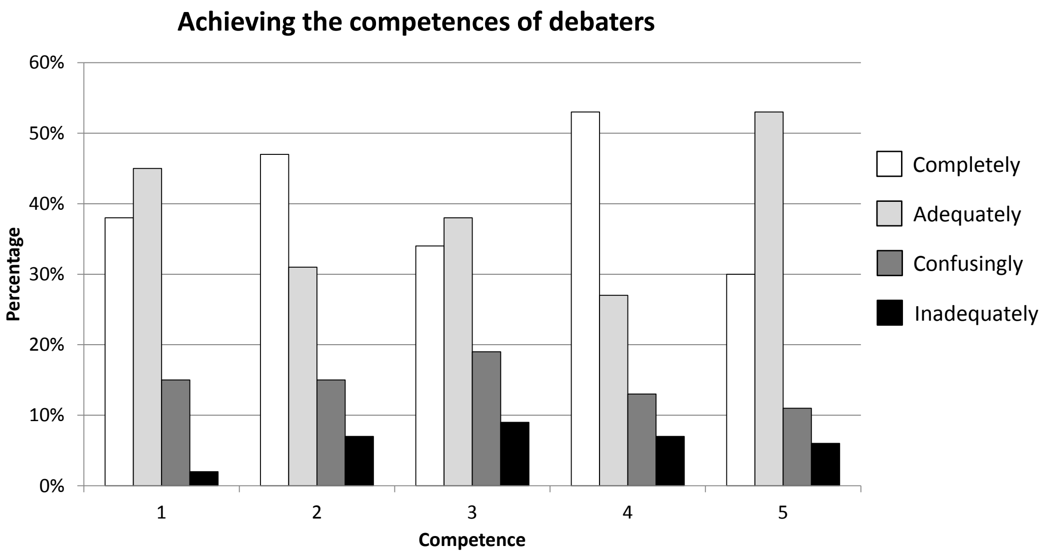


Figure 3. Achieving the competences of debaters. 1 - knowing, understanding and using the professional terms, their connections and theories (content knowledge). 2 - developing the ability to present and understand the debate content. 3 - evaluation, interpretation and connection of information and data. 4 - understanding the environmental issue and measures to prevent and reduce pollution. 5 - following the didactic principles. The descriptive grade was transformed into the number grade with a acoreboard. Achieving an individual competence group was presented in percentages.

The debaters clearly and precisely interpreted their results and adequately argued them in the form of a monologue and dialogue (discussion). At the same time, they allowed replies by the opposite debate team.

Therefore, we can conclude from figure 3 that most of the competences were expressed with the descriptive grade "*completely*" or "*adequately*", yet with only a small portion showing "*confusingly*" or "*inadequately*", which is an indication of good skills of the students – debaters and appropriate preparation for the educational debate.

Interpretation of table 10: From the range of debaters' subject-specific competences is necessary to highlight competence No. 2 (*Developing the ability to present and understand the debate content)* which is reflected in the ability to deliver previously acquired knowledge. The debaters adequately presented the content (objective 2.2), namely in 42% with a descriptive grade "*completely*" and in 33% with "*adequately*". Only two students were graded "*inadequately*" which is equal to 6% of all the debaters. The objective 2.4 (*the ability to concentrate*) was realized by the debaters to a slightly lesser extent according to other objectives. The most efficient concentration was demonstrated by the students of lower grades. There were no problems in *knowing the terminology* (objective 2.8) and *constructive delivering of conclusions* (objective 2.7), thus such high percentage.

Moderator's Competences

Interpretation of the Figure 4: The role of a moderator was the most complex. We defined four competences (competence groups) for this function (see appendix B). Special attention is based on the organization and management of the work flow, as well as criticalness towards colleagues in the role of the moderator as a co-assessor.

Table 10. How assess the quality of achieved individual competent goals for debaters?

N	Independent variable - as target divided competence	Competence No. 1: Knowing, understanding and using the professional terms, their connections and theories (content knowledge)							
		inadequately		confusingly		adequately		completely	
		f	f%	f	f%	f	f%	f	f%
1.1	Reasonable to define the problem	3	8%	2	6%	6	17%	25	69%
1.2	Integrated understanding of debating content	4	11%	2	6%	19	53%	11	31%
1.3	Adequately define curricular concepts (depending on the content)	2	6%	3	8%	24	67%	7	19%
1.4	Recorded or mentioning: structural / rational formulas	2	6%	4	11%	22	61%	8	22%
1.5	Use: relevant professional terminology	2	6%	10	28%	14	39%	10	28%
1.6	To explain ← concepts	1	3%	10	28%	16	44%	9	25%
1.7	Be aware ← critical attitude to	4	11%	5	14%	9	25%	18	50%
1.8	Thinking ← about prevention or reducing the effects of hydrocarbons – their products (plastics) on the environment. Expression of suggestions, incentives for constructive solutions	3	8%	4	11%	15	42%	14	39%
1.9	Reasonable to interpret the concepts, according to debating password	2	6%	4	11%	16	44%	14	39%
Competence No. 2: Developing the ability to present and understand the debate content									
2.1	Transfer and use of the prior knowledge and experience to new situations	3	8%	4	11%	12	33%	17	47%
2.2	Know-how of presenting the content	2	6%	7	19%	12	33%	15	42%
2.3	Know-how of interpreting concepts	0	0,0%	10	28%	13	36%	13	36%
2.4	The ability to concentrate	5	14%	5	14%	8	22%	18	50%

Table 10. (Continued).

N	Independent variable - as target divided competence	Competence No. 2: Developing the ability to present and understand the debate content							
		inadequately		confusingly		adequately		completely	
		f	f%	f	f%	f	f%	f	f%
2.5	Distinguishing between important and unimportant information	3	8%	8	22%	14	39%	11	31%
2.6	Communication skills: auditory-visual-kinesthetic profile present	3	8%	5	14%	13	36%	15	42%
2.7	Constructive delivering of conclusions	2	6%	5	14%	13	36%	16	44%
2.8	Knowing the appropriate terminology	1	3%	1	3%	11	31%	23	64%
Competence No. 3: Evaluation, interpretation and connection of information and data									
3.1	The ability of logical, creative, initiative, divergent thinking	5	14%	3	8%	17	47%	11	31%
3.2	Used different ways of interpreting the results. Cause-effect →reasoned	1	3%	5	14%	17	47%	13	36%
3.3	Types of debater's communication: Implementation of monologues (in the time limit) Implementation of replicas Engaging in a dialogue between the teams (double trio) and moderator	4	11%	8	22%	10	28%	14	39%
Competence No. 4: Understanding the environmental issue and measures to prevent and reduce pollution									
4.1	Active recognition and understanding the environmental problematic	2	6%	2	6%	14	39%	18	50%
4.2	Responsible and active participation in solving sustainable development	7	19%	4	11%	13	36%	12	33%

N	Independent variable - as target divided competence	**Competence No. 4: Understanding the environmental issue and measures to prevent and reduce pollution**							
		inadequately		confusingly		adequately		completely	
		f	f%	f	f%	f	f%	f	f%
4.3	Recognizing and avoiding hazards in taking care of their own health and the health of others	5	14%	7	19%	13	36%	11	31%
Competence No. 5: Following the didactic principles									
5.1	The principle of activity (physical, emotional, intellectual)	0	0%	2	6%	16	44%	18	50%
5.2	Principle of clearness - an example of transition from the concrete to the conceptual	1	3%	3	8%	19	53%	13	36%
5.3	The principle of appropriateness, gradualism and systematic - the content is presented without errors in a logical order	3	8%	7	19%	10	29%	16	44%
5.4	The principle of life aspect - presented content is apparent from the experience of everyday life, and not only in literature	0	0%	3	8%	19	53%	14	39%
5.5	The principle of problem situations – in defense speeches are exposed so acceptable as well as the problematic aspects of the debate claim	0	0%	4	11%	19	53%	13	36%

Competent goals, specially selected for the purpose of debater are given explicitly by the frequency of occurrence. The objectives of each subject-specific competences are numbered (for a better overview). The number (f) and structural percentage (f %) of answers of all competences by the students – debaters.

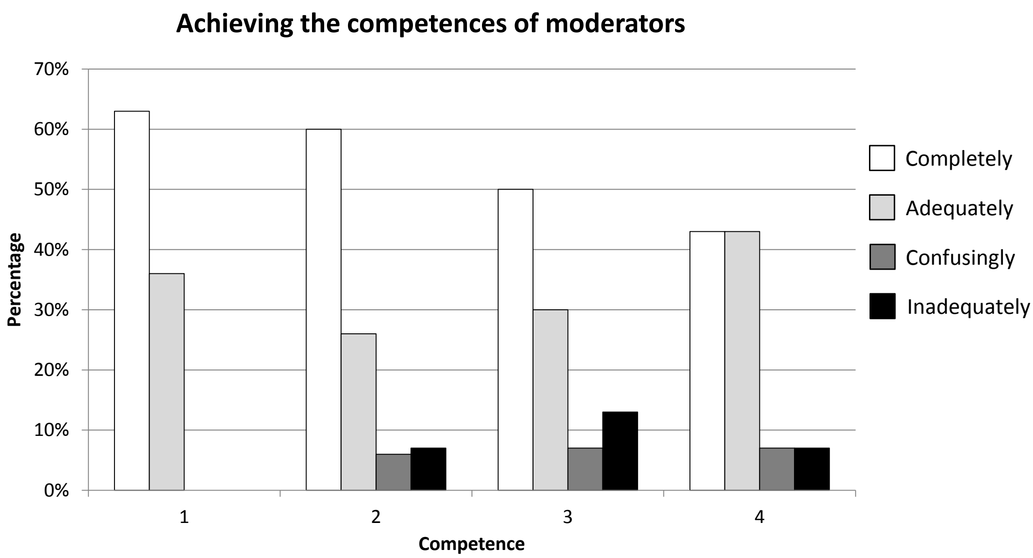


Figure 4. Achieving the competences of moderators. 1 - developing the ability to present and understand the debate content; 2 - evaluation, interpretation and connection of information and data; 3 - organization and management of the active work method; 4 - following the didactic principles

It must be stressed that the moderators are more competent students from the point of view of organization and the debate dialogue management. They knew how to continuously connect separate debate phases and at the same time successfully encourage the debaters to think and inspire the entire class. To sum up, the debaters successfully achieved the planned competences in general. The competence No. 1 (*developing the ability to present and understand the debate content*) came to the fore in the greatest extent. 63% of students achieved the descriptive grade "*completely*". The moderators successfully studied the debate content which was a condition for more successful guidance of the debaters. Also, the competence No. 2 (*evaluation, interpretation and connection of information and data*) was achieved on a high level (60% with the descriptive grade "*completely*") which is demonstrated mostly in the argumentative formation of an objective grade. All the moderators graded (as co-assessors) with the utmost seriousness and mostly delivered objective and reliable grades which is evident in the Figure 5.

Although, the competence No. 1–4 are noticeably declining. A greater diversity appeared in realizing the competence No. 3 (*organization and management of the active work method*) which is apparent in the graphic representation. The students – moderators realized this competence in 50% with the descriptive grade "*Completely*", 30% with the grade "*adequately*". In 13%, this competence of the moderators was graded with the negative descriptive grade. The competence No. 4 (*following the didactic principles*) was developed by the moderators relatively well (descriptive grades "*completely*" and "*adequately*" were expressed each with 43%), however, moderators mostly forgot about the system during the realization which can be attributed to a slightly worse preparation and careless following of separate realization steps of the educational debate.

Competences Achieved by Students According to the Location of the Primary School

The study was a particular focus on the difference in the representation of competence in relation to different environmental education.

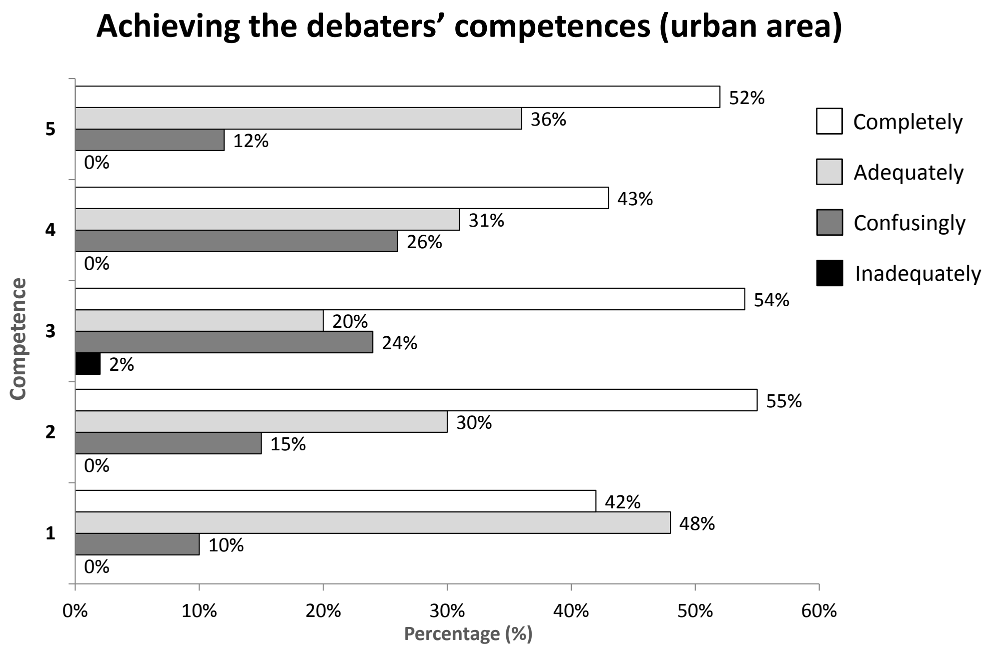


Figure 5(a). Achieving the competences of debaters at urban primary schools.

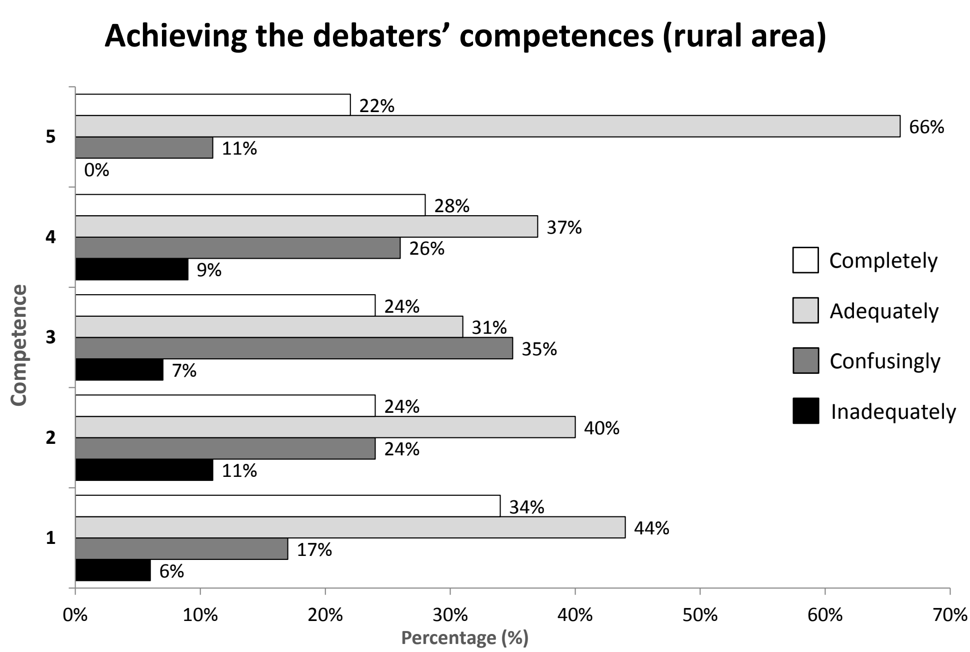


Figure 5(b). Achieving the competences of debaters at rural primary schools.

We were interested to see whether there are any differences between primary school (PS) in urban and rural areas. As the research sample comprises only 71 students from urban and 53 students from wider region of Ptuj, so these data as well as obtained results cannot be generalized.

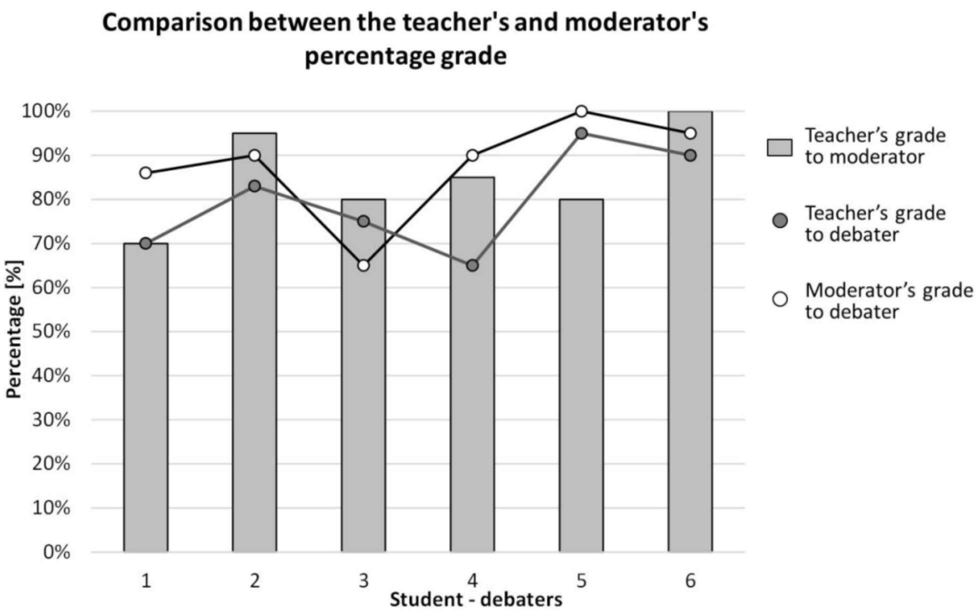


Figure 6. Successfulness of the moderators and students – debaters.

Interpretation of figures 5 and 6: Both figures suggest that the debaters of both areas (urban and rural) achieve good results in achieving scheduled curricular competencies.

Urban students (figure 5(a)) show a bit more the descriptive assessment *"completely",* wherein stand out three competences: as 55% for competence 2 *(developing the abilities for presentation and understanding the debate contents)*; as 54% for competence 3 *(evaluation and interpretation as well as integration of information and data);* as 52% for competence 5 *(observance of didactic principles).*

Figure 5(b) suggests that descriptive assessment of "adequately" is represented in somewhat greater extent for rural debaters. A dramatic difference is observed for competence 5 (*observance of didactic principles*), which the students practiced at 66% (compared to 52% in urban schools). As regards the descriptive mark "confusingly" there are major discrepancies between the debaters of PS in these areas. This descriptive assessment for rural PS occurs mainly by competence 4 *(understanding of environmental issues and appropriate measures for preventing and reducing pollution),* as well as by the competence 3 *(evaluation and interpretation as well as integration of information and data*). The latter is recorded 35% for the rural PS areas (compared to 54% in urban PS).

Descriptive assessment *"inadequately"* was detected very infrequently (2%) for competence 3 *(evaluation and interpretation as well as integration of information and data)* in the urban PS research sample. In students of the rural PS research sample, the "inadequately" descriptive assessment was observed at higher percentages.

UNIFORM ANALYSIS: COMPETENT ACTIVITIES FOR PARTICIPANTS OF EDUCATION DEBATE

The moderators were given the instructions for the preparation for the debate situation. They were encouraged to study and acquire information in a self-directed manner. On the day of the educational debate, the students received the evaluation forms on which they graded their classmates – debaters. Their students' grade represented 50% of the final grade composed from teachers and moderators assessments. This evaluation was carried out using pre-prepared point-percent-numeric scale (appendix B) using the following approach: (i) proportion of the realized criteria defined specifically for each competence are pointed; (ii) these point shares are converted to a percentage which are latter transform to numerical grade.

It must be stressed that the moderators diligently achieved the required *criticalness* competence and positively graded their classmates – debaters. In the following text (figure 6), the comparison between debaters is represented.

Figure 7 shows that, where a teacher is the assessor, the debaters were generally graded with a lower percentage compared to the moderators' grade for the debater. The exception was the student – debater 3 which can be explained regarding to the fact that students – moderators grade only the skillful aspect of competences. The debater who was convincing in all aspects (debater 5) reached 95%.

On the other hand, the lowest graded student debater (debater 4) reached 65%. According to the moderators' opinion, the debaters reach from 65% to 100% which correspond to numeric grades good(3), very good(4) and excelent(5). Figure 7 shows also that the moderators were graded with high grades between 70% and 100%.

Figure 7 shows that the testees were generally satisfied with the new work method. The moderator's work was graded with the best grade, namely 4.6. This grade is equivalent to the statements *I liked the work method* and *The debaters enthusiastically argued their claims*. Both are graded with 4,3.

The claim *Thus acquired grade is equal to the grade from a school test* is graded with 3.6 by the "bench" testees.

CONCLUSION

The educational debate method used in the didactic situation of knowledge testing through grading enables a student – debater to interactively present his/her acquired knowledge. In the exit debate thesis (learning material problem for testing), this method is in part transformed into self-investigating of the debater's acquired information for the formulation of his/her for/against arguments. Such research and argumentative approach represents developing of the lifelong learning competence for a student – debater, also called "learning to learn". This competence enables creating new thinking patterns or strategies. Other students in the class participate as testees – passive debaters as well, and they answer the questions in writing on the s.c. sheet of tasks with the debate content.

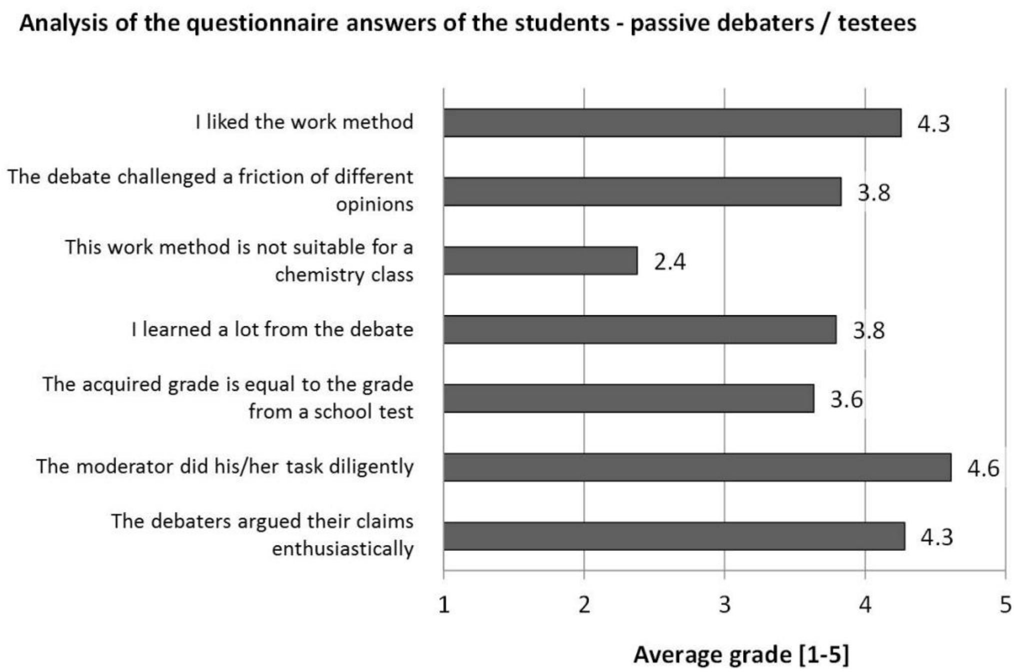


Figure 7. The analysis of the questionnaire for the students – "passive testees". Grades are as follows: 1- I do not agree at all, 2- I do not agree, 3- I partly agree, 4- I agree, 5- I completely agree.

The fact that all students of the sample schools are aware of environmental and ecological problems is pleasing. Stating many arguments in favor of the environment is very encouraging information. With this work method, the students are becoming familiar with the culture of dialogue which is nowadays rather neglected due to the ever faster pace of life.

In a teaching situation (such as presented in this chapter), describing testing using the method of education debate, as students-passive debaters are included in the collaborative process as part of the class. They are writing reply to questions with the debating contents of which are bused on task sheets, articulated for the purpose of testing by examining. A special value of the educational debate used for knowledge testing through grading as an alternative didactic approach is evident in encouraging students to connect previously-acquired knowledge and use it in a formal dialogue with their classmates as a form of self-reflection.

Knowledge testing with a debate was performed in a relaxed atmosphere as a result of the students' motivation. It thus helped to control the content curriculum knowledge as well as other recognized subject-specific competences. The authors of this article established that the topical ecological and natural scientific contents are suitable to be used for collaborative learning. This should be understood as a recommendation: that educational debate should be included in the educational process in a larger extent also in natural science and especially in chemistry.

APPENDIX A.

TEACHER'S INSTRUCTIONS FOR THE IMPLEMENTATION OF THE DEBATE ROLES

For students preparation in performing various roles of educational debate the following four sheets are articulated:
A.1- Implementing Guidelines for Self-Preparation of the Role of Moderator:
(i) in general, (ii) concrete
A.2. Implementing Guidelines for Self-Preparation for the Role of Debater:
(i) in general, (ii) concrete

A.1. Implementing Guidelines for Self-Preparation of the Role MODERATOR

Motivational address to moderator-keyword record: the need for knowledge of mutual listening, dialog acceptance of different opinions, assumed the leadership debates, the experience of the evaluator classmate, providing an estimate of successful moderation.

What do I need to do PRIOR TO IMPLEMENTATION?
(i) Carefully read the so-called Debate text passwords - so you will have an overview of the topic (the time you've got more than enough).
(ii) More specifically look at the course of debate: http://www.zainproti.com/web/index.php/galerija/video-vsebine.html

VERY IMPORTANT for the success of your functioning-moderating:

(1) Be attentive and clear, understandable spoken (debaters must know exactly and be familiar with the topic being discussed.
(2) Do not let others lead you.
(3) Be fair to all and every classmate-debater give the opportunity to express their views.
(4) Connect the end of the first argument (evidence) with the beginning of the second and so on.
(5) The debaters warn on time.
(6) If you consider that it comes to unwanted tension (conflict or similar situations) you can the debaters noted on their inappropriate behavior (even you may temporarily break up so implementation).
(7) Be relaxed at the leading and impress your classmates with your unique appearance.

What should I do DURING THE IMPLEMENTATION OF THE EDUCATION DEBATE?

The course of debate is pre-structured and follows to the particular directions:

✓ sequence of speeches advocacy and the opposing team; ✓ content of speech of each of the speakers; ✓ time which disposes each speaker.

Guidelines for Moderator

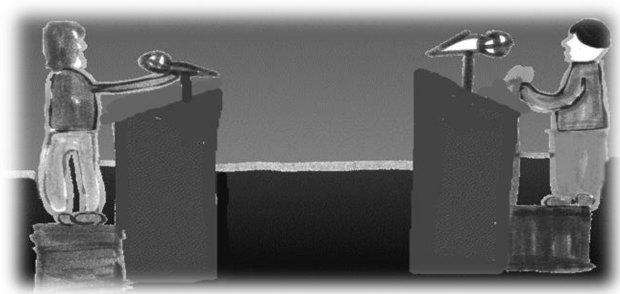
Step 1➜ Introduction to educational debate
Your classmates - debaters nice greetings, e.g. (one hint): Hello and welcome, dear debaters and others who are present. Our present debate, as its leader, I open it with a thought ... Topic of today's debate is … Firstly, I begin by presenting the main concepts of today's debate arguments, and then continue by giving a short review of the topics covered. Predict the introductory thesis, e.g.: "ARTICLES OF PLASTIC MATERIALS ARE CHANGING THE WORLD FOR BETTER" This thesis consists of two different arguments, namely: 1. Natural polymers are more important than synthetic. 2. Plastic is most important discovery in human history, we cannot live without it.
Step 2 ➜ First Round
Argument No. **1:** ✓ Read the first argument. ✓ Predict the first speaker of the advocacy team. Warn him on a time limit (4min). ✓ Finish the thought of the first speaker. ✓ Predict the first speaker from the opposing team. Warn him on a time limit (4min). ✓ Completed the first round with some interesting story. ✓ Allow the implementation of replicas on one and the other side (1-2min).
Step 3 ➜ Second Round
Argument No. 2: ✓ Read the second argument. ✓ Predict the second speaker of the opposing team. Warn him on a time limit (4min). ✓ Complete the first round with some interesting story. ✓ Allow the implementation of replicas on one and the other side (1-2min).
Step 4 ➜Third Round
<u>Conclusion</u>: ✓ Invite a speaker No. 3 of advocacy team to complete and summarize debate with the arguments of their group. Warn him on a time limit (4min). ✓ Invite a speaker No. 3 from the opposing team to complete and summarize debate with the arguments of their group. Warn him on a time limit (4min).
Step 5➜ ***Moderator's final thought***
✓ Thank to debaters for their active participation, all other participants for patience. ✓ Announce the winning team, which has you convinced (explain why). ✓ Conclude this debating learning situation with a final thought. ✓ Classmate-debater, you've assessed (using co-evaluation sheet), call to him and give him/her a reasoned assessment of his/her performance.

A.2. Implementing Guidelines for Self-Preparation for the Role of DEBATER

Motivational address to moderator - keyword record: the need for knowledge of mutual listening, dialog acceptance of different opinions, the experience of the public speaking, an opportunity to obtain an assessment of successful debater.

What do I need to do PRIOR TO IMPLEMENTATION?

(i) Carefully read the text of so-called debate password (for which you have more than enough time) and examine it in depth. So you'll get an overview of the learning topic about which you will debate hereinafter.
(ii) Explore! (Help with a variety of resources, the Internet, ask the teacher for an opinion ...)
(iii) More specifically look at the course of debate: http://www.zainproti.com/web/index.php/galerija/video-vsebine.html



It is VERY IMPORTANT for the success of your debating:

(i) Follow the instructions of moderator because he was the one who assigned the content that you advocate.
(ii) Be aware that you belong to the group (which means that all members of the group hold together).
(iii) Specify the name of the group and also present it at the beginning of implementation.
(iv) You must pay attention (as a debater) in a clear, understandable and persuasive speech.
(v) The argument clearly and accurately overruled or excuses (depending on the group to which you belong).
(vi) Do not forget that your inaugural speech timed at 4 minutes - at home you draw up guidelines (indent), what are you going to explain.
(vii) Be relaxed when interpreting - convince us, and we believe your argument.

What should I do DURING THE IMPLEMENTATION of the education debate?

The course of debate is pre-structured and follows the regulations about:

✓ sequence of speeches advocacy and the opposing team; ✓ content of speech of each of the speakers; ✓ time which disposes each speaker.

Guidelines for Debater

Speaker (he/she)/ duration	Task of speaker (he/she)/
Advocacy team ↓ speaker 1/4min	✓ Opens debate (greets the audience and the opposite team). ✓ Present the position of advocacy group to the debate claim 1 and objective (explain the position of team and why it will be argued). ✓ Present the arguments of advocacy team.
Opposing team ↓ speaker 1/4min	✓ Present the position of the opposing team to debate claim 2 and objective (explain the position of team and why it will be argued). ✓ Present the arguments of opposing team.
Time to reply (1-2min)	
Advocacy team ↓ speaker 2/4 min	✓ Present the position of the advocacy team to debate claim 2 and objective (explain the position of team and why it will be argued). ✓ Present the arguments of advocacy group.
Opposing team ↓ speaker 2/4 min	✓ Present the position of the opposing team to debate claim 2 and objective (explain the position of team and why it will be argued). ✓ Present the arguments of opposing team.
Time to reply (1-2min)	
Advocacy team ↓ speaker 3/4 min	✓ Summarize the debate: the arguments and counter-arguments. ✓ Emphasize the facts of the advocacy team. ✓ Exposes the weakness of argumentation opposing team. ✓ Convincingly complete the defense of advocacy positions.
Opposing team ↓ speaker /4 min	✓ Summarize the debate: the arguments and counter-arguments. ✓ Exposes the weakness of argumentation advocacy team. ✓ Exposes the weakness of argumentation advocacy team. ✓ Convincingly complete the defense of opposing positions.

APPENDIX B.

DEBATE ASSESSMENT SHEETS

For performing this educational debate three needed evaluation sheets are articulated:
B.1 - Teacher's sheet for: (i) debaters, (ii) moderators;
B.2 - Moderator's sheet for one classmate-debater;

B.1. Teacher's Debate Assessment Sheets

In the teachers' competences is evaluation (assessment) of two method's roles such as moderators and debaters. The needed sheets are shown below.

Teacher's Debate Assessment Sheet For Moderator

Moderator (student):___________________________

POINTS	PERCENTAGE	**MARK**
57 - 63	90 - 100%	Excellent (5)
47 - 56	75 - 89%	Very good (4)
38 - 46	60 - 74%	Good (3)
32 - 37	50 - 59%	Sufficient (2)

Points – mark scale

COMPETENT SET	THE SCALE OF SCORING: Completely	Satisfactorily	Confusingly	Inadequately
	3p	2p	1p	0p
Developing skills for the presentation and understanding of debate content				
Download and use prior knowledge and experiences to new situations				
Being able to present content				
Ability to concentrate				
Skill in communication (facial expressions, gestures, tone of voice, present auditory-visual-kinesthetic profile)				
Constructive presenting conclusions				
Knowing the proper terminology				
Evaluation and interpretation as well as integration of information and data				
Assess, consider the purposefulness of targets, usability, argumentation of acquired knowledge				
Define tasks and objectives for the realization of this knowledge (taking into account the methodological steps debates)				
Developing communication skills				
Promoting critical thinking				
Reasoned putting the mark to classmate-debater				

The organization and conducting the active methods				
Ability to lead and handling in different situations				
Ability to classify work				
Ability to logical, creative thinking				
Knowing the external factors that affect the organization and work plan				
The ability to conduct a comprehensive review of the place of learning units as a prominent moderator's role as a head of				
Compliance with didactic principles				
The principle of activity (physical, emotional, intellectual)				
Principle of clearness - an example of transition from the concrete to the conceptual				
The principle of appropriateness, gradualism and systematic - the content is presented without errors in a logical order				
The principle of life aspect - presented content is apparent from the experience of everyday life, and not only in literature				
The principle of problem situations - exposed is debating problem				

TOTAL No. POINTS	MARK	TEACHER SIGNATURE

Teacher's Debate Assessment Sheet For Debater

Debater (student):____________________________

POINTS	PERCENTAGE	**MARK**
75 - 84	90 - 100%	Excellent (5)
63 - 74	75 - 89%	Very good (4)
50 - 62	60 - 74%	Good (3)
42 - 49	50 - 59%	Sufficient (2)

Points-mark scale

COMPETENT SET	THE SCALE OF SCORING: Completely 3p	Satisfactorily 2p	Confusingly 1p	Inadequately 0p
Knowledge, understanding and application the concepts of science, their connections and theories (content knowledge)				
Reasonable to define the problem				
Integrated understanding of debating content				
Adequately define curricular concepts (9. class)[1]				
Recorded or mentioning: structural / rational formulas				
Use: relevant professional terminology (see explain)				
To explain ← concepts: e.g. 9. class[2]				
Be aware ← critical attitude to: e.g. 9. class[3]				
Thinking ← about prevention or reducing the effects of hydrocarbons – their products (plastics) on the environment. Expression of suggestions, incentives for constructive solutions				
Reasonable to interpret the concepts, according to debating password				
Developing capability for the presentation and understanding of debating content				
Transposition and application of prior knowledge and experiences to new situations				
Being able to present content				
Being able to interpret concepts				
Ability to concentrate				
Distinguish between relevant and non-relevant information				
Skills in communication (facial expressions, gestures, tone of voice, present auditory-visual-kinesthetic profile)				
Constructive presenting the conclusions				
Knowing the proper terminology				

[1] Adequately define curricular concepts (9. Class): polymers in everyday life, plastics.

[2] To explain (9. class): polymer, monomer, polymerization.

[3] Critical attitude to (9. class): recycling of waste, the consequences of pollution from plastic materials.

Teacher's Debate Assessment Sheet For Debater (continued)

Evaluation and interpretation as well as integration of information and data				
The ability of logical, creative, initiative, divergent thinking				
Used different ways of interpreting the results. Cause-effect →reasoned				
Types of debater's communication: Implementation of monologues (in the time limit) Implementation of replicas Engaging in a dialogue between the teams (double trio) and moderator				
Understanding of environmental problematic and actions to prevent and reduce pollution				
Active recognition and understanding the environmental problematic				
Responsible and active participation in solving sustainable development				
Recognizing and avoiding hazards in taking care of their own health and the health of others				
Expression of the teaching principles				
The principle of activity (physical, emotional, intellectual)				
Principle of clearness - an example of transition from the concrete to the conceptual				
The principle of appropriateness, gradualism and systematic - the content is presented without errors in a logical order				
The principle of life aspect - presented content is apparent from the experience of everyday life, and not only in literature				
The principle of problem situations – in defense speeches are exposed so acceptable as well as the problematic aspects of the debate claim				

TOTAL No. POINTS	MARK	TEACHER SIGNATURE

B.2. Moderator's debate assessment sheet

Below is given an example of evaluation sheet used by moderators' assessment of self-selected classmate who is acting as a debater.

.

Moderator's Debate Assessment Sheet For Classmate-Debater

Assessed classmate-debater:___________________________

CRITERIA SET Topic: Hydrocarbons Family – Polymers Debate thesis: "Articles of plastic materials changing word for the better"	THE SCALE OF SCORING Completely	Satisfactorily	Confusingly	Inadequately
	3p	2p	1p	0p
Developing abilities for the presentation and understanding of debate content (the criticality)				
Debater (he / she): knows to transfer and use prion knowledge and experiences to new situations (for example, explains the use of plastics in everyday life)				
Debater (he / she): knows how to present debating content				
Debater (he / she): is able to concentrate well on the addressed debating content				
Debater (he / she): skillfully communicates (with facial expressions, body gestures, tone of voice)				
Debater (he / she): gives the conclusions, which are directed towards the goal, thus corroborating or denying claims each of debate thesis				
Debater (he / she): knows the appropriate expertise-subject terminology				
Debater (he / she): has a clear and loud voice, keen (supported by facial expressions, body gestures, tone of voice appropriate) argues the current debating thesis				
Debater (he / she): develops systematic thinking (connected) emphasizes the necessary information, the expert opinion is satisfactory range (not to sparingly)				
Debater (he / she): is a sovereign and persuasive (thesis is supported with the verified data)				
Debater (he / she): established eye contact with the audience interlocutors, responds to the moderator's interventions or interruption				
Debater (he / she): is attractive and interesting (with his speech convinces the audience). It gives his/her own views on a given situation.				

No. possible points: 36 No. of achieved points:	MARK (worth 50% of the total score)	Moderator's SIGNATURE:

Points-mark scale

POINTS	PERCENTAGE	**MARK**
32 – 36	90 - 100%	Excellent (5)
27 – 31	75 - 89%	Very good (4)
22 - 26	60 - 74%	Good (3)
18 - 21	50 - 59%	Sufficient (2)

Location, date and signature of the teacher:

REFERENCES

Bačnik, A. *et al*. (2011). Učni načrt (Curriculum): Program osnovna šola (Elementary School Program): Kemija (Chemistry), 8th and 9th class. Ljubljana: Ministrstvo za šolstvo in šport (only in Slovene).

Bloom, B. S. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain. New York: David McKay Company.

Branham, R. J. (1991). Debate and critical analysis: The harmony of conflict. Routledge: Routledge Communication Series.

Chien-Hui, Y. and Enniati, R. (2012). Using Debate as a Pedagogical Tool in Enhancing Pre-Service Teachers' Learning and Critical Thinking. *Journal of International Education Research,* 8: 135-144.

Day, C. (1999). Developing Teachers: The Challenges of Lifelong Learning. London: Palmer Press.

Driscoll, W. and Zompetti, J. (2005). Odkrijmo svet s pomočjo debate. Priročnik za izobraževalno debate. Ljubljana.

Felder, R. M. and Brent, R. (2008). Active and Cooperative Learning. Penn State University. USA. http://www.personal.psu.edu/ryt1/blogs/totos_tidbits/Felder.pdf

Fisher, A. (2011). Critical thinking. An introduction (second edition). Cambridge: Cambridge University Press.

Horvat, D., and Sikosek, D. (2013). Izobraževalna debata kot metoda makro-didaktične komponente preverjanje z ocenjevanjem pri pouku kemije in naravoslovja v osnovni šoli (Education debate as the testing and assessing method in Chemistry and Science teaching of elementary education). Diplomsko delo [Graduation Thesis]. Department of Chemistry-Chair of didactics of Chemistry. Maribor: Fakulteta za naravoslovje in matematiko (Faculty on Natural Sciences and Mathematics) (only in Slovene).

Johnson, D., Johnson, R. and Stanne, M. (2000). Cooperative Learning Methods: A Meta-Analysis. Minessota: University of Minessota. From: http://www.tablelearning.com/uploads/File/EXHIBIT-B.pdf. Accessed 13/3/13.

Kennedy, R. (2007). In-Class Debates: Fertile Ground for Active Learning and the Cultivation of Critical Thinking and Oral Communication Skills. *International Journal of Teaching and Learning in Higher Education*, 18:183-190.

Kramar, M. (2003). Metode pouka in izobraževanja: teoretično-didaktične razsežnosti. *Sodobna pedagogika*, 54:116-138.

Lipman, M. (1988). Critical Thinking-What Can It Be? *Educational Leadership*, 45: 38-43.

Marzano, R. J. (2000). Designing a new taxonomy of educational objectives. Thousand Oaks, CA: Corwin press.

Ministry of Education, Science and Sport (2014). Legislation and documents applicable regulations in the field of education. From: http://www.mizs.gov.si/si/zakonodaja_in_dokumenti/veljavni_predpisi_s_podrocja_izobrazevanja. Accessed 22/1/13

Novak, M. (2005). Preverjanje in ocenjevanje znanja kot sestavni del pedagoškega procesa. *Preverjanje in ocenjevanje*, 4:7-27.

O'Rourke, M. (2001). UI Critical Thinking Handbook. From: http://www.class.uidaho.edu/crit_think/ Accessed 22/3/13

Peklaj, C. (2004). Tekmovanje, sodelovanje in individualno učenje ter razvoj različnih kompetenc. *Vzgoja in izobraževanje*, 35:.4-7.

Peklaj, C. (2001). Sodelovalno učenje ali kdaj več glav več ve. Ljubljana: DZS.

Pisar, L. and Sikosek, D. (2006). Razvijanje kompetenc študentov-učiteljev kemije za preverjanje in ocenjevanje znanja z uporabo metod sodelovalnega učenja (Developing the competences students – Chemistry teachers for testing and assessing using the methods of cooperative learning). Diplomsko delo [Graduation Thesis]. Oddelek za kemijo (Department of Chemistry-Chair of didactics of Chemistry) in oddelek za pedagogiko, didaktiko in psihologijo (Department for Pedagogy, Didactics and psychology). Maribor: Predagoška Fakulteta (Pedagogical Faculty) (only in Slovene).

Repp, A., and Horner, R. H. (Ed.) (1999). Functional analysis of problem behavior: From effective assessment to effective support. Belmont, CA: Wadsworth.

Romainville (1996). Key Competences 2002. Survey 5. Brussels: Eurydice. European Unit, 13.

Rupnik Vec, T. and Compare, A. (2006). Kritično mišljenje v šoli. Strategije poučevanja kritičnega mišljenja. Ljubljana: ZRSŠ, pp.11-28 and pp.55-74.

Sikošek, D. and Horvat, D. (2014). Educational debate as alternative approach to detecting students technologically-eco-environmental problems. In D. Katalinič, (Ed.) Collection of abstracts: Ecology for better tomorrow, IX International scientific symposium / conference. Rakičan: Science educational center. (only in Slovenian).

Sikošek, D. and Horvat, D. (2013). What is the methodology of the debate method for the purpose of examining with assessment on the level of elementary science education. In Z. Kravanja, et al. (Eds.), Collection of abstracts: Slovenian Chemical days 2013, [CD-ROM], pp. 1-9. Maribor: Faculty of Chemistry and Chemical Engineering (only in Slovene). p 96.

Sikošek, D. (2010). Naravoslovne kompetence kot kurikularen parameter kemijskega izobraževanja (Natural competences as curricular parameter of chemical education). V: Rozman, I. (nosilec pr.), Gerlič, I. (vodja pr.). Opredelitev naravoslovnih kompetenc (Development of science competences), pp.132-143. Maribor: Fakulteta za naravoslovje in matematiko.

Sikošek, D. (2006). Predmet didaktika kemije I: Snopič predavalnih izročkov (Subject didactics of chemistry I: Fascicle handouts from lectures. Maribor: Pedagoška fakulteta (Pedagogical Faculty) (only in Slovene).

Skrt, B. (2004). Kritično zagovorništvo za informacijsko dobo ali izobraževalna debata za nove competence informacijske družbe 21. stoletja. *Vzgoja in izobraževanje.* 6: 13-27.

Skvarč, M. and Vilhar, B. (2011). Učni načrt (Curriculum): Program osnovna šola (Elementary School Program): Naravoslovje (Natural Science) 5th and 6th class. Ljubljana: Ministrstvo za šolstvo in šport (only in Slovene).

SPSS Statistics (2013). Version 21. IBM Corporation.

Šuster, D. (1998). Moč argumenta. Logika in kritično razmišljanje. Maribor: Pedagoška fakulteta.

The Institute of the Republic of Slovenia for education (2013). from: http://www.zrss.si/ default.asp?rub=2097. Accessed 1/11/13

Tolmie, K. A., Topping, J. K., Christie, D., Donaldson, C., Howe, C., Jessiman, E., Livingston, K. and Thurston, A. (2009). Social effects of collaborative learning in primary schools. *Learning and Instruction.* 20: 177-191.

Tuning Educational Structures in Europe (2013). From: http://www.unideusto.org/tuningeu/links.html. Accessed 13/5/13

Wikipedia (2014). Stephen Toulmin. From: http://en.wikipedia.org/wiki/Stephen_Toulmin. Accessed 13/1/13

XMind SE 2012 (2013). Professional and Powerful Mind Mapping. Version 3.3.1.

Žarić, K., Sikošek, D. and Golob, N. (2009). Kompetence, specifične za kemijske vsebine v šolski vertikali (Competences specific to the chemical contents in the vertical school). V: Golob, N., Sikošek, D., Žarić, K., Ferk, E. (Eds.) Kompetence, specifične za kemijske vsebine po šolski vertikali; S1.05: projekt *Razvoj naravoslovnih kompetenc*, 1.4.2009-30.6.2009). Maribor: Fakulteta za naravoslovje in matematiko. pp 8-10.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 6

LESSON STUDY: COLLABORATIVE LEARNING THAT PROMOTES MINDFULNESS

Norman K. N. Kee [*] ***and Noel K. H. Chia***
National Institute of Education, Nanyang Technological University, Singapore

ABSTRACT

Interest in Lesson Study (LS) as an approach for collaborative learning is gaining momentum, especially in Singapore. Another equally interesting approach is Learning Study within LS. This chapter elaborates how LS collaborative approach for research lesson brings about active mindful learning. The theory, strategies and educational benefits of creating conditions compelling all involved to have an "open mind" to perceive, be aware and be sensitive to multiple context and perspectives, including one's own, for socio-cultural learning and appreciation of participants learning orientations, experiences and tacit knowledge, will be shared. Essentially, LS helps to bring diverse details of observers of the research lesson into conscious attention for mindful awareness and reflective deliberation of the various processes and their impact on learning, levelling up the professionalism of educators.

Keywords: Lesson Study, Mindfulness, Mindful learning

INTRODUCTION

Lesson Study in Singapore

Lesson Study (LS) was first introduced in mainstream Singapore schools in 2005 (Lim et al.,, 2011). LS gained momentum in implementation after 170 out of 354 schools in Singapore received introductory workshops in LS from 2005 to 2010. However, its implementation is still at the infancy stage according to a survey conducted in January 2009, involving sixty-four schools, with a mix of 20 primary schools, 32 secondary schools and 2

[*] Corresponding author: kiaknam.kee@nie.edu.sg.

junior colleges in Singapore (Lim et al., 2011). Findings of the study revealed that teachers reported that they needed more support from school leaders to incorporate LS into curriculum time (41%) and reduction of workload (31%). The latter observation is in view of existing administrative and committee tasks and co-curricular activities in addition to committed teaching workload. Cheah (1998) reflected that Singapore's education system is characterized by efficiency and competition with a strong performance-driven culture in schools.

The implicit requirement of LS for all participants to be willing to share and be prepared to empower others with their professional insight and knowledge also requires a sociocultural change for a healthy competitive mindset and inclusive reward system. It may transform to a movement towards a compassionate meritocratic (Ong, 2014) educational system, where we would operationalize as everyone helping each other to be counted as relevant, needed and part of the whole educational fraternity of Singapore. Nevertheless, both school leaders and teachers are generally convinced of the value of LS (Lim et al., 2011). Moreover, LS supports the strong culture of reflective practice and collaborative professionalism (Ministry of Education, 2012) that the Ministry of Education supports.

Acknowledging the value of LS and in view of additional challenges involving catering to people with special needs, Chia and Kee (2010) proposed a modified LS approach for special school teachers for their teaching practicum to overcome practical and pragmatic challenges in special schools. Their LS study results involving three local special schools in Singapore for children with autism were found to be promising. The practicum teachers showed significant improvements in teaching and strongly suggest a good potential model for formative evaluation of practicum for trainee Special Education teachers (Chia and Kee, 2012). Essentially, the contextual and dynamic complexity involved, in order to be effective, needs to be unpacked with clarity through the LS experience as well as multiple examples and non-examples from academics and skilled teachers.

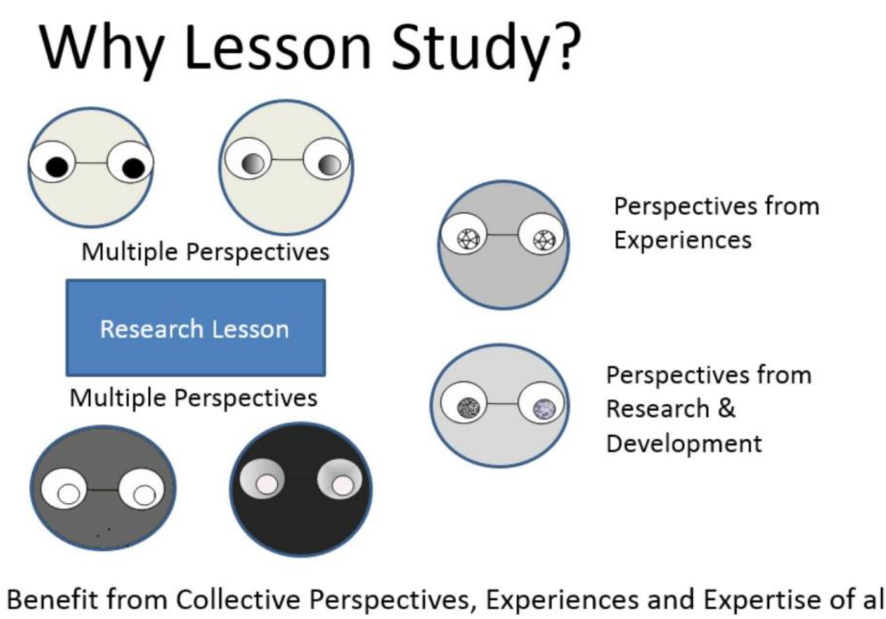


Figure 1. Why Lesson Study?

What and Why of Lesson Study Approach

Historically, the Japanese encountered similar needs in the 19th century when they wanted to acquire professional skills in knowing how to teach to a class rather than individually (Isoda et al., 2007). Traditionally, the Japanese were familiar with individualized instructional model where lessons were carried out in temples in a one-to-one fashion. Perhaps, the observations of the advancement in science and technology, especially in the invention of superior military weaponry like canons and guns and industrialization, could have prompted the Meiji government in 1872, to explore the Western scholarship on teaching. Probably, the prohibitive cost of sending educators to learn from the West (Europe and the United States) or inviting the Western teachers to teach in Japan could have prompted the need to devise ways of harnessing the learning from the rare opportunity. It is plausible to postulate that LS approach could have been developed to efficiently and effectively harness the learning of a few to be observed by large numbers of educators for deliberation and adoption.

Fundamentally, one member of the LS team will lead in preparation of a research lesson. The rest will then contribute constructively from different perspectives to improve it. Upon improvement, the lead member will then teach while other team members observe and collect data on the processes involved in teaching and learning. The team will follow-up by sharing and analyzing the collected data together. Through collective discussion, reflection and consolidation of learning, the lesson plan is then improved for future use. The collaboration in LS brings up to speed inexperience members who will have the opportunity to learn, question and model from hearing the deliberations of experienced teachers and/or academia, the processes involved in decision making and skills needed to be effective. All members of the LS team benefit from collective perspectives, experiences and expertise (see Figure 1).

LS is essentially a collaborative learning approach for professional development. The team of educators will collaboratively work on a research lesson plan, teach and observe the lesson with data collection on student learning. The data collected is used to refine the lesson through the input and insight of all in the team (Stepanek et al., 2007). The value is more in the process rather than the product of LS as the collective and synergistic sharing of perspectives and insights builds each other with sociocultural understanding of diverse views and beliefs.

WHAT'S SO SPECIAL ABOUT LESSON STUDY? WHY BOTHER?

Dr. Semmelweis and Mindlessness

In order to appreciate the value of LS in awakening educators from mindlessness to mindfulness, WeI will use Dr. Ignaz Semmelweis story to illustrate (Biddle, 2009). In 1840, Dr. Ignaz Semmelweis, a Viennese obstetrician, observed that 20% of women died of febrile illness while experiencing childbirth in Vienna General Hospital, whereas maternity mortality in the home setting was only about 1%. Doctors in the teaching-and-research hospital under Dr. Semmelweis had to balance their time between research using cadavers and treating patients. As epidemiology and bacteriology were unknown during those days, both doctors and medical students would routinely move from dissecting corpses to examining new mothers, without cleaning their hands. As a consequence, there was a cross-contamination of germs causing fatal infection in new mothers resulting in what was then known as puerperal or ‘childbed’ fever. The urgency to discover an explanation and to address the embarrassingly-high mortality shook up Dr. Semmelweis from a life that he had been on automatic mode. Existing practices were reexamined. After considerable personal reflection of the comparison between hospital and home setting processes, he finally narrowed down to the possible significance that the research done by the doctors on cadavers have an effect on mortality. He thereafter developed a theory that ‘particles’ from cadavers and other diseased patients were transmitted to healthy patients on the hands of the physicians. He thereafter instituted simple hand washing and the mortality rates plunged to a level comparable to that of home delivery. The mindfulness of Dr. Semmelweis had led to change from the norm. Without the mindfulness of Dr. Semmelweis, all doctors and medical students would have mindlessly continued the trend of fatal practice.

Siegel (2007) explains mindfulness as the state of “waking up from a life on automatic, and being sensitive to novelty in our everyday experience” (p. 5). Mindfulness allows one to move from a state where one’s actions or activities are done mindlessly, without much consciousness, to a state where one becomes conscious and aware of our environment, actions and everyday experience. It also involves reflecting on the happenings, with the ability to make choices, allowing change from the norm to be possible.

From the authors’ combined experiences in supervising mainstream and special school trainee teachers’ Teaching Practicum (TP) as well as from observations from LS research projects, there appears to be mindless continuation of teaching practices that have been shown ineffective by literature or by academic results in school over time. However, in the absence of known alternatives, these practices are still commonly perpetuated. This is analogous to doctors and medical students continuing practices that cause fatality in Dr. Semmelweis story.

Experienced teachers, academics and all members of a LS team have diverse and multiple perspectives. When working together, the diverse perspectives of the LS team members on the research lesson awakens appreciation and knowledge of diversity which would otherwise not be known. It took the Dr. Semmelweis desperation and urgency to reexamine all possibilities. LS, on the other hand, brings the professionals, academics and trainees or novices with diverse perspectives to work together for synergistic collaboration and crystallization on the research lesson. The benefit of examining from multiple perspectives promotes exploration of potential new paradigms for effectiveness.

How Lesson Study Promotes Mindfulness

Lesson Study and the Establishment of a Great Sense of Urgency to Act

The formal set up of a LS team by the school management involving skilled teachers, academics and teachers, entails accountability by team and thus a greater sense of urgency to act. This approach implicates that it is more dangerous to remain in the current comfort state of status quo than to try the collective proposal and thus collective responsibility of the team to resolve identified problems that their research lesson works to address. The endorsement by management and collective team responsibility averts the situation of becoming paralyzed by risk of embarking on new initiative (Knotter, 2011). The team is thus empowered to be open to new ideas and angles to address the short comings of existing practices in the lesson undergoing research.

Lesson Study and the Formation of a Powerful Guiding Coalition

The LS team if empowered by the school management can be a powerful guiding coalition to lead the change effort (Knotter, 2011) needed based on findings of the LS. An important caveat for consideration in terms of recognition and rewards, is that all members of the team are to be treated equally without hierarchy and will share equally all benefits derived of LS. The perception of fairness and equality, would promote honesty and honest appraisal of existing practices and avert politics of power. The authentic sharing will awake all to the reality and actual processes at play during the research lesson. Only with authentic and valid appraisal of strengths and needs of existing practices without prejudices can real progress be made to address the “real” challenges and needs. Thus, mindfulness to the reality can be achieved with a powerful guiding coalition in LS.

Lesson Study and the Creation of a Vision

Professionals and academics may have different perspectives and focus on what works and why in lessons, but will supply their expertise and contribute to a clear and articulated common vision of LS. All those involved in the team will be sensitized and made aware of the differing perspectives and foci of attention and thus a clear collective vision of what would be considered effective of the research lesson will be constructed socio-culturally, through the interactions. The clarity of the vision (Knotter, 2011) is essential for a collective breakthrough for needed change.

Lesson Study Promotes Mentoring of Mindful Teaching

Trainee teachers and/or beginning teachers can be involved in LS projects to increase their grasp of applied pedagogy or praxis in mainstream and special schools. Frankly, trainee teachers and beginning teachers may find the demands of skillful teaching daunting and overwhelming. They will need to not only grasp diverse knowledge of subject content for teaching but be able to also acquire teaching expertise. The need to dynamically assess, adopt and adapt diverse teaching approaches to diverse students needed for effectiveness can be stressful and paralyzing. Saphier et al. (2008) have conceptualized three kinds of knowledge comprising the professional teaching: moves, patterns and abstractions. These will be used to illustrate how LS brings mindfulness for the praxis of professional teaching

Lesson Study Initiates Awareness of *Moves*

Moves are teaching skills that are quick, discrete and observable (Saphier et al., 2008). For example, when an experienced teacher notices simple signs of agitation, such as pencil tapping of a student, the teacher would probably redirect the student attention by offering appropriate help or opportunity to take a break. The quick, discrete and observable actions of the teacher could potentially avert challenging behaviour. During the review of an observed lesson, through the medium of a captured video, all in the team can contribute their perspectives effectively. Such a review also provides an opportunity for the trainee teacher to clarify and explicate the thinking behind certain actions observed. The academics and skilled teacher can thereafter with gentleness and kindness, help the trainee teacher to perceive and appreciate the perspectives as seen from different backgrounds and experiences.

From the authors' experience in supervising teaching practice (TP), many trainee teachers were unable to appreciate the value of the theory they have previously learnt for application in their TP. Many need the explication of the theory and its application in an observed TP lesson that they must be directly involved, before they are awakened to its value. A case in point, as in the earlier example, is on the importance of knowing the acting-out cycle (Colvin, 2004). A student's learning or behavioral concern, if left unaddressed, may lead to school-based trigger of a student's off-task behavior or misbehavior, evidenced by unacceptable behavioral symptoms, such as pencil tapping, "slouched position, feet outstretched, arms folded, head down staring at the floor and basically motionless" (Colvin, 2004, p.8).

The observed lesson video, directly and richly experienced by the trainee teacher, the actor, with contextual information, provides convincing evidence of areas of need which can be replayed and examined. Moreover, the explication by academics of how the theories do explain the experienced situation, as well as the praxis to address the challenges, allows the socio-cultural construction and deep learning of the value of theory and praxis. On the other hand, skilled and experienced teachers sharing multiple case studies with vivid details of what to do and what not to do, brings clarity to appreciate context and understand rationale behind certain actions. The collaborative sharing in LS enlightens the trainee teacher with depth on how to address areas of need. In addition, an individual's honest sharing of the learning journey as a teacher, learning curve experienced and humanness as an imperfect person, encourages and awakens the trainee teacher to be reflective, as well as be mindful of the happenings during a class session.

Moves are essentially dynamic aspects of classroom management which requires mindfulness of classroom climate, student-teacher relationship and sound instruction. LS approach allows the trainee teacher the opportunity to construct socio-culturally what it means to become a skilled teacher. It also provides a useful platform and context to clarify any misconceptions of pedagogy or praxis of teaching.

Lesson Study Initiates Awareness of *Patterns*

Generally, teachers are observed to repeat practices that they have been used-to, even though some may not necessarily be effective. The ineffective practices are automatically carried out or mindlessly repeated when there is lack of known alternatives that work. LS creates an environment and opportunity to be mindful of ineffective practices and to experience exploration of diverse perspectives to address the challenges. Patterns of effective and ineffective teaching will eventually be perceived through explanation, debate and explication of processes involved over time, through examples and non-examples from sharing of experiences and research findings of team members. The tacit knowledge of effective skilled and/or experienced teachers can be powerful in revealing patterns (Saphier, 2008), such as importance of personal relationship-building with students over time. Though teachers may witness the happenings, they may not figure out the patterns required for the success. LS provides the platform for direct and effective communication and appreciation of the building processes involved in patterns of best practice, such as effective models of teaching in a particular school context, or an eclectic approach based on multiple models of teaching depending on contextual needs over time.

Lesson Study Initiates Awareness of *Abstractions*

Abstractions are important things that skillful and/or experienced teachers do in curriculum planning (Saphier, 2008), which are hard to observe unless the skillful teachers explicate and help all in the LS team to be aware and be mindful of the aspects involved. The expert experiences and insights are developed over time and require explicit unpacking and mindfulness of the many parameters and concurrent concerns, as well as tacit knowledge to guide the selection of overarching objectives, curriculum maps and sequencing.

The connections between actions and decisions require mindfulness and mindsight. Siegel (2010) coined the term *mindsight*: “Mindsight is the basic skill that underlies everything we mean when we speak of having social and emotional intelligence” (Siegel, 2010, p.*x*). Mindsight allows one to direct our thoughts and feelings rather than be driven by them. One who has mindsight would be able to say “I feel sad” rather than “I am sad”. The difference between the two statements lies in the latter being a self-definition, and thus a very limiting one when compared to the ability to recognize and acknowledge a feeling, without being consumed by it. Mindsight is essential for “buy-in” and acceptance of any program for implementation. Oftentimes, mindsight is neglected, which leads to limited success of any initiative. In general, there will be greater success for any program if there is open and transparent communication with people involved. If people are also empowered to have ownership of the proposal, such as in deliberating and voting for it, chance of success of the initiative would be greater.

The authors’ joint experiences in most LS sessions reveal that mindsight seems to be of least concern. Most teachers are concerned with the logic, flow, content and evidence-based strategies and results. Skillful and experienced teachers on the hand are mindful and operate with mindsight of the processes and praxis of teaching. The authors have found it challenging in some of their experiences to share their mindsight to experienced teachers who are quite insistent on positivistic approaches and seem quite resistant to any infusion of humanistic approaches. Fortunately, in most cases from the authors’ joint experience, most teachers are open to develop mindsight.

Lesson Study Initiates Awareness of Non-verbal Communication

Skillful and experienced teachers demonstrate mindfulness and mindsight each time they start a class. They are able to assess the class climate effectively with all their senses through mindful observations. They are observed to be able also to connect dynamically and affectively with the class, with the mindsight they have developed over time. Trainee teachers and beginning teachers, on the other hand, are often observed to lack mindfulness and mindsight, especially in terms of non-verbal communication.

Non-verbal communication refers to all ways of communicating without using words, written or spoken (Ivy and Wahl, 2007). It is a critical primary means by which teacher and student relationship becomes built up or becomes fractured. As feelings and attitudes are mutually communicated non-verbally, it is more believable than verbal messages. Ivy and Wahl (2007) argued that non-verbal messages can substitute for, complement, contradict, repeat, regulate and accent verbal messages. During the LS post-research lesson meetings, where collective viewing of the recorded lessons were shown, student teachers and teachers often remarked that they have learnt a lot from the constructive comments and help to understand their non-verbal communication and its impact on their effectiveness in class. Skillful teachers with vast experiences are often able to illustrate the rationale and need to be mindful of their non-verbal communication with many examples and non-examples with clarity and impact.

Lesson Study Initiates Awareness of the Effect of Home Upbringing

Trainee teachers and beginning teachers in many LS projects are often observed to lack the awareness and appreciation of the highly significant impact of home upbringing from a functional or dysfunctional family. Though many are have the knowledge and are aware of the impact of home on student's behaviour, they somehow fail to bring it into focus during discussion. The preoccupation focus is on their pedagogy and classroom management competency.

However, skillful teachers, during LS meetings, are quick to point out the need to know the profiles of students, their learning potential, learning propensity and their learning capacity. Realistic, achievable goals and interesting activities are thereafter conceived by skilled teachers, who calibrate dynamically for developmentally appropriate lesson delivery as they continuously gather visual and auditory feedback from their students on its effectiveness. It is common to observe that trainee teachers and beginning teachers need to hear multiple examples of students they are teaching, and the impact of family on them, before they are able to appreciate the impact of homes and internalize the need to always check on family functionality and its impact.

Academics can provide research findings on best practices to work and collaborate with caregivers as well as statistics of profiles of families and their functioning in the context relevant for the school. LS provides the ideal environment where contextual sharing sharpens awareness and leads to mindfulness as well as mindsight. The situated cognition (Wilson and Myers, 2000) is cultivated through the socio-cultural sharing and learning from skillful teachers and academics of the impact of functional and dysfunctional families.

Lesson Study Initiates Awareness of Need for an Eclectic Teaching Approach

The authors have observed that many trainee teachers and beginning teachers are often fixated on certain models or strategies of teaching during LS sessions. Most of them did not realize that many skillful and experienced teachers often adopt diverse and multiple strategies depending on contextual understanding of learning needs of the class and individual students' potential and capacity for learning. The dynamic and fluid nature of actively calibrating for effectiveness depending on moment by moment assessment of effectiveness with diverse groups of learners by skillful teachers, speaks of the eclectic approach. It is, therefore, not surprising to note that many trainee teachers and beginning teachers often appear to be "in shock" when they learnt of multiple moves, patterns and abstractions concurrently at play during a lesson. The deep understanding of the complexities develops when they probe the suggestions for improvement with insightful questions or comments for verification. The sharing of rich experiences and tacit knowledge of what works and why under different context and for diverse students may seem overwhelming initially but it brings about mindfulness and mindsight. Generally, most members of the LS team are sensitized to consider alternative perspectives and teaching approaches that they may not be comfortable with.

A case in point is teachers who whole heartedly adopt Canter's assertive discipline approach (Edwards, 2008), as it matches their beliefs. Esposito and Evan-Winters (2007) have reported that:

> "As they argued, while attempting to 'state the problem', their low-income students simply did not know how to behave in middle class schools. Somehow our course readings and discussions on how American schools are reflective of white middle class values and transferred into black children simply cannot conform to the rules of white middle class teachers. Instead of focusing on how to change the cultural climate of the school to meet social and cultural needs of the students, the teachers decided to develop and implement a project that served to change and mold the students into more disciplined-bodies (Foucault, 1984)." (p.234)

As in the illustration above, many of these teachers may be from families of middle class. The teachers may find Assertive Discipline approach effective for high ability classes with generally better socio-economic status (SES) students but may find it frustrating and ineffective for low ability students with low SES. Barbara Coloroso's theories of Inner Discipline (Manning and Bucher, 2007) may work better in such situation, as effective teachers aim to develop good teacher-student relationship based on philosophical and psychological foundation of holding all children with high esteem (Manning and Bucher, 2007) regardless of SES and cultural values. A possible explanation could be that many from low SES may not perceive that they have the same rights to opportunities in school and life as other students. Further assertion may lead to increased negative perception and resistance. Student teachers and beginning teachers learn mindfulness and mindsight of the dynamic nature of teaching and learning and the need for eclectic approach when skilled teachers expound on how they will approach and manage the research lesson, leveraging on specific understanding of profile of class as well as individual students. The rich and vivid examples using the video context allows the team members to construct with fidelity how the skilled teacher manages the dynamic processes as well as how the goals are always kept in view.

Lesson Study and Learning Study

Learning Study is a variant of LS where there is a common, explicit conceptual framework (Pang and Ling, 2012) from which the team of educators leverage on when planning, implementing and reviewing the research lesson. Essentially, there is a focus on the object of learning and the use of variation theory to direct the focus on the object of learning. The variation theory requires critical aspects of the objects of study to be discernable and experienced by both teachers and learners (e.g. color differences). Examples and non-examples are thus important for discerning the differences. The value of using LS is the awareness of its structured approach and being mindful of the structure that facilitates the ease of implementation.

CONCLUSION

Generally, automaticity in daily life is expected as it reduces complexity in negotiating through demands of life. Moreover, it increases the ability and capacity to manage change. However, in instances where the existing practices are less than ideal, there arises a need to be awaken from mindlessly following current practices. Mindfulness is promoted through the socio-cultural learning from experiencing divergent thinking from multiple perspectives of different cultural habitus (Bourdieu, 1984) of members. Moreover the dialogic interactions within the LS framework (Shields, 2007), provide a platform for LS members to clarify the semiotic domain of education of the signifier and signified (Chandler, 2002). This process powerfully brings mindfulness and mindsight to the rich heritage of education literature and research. Essentially it is the synergistic collaboration of the LS team of professionals with diverse expertise and multiple perspectives that promote mindfulness and mindsight within the processes of LS.

REFERENCES

Biddle, C. (2009). Semmelweis Revisited: Hand Hygiene and Nosocomial Disease Transmission in the Anesthesia Workstation. *AANA Journal. 77*, 229-237.

Bourdieu, P. (1984). *Pierre Bourdieu: Distinction (Nice, R., Trans.)*. London, UK: Routledge Kegan and Paul.

Chandler, D. (2002). *Semiotics: The basics*. New York, NY: Routledge.

Cheah, Y. M. (1998). The Examination Culture and Its Impact on Literacy Innovations; The Case of Singapore. *Language and Education. 1*, 192-209.

Chia, N. K. H. & Kee, N. K. N. (2010). *Teaching practicum workbook for special education teacher trainees: A modified lesson study approach*. Singapore: McGraw-Hill Education (Asia).

Chia, N. K. H. & Kee, N. K. N. (2012). Modified lesson study for trainee special education teachers: An approach to formative evaluation of their teaching practicum. *Education Today*. *62*, 22-28.

Colvin, G. (2004). *Managing the cycle of acting-out behavior*. Eugene, OR: Behavior Associates.

Edwards, C. H. (2008). *Classroom discipline and management* (5th ed.). River Street, NJ: John Wiley & Sons.

Esposito, J. & Evans-Winters, V. (2007). Contextualizing critical action research: lessons from urban educators. *Educational Action Research. 15*, 221-237.

Isoda, M., Stephens, M., Ohara, Y. & Miyakawa, T. (2007). *Japanese lesson study in mathematics: Its impact, diversity and potential for educational improvement*. Singapore: World Scientific Publishing.

Ivy, D. K. & Wahl, S. T. (2009). The nonverbal self: Communication for a lifetime. Boston, MA: Pearson Education.

Kotter, J. P. (2011). *Leading Change.* In *HBR's 10 must reads: On change*. Boston, MA: Harvard Business School Publishing.

Lim, C., Lee, C., Saito, E. & Haron, S. S. (2011). Taking Stock of Lesson Study as a Platform for Teacher Development in Singapore. *Asia-Pacific Journal of Teacher Education, 39*, 353-365.

Manning, M. L. & Bucher, K. T. (2007). *Classroom Management: Models, applications and cases* (2nd ed.).. Upper Saddle River, NJ: Pearson Prentice Hall.

Ministry of Education. (2012). Address by Mr Heng Swee Keat, Minister for Education, at the *6th Teachers' Conference 2012*, on Thursday 31 May 2012, at 9.50 am, Suntec City Convention Hall. From: http://www.moe.gov.sg/media/speeches/2012/05/31/address-by-mr-heng-swee-keat-a.php

Ong, A. (2014, January 8). '*Consider what compassionate meritocracy entails*'. The Straits Times: Singapolitics. From: http://www.singapolitics.sg/news/consider-what-compassionate-meritocracy-entails-lim-siong-guan

Pang, M. F. & Ling, L. M. (2012). Learning Study: Helping Teachers to Use Theory, Develop Professionally, and Produce New Knowledge to Be Shared. *Instructional Science: An International Journal of the Learning Sciences. 40*, 589-606.

Saphier, J., Haley-Speca, M. A. & Gower, R. (2008). *The skillful teacher: Building your teaching skills* (6th ed.).. Acton, MA: Research for Better Teaching.

Shields, C. M. (2007). *Bakhtin*. New York, NY: Peter Lang.

Siegel, D. J. (2007). *The Mindful Brain*. New York, NY: W.W. Norton & Company.

Siegel, D. J. (2010). *Mindsight*. New York, NY: Bantam Books.

Stepanek, J., Appel, G., Leong, M., Mangan, M. T. & Mitchell, M. (2007). *Leading lesson study: A practical guide for teachers and facilitators*. Los Angeles, CA: Corwin Press.

Wilson, B. G. & Myers, K. M. (2000). Situated cognition in theoretical and practical context. In: D.H. Jonassen and S.M. Land (Eds.)., *Theoretical foundations of learning environments*. Lawrence Erlbaum Associates, Mahwah, NJ, USA. 57 – 88.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 7

COLLABORATIVE STRATEGIES OF TEACHING AND LEARNING IN HIGHER EDUCATION

***Dora Simões*[1,*] *and Margarida M. Pinheiro*[2]**
[1]Research Centre for Communication Technologies and Sciences (CETAC.MEDIA), Higher Institute of Accounting and Administration, University of Aveiro (ISCA-UA), Aveiro, Portugal
[2]Research Centre Didactics and Technology in Education of Trainers (CIDTFF), Higher Institute of Accounting and Administration, University of Aveiro (ISCA-UA), Aveiro, Portugal

ABSTRACT

Different methods of learning have been explored in connection with different learning orientations and conceptions of learning, giving rise to the fine-tuning of the concepts and their development in relation to particular educational contexts. The main educational goal is to have learners acquiring appropriate knowledge contents in order to rebuild this knowledge for themselves, but also to have a process of socialization including sharing of knowledge communication skills. Closely related to the notion of collaboration is the notion of promoting active and collaborative practices by fostering the change of a traditional teaching system to adopt and incorporate information and communication technologies in the teaching and learning process.

Having this issue as a backdrop, the overall goal of this chapter is to contribute to the discussion on how the use of collaborative platforms, within a technological environment, impacts upon knowledge construction in Higher Education Institutions. More specifically, we intend to explore: (1) how environments sustained in collaborative platforms can actively involve students in the learning process; (2) how the e-learning context at the group work level influences the regulation of learning by the students themselves; and (3) how the use of elements similar to those which are perceived by

* Corresponding author: Dora Simões. Research Centre for Communication Technologies and Sciences (CETAC. MEDIA), Higher Institute of Accounting and Administration, University of Aveiro (ISCA-UA), Aveiro, Portugal. E-mail: dora.simoes@ua.pt.

students as part of their future professional activity, leads to different postures of learning.

Starting from a specific environment that makes use of several collaborative platforms and e-learning contexts, data collection was based on questionnaires. The study followed students enrolled in one same curricular unit of Marketing Bachelor at the Institute of Accounting and Administration of the University of Aveiro (UA).

In light of the questions, the results seem to confirm that the collaborative nature of learning leads to greater student participation and more active presence during the process, the more dynamic as the developed tasks involve empirical components. Moreover, students seem to identify the need to regulate their own learning, reinforcing the issue of planning and regulation of the collaborative activities and the role of synchronous and asynchronous opportunities, sponsored by collaborative platforms. Finally, the study suggests that the use of elements similar to those that are perceived by students as part of their future professional activity, leads to more proactive postures of learning.

Keywords: Teaching and learning strategies, collaborative platforms, learning styles, information and communication technologies, e-learning context

INTRODUCTION

Meeting the challenges that are currently being faced by Higher Education Institutions (HEIs), either in terms of the required roles for teachers and students or of teaching and learning processes, requires more than the reformulation of the (theoretical) mission of higher education but also the recasting of the practice of the institutions that comprise it. In parallel, the methodological model sustained by the Bologna Process has also generated profound implications in the change to student-centered methodologies, which make the student an active element in learning, properly guided by tutorial support (Pinheiro et al., 2011).

In such a perspective, it is possible to sustain the idea that learning cannot occur without people or a reference to its subjectivities and personal and social contexts.

However, the fact that most students have been exposed only to traditional methods of learning, that emphasize a competitive and individualistic approach, and the fact that teachers were taught by the lecture method, constitutes a major problem. So, unless teachers and students are trained in alternative teaching and learning techniques and the debate around those issues increases, it seems that a change in this paradigm will be rather difficult.

One possible approach to promoting active and collaborative practices is that of fostering the change of a traditional teaching system to adopt and incorporate Information and Communication Technologies (ICT) in the teaching and learning process. However, as ICT-mediated learning promotes the construction of complex knowledge structures, the interplay of learning with technology has problematized the very notion of learning. One possible application of technology is the e-learning context, which is already changing the teaching and learning processes. Moreover, given the nature of the complex relations within an e-learning environment, the ways of using technology and the level of student learning and engagement, it is important that the learning environment can adapt to different learners and different learning styles.

Having this issue as a backdrop, the overall goal of this chapter is to contribute to the discussion on how the use of collaborative platforms, within a technological environment, impacts on knowledge construction in HE.

More specifically, we intend to explore: (1) how environments sustained in collaborative platforms can actively involve students in the learning process; (2) how the e-learning context at the group work level influences the regulation of learning by the students themselves and (3) how the use of elements similar to those that are perceived by students as part of their future professional activity leads to different postures of learning.

Starting from a specific environment that makes use of several collaborative platforms and e-learning contexts, data collection was based on questionnaires. The study followed students enrolled in one curricular unit of Marketing Bachelor at the Institute of Accounting and Administration of the University of Aveiro (ISCA-UA).

This chapter is organized into five key points. After the introduction, we seek to contextualize the use of information and communication technologies at the level of active and collaborative methodologies in the teaching and learning process in higher education. The following section focuses on the methodological aspects of the study. The fourth section is devoted to the presentation of results and the last section presents the main conclusions of the study.

THE LEARNING AND TEACHING PARADIGM IN HIGHER EDUCATION

The Learning Environment

Different methods of learning have been explored in connection with different learning orientations and conceptions of learning, giving rise to the fine-tuning of the concepts and their development in relation to particular educational contexts. The findings of several studies have led to suggestions of new and intermediate approaches between deep and surface learning and to focus on the concept of understanding (Fyrenius et al., 2007). For example, if in the 1970s, studies contrasted memorization and rote learning (surface approaches to learning), compared to active construction and focus on meaning (deep approaches to learning). More recent studies arose in the 2000s which showed that understanding and memorizing appear to be mixed and closely-related to each other, and that understanding can be conceived of and attained in various ways. As students' approaches to learning and the concept of understanding evolves, the deep and surface dichotomy that has served as one base for studies of students' learning in higher education is being replaced by intertwined and collaborating activities. This leads to the current importance of the experience of variation in learning and shows that understanding is a multifaceted phenomenon in itself that can be experienced and accomplished in various ways (Fyrenius et al., 2007). At the same time that the learning environment is attracting attention and complicates the picture in itself, HEIs are requiring an extraordinary educational commitment in the training for new generations (Pinheiro et al., 2011). The expectation that education must be built on learning to know, learning to do, learning to live together and learning to be, is shared in Jacques Delors' report (Unesco, 1998), which considers education for the twenty-first century as being capable of nurturing the potential for learning in every individual in light of the challenges of global interdependence. Alternatively, as stated by Fyrenius et al. (2007), it is possible to sustain the idea that learning cannot occur without people or a reference to its subjectivities and personal and social contexts.

Although there are some universal frames enacted in the Declaration on Higher Education for the Twenty First Century (Unesco, 1998) some authors (e.g. Clifford and Montgomery, 2014) defend that global citizenship still needs to be acknowledged. From this background, it is possible to realize that the idea of educating students for global citizenship reopens the debate on the mission of higher education. The literature review of Clifford and Montgomery (2014) realizes that, due to the expansion of tertiary education, HEIs are powerful places of social, economic and cultural reproduction able to orient curricula to the market economy. Academics, therefore, are an essential part of policy implementation as transformative intellectuals. So, despite HEIs being seen as somewhat inert institutions, where consigned interests lead changes, teachers need to have not only the necessary knowledge and skills to understand and interpret institutional policies but also the willingness to put them into practice (Clifford and Montgomery, 2014).

In the context of the design of the learning environment, what should be considered important to be taken in account when thinking about classroom organization? According to Vivet (1996), the main concerns are about human and social aspects, the association with learning theories, and the inclusion of a system of interactions between learners and a system of available knowledge carried out either by teachers or peers or mediatized contents. The main goal is to have learners acquiring appropriate knowledge contents in order to rebuild this knowledge for themselves.

There should be a process of socialization that includes sharing of knowledge communication skills, reinforced by autonomy, self-education, and self-evaluation. In this sense, it is quite important to pay attention to student-centered learning. Namely, as the studies of Silén and Lars (2008) show, self-directed learning embodies factors associated with students' responsibility and independence in learning. The importance of becoming a self-directed learner is a learning process, promoting reflection and the need for teachers to challenge students' critical awareness in their interaction, which are essential cornerstones of the students' ownership in learning. In addition, the collaboration between students and teachers towards self-directed learning seems very important as a process of lifelong learning.

High-level discussions about learning and, consequently, teaching in higher education, would not be complete without talking about technology. The fact remains that we live in an increasingly digital world and information technology (IT) allows learning to take place everywhere at any time (Sirkemaa et al., 2007). But, as Stahl et al. (2006) say, the interplay of learning with technology has problematized the very notion of learning. Since learning is an active and a constructive process where the learner plays a central role, technology must be a tool and not the main issue in itself. For that, learning remains in the main focus; learners and teachers need to have knowledge and skills in using technology (Sirkemaa et al., 2007).

Widespread discussions and debates regarding the benefits of technology to create a shared space among learners are taken place (e.g. Nor et al., 2012). It is believed that actual and future learning environments should motivate and engage learners in reflective thinking and active knowledge construction. The potential of technology is in knowing how to help students and teachers in doing so. It is important to find patterns of discourse to implement and accomplish the necessary interaction, mediated by technology, in the learning process.

Active and Collaborative Methodologies

As active learning becomes a key instructional tool in a variety of educational settings, it has received considerable attention from researchers over the past several years (e.g. Grau and Whitebread, 2012; Kaufman et al., 1997; Prince, 2004). Even if a small number of skeptics regard active learning as another methodological feature in a long line of educational trends, a considerable number of others strongly advocate the conception of an alternative to traditional teaching methods that engages students in the learning process.

The main reason why some confusion arises is because it is not possible to provide universally accepted definitions for active learning, since diverse authors interpret some vocabulary terms differently. Yet, it is possible to provide some commonly recognized definitions and to highlight distinctions in how common terms are used.

As identified in Prince (2004) active learning requires students to undertake meaningful learning activities and think about what they are doing, which engages students in the learning process (Felder et al., 2009). Often, active learning is contrasted to the passivity of students in traditional lectures.

Another definition is the one of collaborative learning. Consensually, collaborative learning refers to any method in which students work together in small groups headed for a common goal. As Kaufman et al. (1997) discuss, collaborative learning is a spectrum of techniques that involve small transient groups of students for immediate in-class discussion. At the other end of the spectrum is cooperative learning, which is characterized by carefully planned learning strategy with groups to whom have been assigned an academic goal. Despite the fact that some authors distinguish collaborative and cooperative learning as having different past developments, in either interpretation the central element is the emphasis on student interactions rather than on learning as a solitary activity. So, it is possible to assume the perspective of Panitz (1997) and Prince (2004) that collaborative learning comprises cooperative learning, as in either interpretation the core element is grounded upon consensus building through cooperation by all members of the group. Or, since the outcomes of cooperative learning are strongly dependent on exhaustive planning and organization, cooperative learning can be accepted as the most operationally structured form of collaborative learning (Kaufman et al., 1997). In short, as the core elements of active learning are student activity and engagement in the learning process, the core element of collaborative learning is the emphasis on student interactions rather than on learning as a solitary activity.

Despite the empirical support for active learning being extensive, not all of it is compelling. In fact, while several authors (e.g. Bonwell and Eison, 1991) conclude that collaborative learning improves students' thinking and writing, leads to better student attitudes, motivates students for further learning (Grau and Whitebread, 2012), fosters students' development as co-learners (Volet et al., 2009), and develops thinking skills; others (e.g. McKeachie, 1972) suggest that the improvement of active learning over lectures seems to be small. But, as Prince (2004) underlines, the variety of methods labeled as active learning muddles the question. Still, some global conclusions arise. First, those simple, periodically placed, procedures during classes provide a baseline to improve the effectiveness of lectures, as it has to do with student attention span. However, merely introducing an activity in the class may fail to capture students' attention if the activities are not designed around significant learning outcomes. So, second, it is central to promoting selfless engagement of the student.

Finally, the work of Prince (2004), offers the statement that collaboration not only enhances student attitudes, academic achievement and student retention, but also provides a natural environment favorable to enhancing interpersonal skills. Most of the studies of learning in groups emphasize the individual benefits of collaborative learning. But, if collaborative learning groups are important interactive learning environments that encourage each student in interpersonal interaction and enable him or her to share information, to explore meanings and to understand curricular knowledge, other points of view can be seen. In the work of authors like Stahl et al. (2006) or Curseu and Sari (2013), by contrast, learning is also analyzed as a group process. In fact, as groups are socio-cognitive structures and in collaborative learning scenarios they co-construct meanings about instructional concepts, it seems essential to give attention to the group-level benefits of collaborative learning. The richness that emerges at a group-level phenomenon, derives either from groups' construction of collective knowledge structures, or from the possibility that these representations have to generate specific outcomes (Curşeu and Sari, 2013).

Conversely, those same collective cognitive structures in groups are driven either by group cognitive exploration or by group socio-affective climate. A good indicator of collaborative learning effectiveness at the group level of analysis is the integration of individual specialized task knowledge through interpersonal interactions. Particularly interesting are the power differences in social interactions. Curseu and Sari (2013) state that power differences are likely to influence both the socio-affective activity as well as cognitive. So inequality in power is an important aspect of group configurations. On the one hand, power inequality has a positive impact on group cognitive complexity through the emergence of task conflicts and group learning behaviors. On the other hand, power inequality reduces trust and psychological safety among the team members, which negatively impact upon group cognitive complexity.

In a similar vein, the studies of Curseu and Sari (2013) show that for low gender diversity, power disparity has a negative effect on group cognitive complexity; while for high gender diversity, power disparity has a small positive effect. Moreover, in heterogeneous groups with respect to gender, the association between power disparity and satisfaction is not significant, while for gender homogeneous groups' power disparity has a negative association with satisfaction. In other words, groups with high power disparity can achieve a high level of group cognitive complexity only if they are mixed-gender groups.

As mentioned, studies on the effects of collaborative learning provide evidence of a positive impact on academic achievement. However, research also suggests that collaborative learning and individual learning are not mutually exclusive; rather, they shall complement each other. So, maybe, and even more true in the 21st century than in the past, there is no single best way of teaching (Schleicher, 2012).

Closely related to the notion of collaboration is the notion of promoting active and collaborative practices by fostering the change of a traditional teaching system to adopt and incorporate ICT in the teaching and learning process. But such a simple idea, the interaction of learning with technology, has brought into question fundamental assumptions about understanding the actions and activities mediated by technologies, about knowing in which arenas and to what extent those act as obstacles or facilitators, or ponder over the risks in using technologies in teaching and learning in HEIs (Vajargah et al., 2010).

These issues were also raised by Stahl et al. (2006) and Ludvigsen and Morch (2007) who argue that not only do the development of technologies make the creation of new forms of socialization and new definitions of individual and collective identities possible, but also that the theoretical rationale for a technological and pedagogical collaborative learning environment, emerged in response to skills linked to a knowledge-based society. So, in order to understand learning in active and collaborative environments, researchers should pay attention to cognitions and, also, to communication technologies (CT).

SUPPORT ON INFORMATION AND COMMUNICATION TECHNOLOGIES

The Role of Technology

As already stated, IT has been more and more considered a strategic resource in educational settings, offering educational institutions an irreplaceable opportunity to enhance learning outcomes and increase student motivation (Blasco-Arcas et al., 2013). However much technology transforms data from a variety of sources into meaningful information, students play the central role in the learning process. The role of technology is to support the learning process in the best possible way, letting the learner to be active and responsible for the process. In this context, the role of technology is to support the learning process, not the key in itself (Sirkemaa et al., 2007). The paradigm of what the impact of technology has been in this context is an ongoing debate about whether it is the design of the instruction or the use of a particular delivery technology that improves learning. Even if it has long been accepted that technologies can provide efficient and timely access to learning materials, more than a few authors (e.g. Ally, 2004; Lehtinen, 2003; Sirkemaa et al., 2007) claim that technologies do not themselves influence student achievement, but are merely vehicles that deliver instruction. In fact, the work of Ally (2004) makes a broader literature revision which suggests that learning is influenced more by the content and instructional strategy than by the technology used to deliver instruction.

So, as more and more HEIs are integrating technologies into their learning systems to support the learning process, it is increasingly necessary to have a comprehensive understanding of the underlying mechanisms of using technologies to support the learning process and their consequences on student learning performance. Wild and Quinn (1998) describe the IT purposes as a way to improve students’ performance by the intelligent application of technology and hopes that this will intensify the efficiency and effectiveness of the learning process. Particularly, the literature advises (e.g. Williams, 2002) that it is important not to get carried away with the capabilities of the technology, and to keep information clear.

Sirkemaa et al. (2007) echoed that the role of information technology (IT) in education is characterized by: (i) the use of student-centered technology enabling students to use it not only to access information content but in various activities; (ii) the realism to replicate real life learning situations; (iii) acting as a tool that mediates in learning and (iv) providing learning environments compatible with knowledge of the twenty-first century, expecting to motivate and engage learners in active knowledge construction. The benefits and opportunities offered by a careful thought to the design and implementation of technological learning environments are plentiful.

Williams (2002) recommends an approach that takes into consideration pedagogy, participation and access. Pedagogy, since transformation and redesigning of courses for the technological environment is central in order to ensure that the advantages of learning are fully exploited. It should then be possible to work through the content incorporating tasks and activities, promoting students' activity in constructing their own learning experience. As Lehtinen (2003) claims, the effects of communication technologies (CT) depend, above all, on the pedagogical implementation of technology, making the pedagogical approaches more important, generally, than the applied technology. That is why a noteworthy role on the development of different theoretical approaches on learning is taking place. The growing body of literature on computer supported collaborative research has been very rich either in terms of methodological approaches or in terms of theory development. But, as Lehtinen (2003) highlights, collaborative use of technical tools in learning environments must be characterized as a deeper change of theoretical and methodological thinking, rather than as a gradual extension of the tradition of learning environment research. In particular technological environments (for example, online forums), lack of participation can happen. Among the greatest strengths of technology is the possibility it brings to mediate and encourage reflection by providing communication links between learners. The importance of CT comes from the fact that these add value to the processes of learning and to the learning institutions (Tasir et al., 2012). In learning, the tools should not be the issue, and as claimed by several researchers (Sirkemaa et al., 2007) the potential of technology lies in the interactions between teachers, students and fellow students.

Finally, the question of access needs to be considered concerning computing facilities and availability. As is commonly known, technological developments in CT are very rapid and quickly become obsolete, requiring new skills to be mastered frequently.

Increasingly, IT has changed the roles of teachers and students: as students are expected to be active learners, teachers are acting more and more as facilitators and tutors. It means that as students' process information that came from a variety of sources into meaningful structures, teachers orientate the formers in the learning process, instead of lecturing, As a consequence, managing technology is a challenge for teachers and students: not only because both should have skills and knowledge in IT, but also because there are different stages in the process. It is required to use different technological devices, or deal with IT related issues at all of these stages, from planning, preparing material and teaching, to feedback and evaluation. As a result, the process of learning with IT and CT may become overwhelming and so pedagogical support should therefore be available both for teachers and for students (Sirkemaa et al., 2007). In particular, the problem of transforming HEIs' teaching force into technology-literate and skilled workers, as reported by the Division of Higher Education of UNESCO (2002), vary markedly between countries, namely on how educational systems cope with change. The importance of a teacher's competency, a teacher's confidence level, and a teacher's satisfaction toward using IT proves to be correlated: a high competency level in using IT derives when teachers know how to use and integrate technological tools in the teaching and learning process. Moreover, a high confidence level in using IT and CT comes when teachers trust themselves in the use of technology. In terms of satisfaction, studies found that highly satisfied teachers are teachers with high levels of competence and confidence (Tasir et al., 2012).

A central foundation for improving teaching is an understanding of learning. Most interesting is that teachers' beliefs about their teaching practice are extraordinarily steady across countries: teachers recognized a constructivist view of teaching, which emphases students as active participants in the process of learning, more intensely than they embraced a belief in the direct transmission of knowledge. Namely, the widespread use of CT and the breakneck speed at which these technologies are evolving are changing the nature of learning for the 21st century (Schleicher, 2012).

As noted previously, by stimulating the learning environment, students can reach higher levels of understanding. But, at the level of the individual learner, the predetermined preferences and the predisposition for learning also play a fundamental role in the process. Broadly speaking, the theory underpinning learning styles recommends that different approaches shall be used and that different IT and CT will be needed to support those. Wild and Quinn (1998), for instance, reflect on the idea that it is important to provide different paths through different technological experiences that support different styles of learning.

Another important aspect is the opportunity that IT and CT offer to students with special educational needs, in accessing information and participation. There are numerous studies, that the work of Ribeiro and Fuentes (2013) enumerate, that repeatedly demonstrate that the use of CT are assumed as important tools and specialized educational strategies at the service of teachers and students to promote the acquisition of skills, overcome barriers, and support academic, cultural and social inclusion. Particularly important are the suggestions, proposed by those very same authors, that categorized key CT solutions by type of disability.

Towards E-Learning

In exploring the relationship between technology and higher education, we shall first consider the ways in which the digital arena reconfigures the nature and form of educational institutions (Jimoyiannis, 2012). One possible application of CT is the e-learning context that is already changing the teaching and learning process.

Broadly and functionally speaking, e-learning includes a wide variety of learning strategies and IT and CT applications for gaining knowledge and exchanging information. In short, e-learning includes all forms of educational technology. As Sirkemaa et al. (2007) say, e-learning refers to learning, which takes advantage of IT and networking. Typically, in HEIs and within an e-learning context, part of the learning material is accessible with a computer and so part of the teaching and tutoring work is similar to traditional methods. It is also possible that some courses may be fully online ones, where educational materials and tutoring are based entirely on computers and networks communications, and where there is no face-to-face contact among students and teachers. The e-learning context of HEI systems are developed to support, enable and empower the information construction in the learning process. Take, for instance, systems like Moodle or WebCT, which are examples of platforms specifically developed for learning purposes. HEIs have found much to like in the web as an instructional tool: a remarkable source of information (although students must bring a lot of their critical thinking skills in evaluating the credibility of what they find when searching the web); an outstanding instrument for interpersonal communication; a supplement to conventional lecture courses; an add-on to virtual courses; or an opportunity to significantly change the partnerships with publishers (with publishers assuming the role of course master by creating web based materials and learning activities to supplement the course text) (Albright, 1999).

The literature offers some guidance for creating a successful learning environment. For illustration, one can see the work of Sife et al. (2007), which discusses different learning technologies and challenges for integrating these in HEIs. In an e-learning environment, students and teachers are supposed to be technically skilled, at least as much as they can deal with technology in an increasingly complex environment. As already mentioned, it is not intended that technology may be an obstacle for learning. So, clearly, information on how to use technology is needed in order to succeed in the e-learning context (Sirkemaa et al., 2007).

There are many reasons that have driven HEIs to adopt e-learning: greater information access, greater communication via electronic services, synchronous and asynchronous learning, enlarged collaboration, cost-effectiveness related to reach a great number of students, or pedagogic improvement (Sife et al., 2007). At the same time HEIs shows a great deal of interest in internet based technologies, and in the possibilities that they offer for learning and teaching, the first and most important issue to consider is that of pedagogy. In fact, as Williams (2002) reinforces, using IT or, more specifically, e-learning, does not automatically improve courses. Quite the contrary, it is necessary to redesign them with reference to pedagogical theories. Even if it feels tempting just to use the web to simply make lecture notes available, the literature reports that the redesigning of a course can provide a good chance to review the curriculum, to reassess the learning outcomes, to incorporate tasks and activities in order to develop and test relevant knowledge and skills, or to construct a more interactive and positive learning experience.

Williams (2002) clearly states that using e-learning and web-based courses can make learning processes more evident and explicit to students. And he goes on, explaining that while the use of hyperlinks embedded in course material helps to identify relational and abstract concepts (that are needed to contextualize information and encourages learning outcomes), the support of a non-linear structure of a web-based course enables connections to be made between readings, concepts or tasks. In his work, Williams (2002) also proposes that online courses can be structured in such a way as to provide some kind of a frame to embolden students in learning how to learn.

Taking e-learning, IT and CT as umbrella terms used to describe systems that enable active communication, it is possible to include synchronous (in real time) and asynchronous (delayed) communications. Maybe one of the most significant advantages of CT is that it can enable collaborative learning and, thus, requires students to be active and interactive. If we accept that students learn successfully through understanding other points of view and articulating their own, or through debate and discussion, and if we accept that collaborative learning methods tend to encourage deeper understanding and greater skill development by their ability to engage students dynamically in the learning process, then it is possible to understand the potential of e-learning contexts (Williams, 2002).

Implementing Technologies

Technologies have opened the doors to a vast array of new learning opportunities for students, which are much more personal and individualized. As the literature recognizes (e.g. Albright, 1999) IT and CT strongly promote active learning, collaboration, mastery of course material, and student control over the learning process. But other functions that go beyond the ones from conventional teaching can be found (Albright, 1999). Interactive multimedia, as

Wild and Quinn (1998) distinguish, provides a powerful tool for both learners and teachers and the opportunity to go back over the design of learning contexts. In fact, it is becoming increasingly necessary to have a thorough understanding of the underlying mechanisms of technologies and their consequences on student learning performance, as more and more educational institutions are integrating new technologies into their learning systems to support the learning process (Blasco-Arcas et al., 2013).

Perhaps most crucially, the way in which technologies are implemented needs to be considered carefully. The literature provides several examples in several different contexts and the results of empirical studies on achievements related to the use of IT in education are well underlined in the literature (e.g. Pinto et al., 2013; Vajargah et al., 2010). Ally (2004) warns that it should be recognized that preparing and implementing technology-based courses for online delivery is a huge task, and proposes a model that shows important learning components that should be used when designing online materials. It is just not good enough to place information on the web or to link to other digital sources. Implementing technologies is successful only when learners go through the sequence of instruction, to complete the learning activities, and to achieve predetermined learning outcomes and objectives. Moreover, implementing technologies is successful when a variety of learning activities are used to accommodate different learning styles and learners are able to choose the appropriate strategy to meet their learning needs (Ally, 2004).

Different theoretical approaches are proposed in the literature: behaviorist (to teach the facts), cognitivist (to teach the principles and processes), and constructivist (to teach the real-life and personal applications) theories have contributed in different ways to the design of online materials. Ally (2004) warns that online materials and their implementation should be considered in small coherent segments and designed for different learners, for different contexts and progressively assorted to respond to different learning cultures, styles, and motivations.

The discussion made in the literature (e.g. Williams, 2002) for designing and implementing successful e-learning environments is taking place, namely in relation to pedagogy, to the problem of a lack of participation in online discussions, to the access and availability, to the nature of student support and to the necessary staff development. Some recommendations are considered and several suggestions are made. Broadly, three main issues are identified. First, the way in which pedagogy is related with the design and implementation of e-learning contexts needs attention: in order to take advantage of the pedagogic benefits offered by technology contexts, the potential to encourage both relational, abstract and conceptual learning outcomes, as well as the possibilities for collaborative learning activities need to be redesigned to be interactive, and online tasks should be incorporated in the process. Second, the problem of participation should be addressed and recommendations are suggested for encouraging involvement. Mainly in terms of whether or not participation should be an essential part of the e-learning environment. As a principal advantage of doing so, studies concluded that students' involvement in the group discussion is guaranteed, with the benefits that such collaborative learning implies. But, on the other side, as literature shows evidence that students usually feel nervous when exposing their thoughts to a written medium, pedagogic approaches that recognize this are needed. In short, the nature of the student support needs to be adapted in order to enable full participation. Finally, the nature of the support required by students and staff leads us to the third issue, which is access. Indeed, if technological facilities are a necessary part of the context, the issue of access must be considered, especially if online participation is compulsory.

Another interesting point is that the question of access, and the practice of participation, which is entwined with pedagogy: on one level, people must learn how to use technology itself, and on another, they also need to learn how to learn, and to teach, with this new technology. Despite these warnings, the right training and support within e-learning environments, together with a thoughtful planning and careful implementation of technological contexts, can improve the learning experience and thus it is consensual that technology does offer exciting opportunities for new ways of learning and teaching (e.g. Blasco-Arcas et al., 2013; Morais et al., 2011; Sirkemaa et al., 2007). Even so, and as Williams (2002) advises, further research is needed in the area of learning and teaching in e-learning environments supported by technology. In conclusion, a careful consideration of the recommendations made in the literature can help to produce effective and motivating technological learning environments.

In any case, the amount of work and time needed to prepare and run an e-learning environment should not be underestimated.

Given the nature of the complex relations within an e-learning environment, the ways of using technology, and student learning and engagement, it is important that the learning environment can adapt to different learners and different learning styles. The literature revision presented here supports the idea, previously explored by authors such as Sirkemaa et al. (2007) and Morais et al. (2011), that the successfulness of adaptation depends on both the developers of the system, system designers, programmers, teachers who provide the content and the pedagogy, and learners who more and more will become better users to work with e-learning environments and technology.

Even though various advantages of online learning are reported, disadvantages and limitations also exist for the implementation and use of technology in schools. Nor et al. (2012) spoke of the sometimes unsatisfactory Internet services, a situation that can make it difficult to implement bandwidth-intensive technologies. In addition to the technological limitations, the social paradigm of online learners, mainly of those enrolled in full-time online contexts, may feel isolated from the other students and the lecturer and express lack of verbal communication and difficulties in working with others. Another issue cited is the delay in completing assignments that can result from lack of personal motivation, which, in turn, derives either from isolation or from difficulty. Despite the challenges and limitations, the advantages of online learning cannot be denied.

Discussion Forums

Online discussion forums are an increasingly common use of CT in education. Nor et al. (2012) state that online discussion forums are probably one of the oldest and most accessible modes of asynchronous communication on the web, used to connect people globally in one virtual space. The shared conception of the online discussion forum is that it is a virtual learning environment in which students are likely to learn as much from course materials or lectures as from one another (Judd et al., 2010).

From this point of view, by reflecting on peers' contributions in online discussions and articulating emergent understanding, students engage in higher-order processing of information and are led towards the construction of personal meaning which is not individualistic, but rather a product of the students' interaction and collaboration. This interpretation stresses that having their ideas criticized or expanded on, and being able to reshape them in light of the peer discussions, student learning can be seen as a creative cognitive process of offering up ideas (Pinheiro and Simões, 2012).

The literature revision of Nor et al. (2012) lists some authors for whom the very same asynchronous nature of online forums gives the opportunity to learners who do not usually participate in class, to contribute. Similarly, the same authors suggest that online forums are less stressful for learners (as there is little pressure for immediate responses) and encourage dialogue, which in turn stimulates critical thinking and collaborative learning. Also, the findings of Judd et al. (2010) bring up to some studies that point in the same direction: forums increase participation and collaborative thinking through the provision of asynchronous, nonhierarchical and shared communication environments. In addition, once forums provide opportunities for students to interact with other students and lecturers outside the traditional class, online forum platforms are used extensively to complement conventional learning and teaching methods. So, a forum gives shy learners the opportunity to interact and to engage in an environment in which they are not pressured to perform or to participate actively.

Among the desirable outcomes, the work of Nor et al. (2012) highlights six main issues. First, it seems that participation in an online discussion enhances not only the quality of social interaction among students and between teachers and students, but also adds value to individual learning results. Second, by allowing students to type their ideas online, the forum indirectly helps make thinking visible. Third, the forum context emphasizes students' active engagement in learning and in sharing information and perspectives through their interactions with others. Fourth, a forum provides a common ground for students to share knowledge that is subsequently applied to constructive and reflective thinking. Fifth, forums provide the opportunity for students to put theory into practice as online discussions usually evolve into a forum for free thoughts of exchange around the topic under discussion. Finally, unlike the classroom scenario in which the teacher's presence is usually dominant, online discussions promote higher rates of peer interaction with minimal teacher intervention.

Learners' participation in online learning environments has been discussed widely and conceptualized differently. As Yukselturk (2010) states, online learning participation is a complex process that comprises communicating, doing, thinking, belonging and feeling. In particular, the author states that both quantity and quality of interaction with peers and the tutor are much more decisive to the success and satisfaction of the learners than in traditional contexts. Moreover, Yukselturk highlights the relationship between grades and level of engagement in the e-learning contexts: students achieving low passing grades were more active than students who failed and also students achieving high or medium passing grades engaged more actively than students achieving low passing grades, even though greater online interaction did not lead to significantly higher performance.

Still, in the analysis of the degree of participation in e-learning environments, it seems that females send more messages to the discussions and are more dependent on their computer skills. Also, students who are proficient in comprehensive reading send more messages. Similarly, popularity among classmates influences the degree of participation.

Another very interesting point is the interest in factors affecting the participation in online asynchronous discussions. The literature review of Yukselturk (2010) also explores the theme. It seems that there are some factors that influence learner participation: online learner participation is influenced by technology and interface characteristics, attributes of the asynchronous online discussion, content area experience, prior knowledge of computer mediated communication, the role of the facilitator, the students' roles, instructional tasks, the design of discussion activities and feedback. The work of Yukselturk also mentions that even that it seems that highly interactive students are generally younger, male and had higher educational qualifications. The two strongest predictors of participation are: living in an urban area and holding a university degree. Yet, Yukselfurk advises that the planning of instructional activities in discussion forums, as well as students' workload and responsibilities, should be taken into account in designing online discussions.

Wikis

Previous research has been done on student collaboration using wikis (Judd et al., 2010; Pinheiro and Simões, 2012). Usually promoted as collaborative writing tools, wikis are gaining in attractiveness in educational settings.

Although wikis include features that are designed to facilitate collaboration, some studies (e.g. Judd et al., 2010) report that the use of wikis do not necessarily ensure or even encourage collaborative learning behavior. In fact, the studies of Judd et al. (2010) show evidence that not only do students make little use of the wiki's commenting feature but also that the majority of students' contributions are made late in the activity, which makes the possibility of extensive collaboration unlikely.

METHODOLOGY

Considering the theoretical background described above, the plan of the curricular unit of the CRM systems was designed. This is a curricular unit of the 3rd year on marketing degree of Aveiro University. This curricular unit was planned to have the maximum student participation, to increase the capacity of reasoning thereof and in addition, to enhance learning in depth. To this end, the syllabus was designed to engage in different methodologies oriented to each objective / learning outcome set.

To meet these requirements, students are organized into groups, according to some specific guidelines. In particular, the groups should consist of 2-4 students, with homogeneous characteristics: similar grades (average) in a specific set of curricular units of the course, compatibility of time to work in groups, and the same system of registration. This information was previously obtained and identified through a simple questionnaire, available in e-learning IES (VLE) platform (Moodle).

In the development of group activities, one student member of the group assumes the role of coordinator. Besides fulfilling its tasks as a group member, the coordinator also has the responsibility of ensuring compliance with a set of work rules, to review all the documents produced, ensuring their consistency, and to promote cooperation and mutual assistance among all members. At the end of each activity, each student self-assesses and evaluates the performance of each one of his colleagues, using a questionnaire, also available via the e-learning platform (Moodle). In the enunciation of each activity the expected learning outcomes are presented.

All classes and group activities are supported on cross-sectional information and communication technologies, including email, themed discussion forums or social networks. The feature, especially discussion forums aimed to foster the sharing of ideas or questions within the group or with the teacher in a more effective way. Thus, each could contribute to and benefit from their learning of shared knowledge, thus increasing the overall level of learning and training. In the development of these two assessment activities based on working groups, different teaching and learning methodologies were used, both supported by collaborative tools.

The first group activity “(1) Preparing and teaching a class” focused on preparing and teaching a class on a topic of the syllabus. Each group addressed a different topic. However, on each topic, two groups had different tasks and functions. One prepared and presented the lesson supported on some type of presentation tool, another prepared a summary of the contents supported on text processing tool and some questions and their answers to discuss in class with all colleagues.

The second group activity “(2) Simulation, reporting and presentation of a business environment (based on a collaborative application - Vtiger CRM)” involved simulation, reporting and presentation of a business environment based on a collaborative application (Vtiger CRM) specifically geared to the acquisition of skills in a practical nature, in scope of the syllabus of the course. Each group member could, according the planning of tasks between the groups, contribute with their knowledge to the final product. The final product is expected to be so much richer, but essentially it is the result of a truly collaborative and cooperative work. In the end, the groups of students present their business in the classroom and deliver a portfolio describing the most relevant topics of the experience. Both activities are developed in order to streamline the cooperative ability of students.

The questionnaires for self-assessment and peer-assessment of the group activities by the students were anonymous. In the treatment and data analysis, techniques of descriptive statistics were used.

Data collection took place in the academic years 2011/2012 and 2012/2013. The sample consisted of all students enrolled in the CRM systems curricular unit of the Degree in Marketing in Institute of Accounting and Administration of Aveiro University (UA).

RESULTS AND DISCUSSION

This study reports on a total of 28 students in the academic year 2011/2012 and 47 students in the academic year 2012/2013, all enrolled in the curricular unit. Following the methodology previously defined, 9 groups were established in the academic year 2011/2012 and 16 groups in the academic year 2012/2013 (see Figure 1).

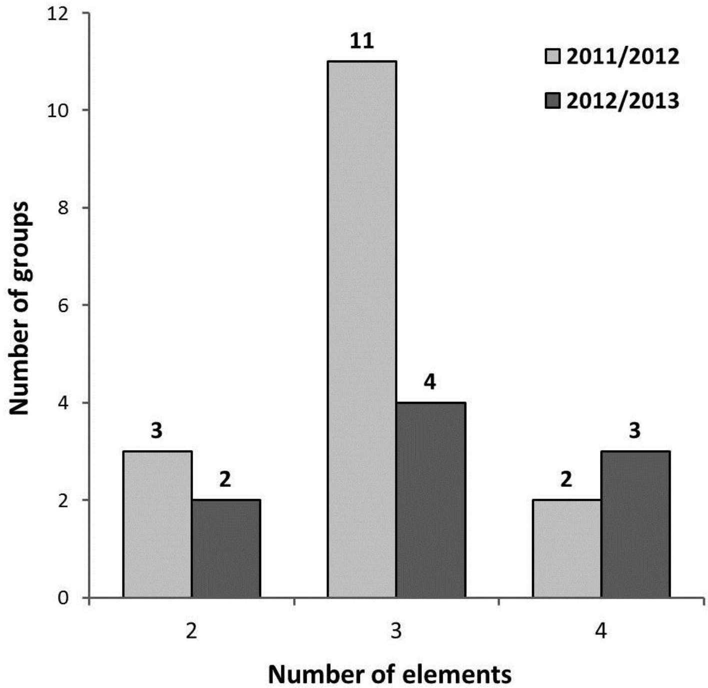


Figure 1. Distribution of students by groups.

With regard to group activities, the response rate by the students to the questionnaires for self- and peer-assessment of their performance, there was a decrease between the two academic years (see Table 1).

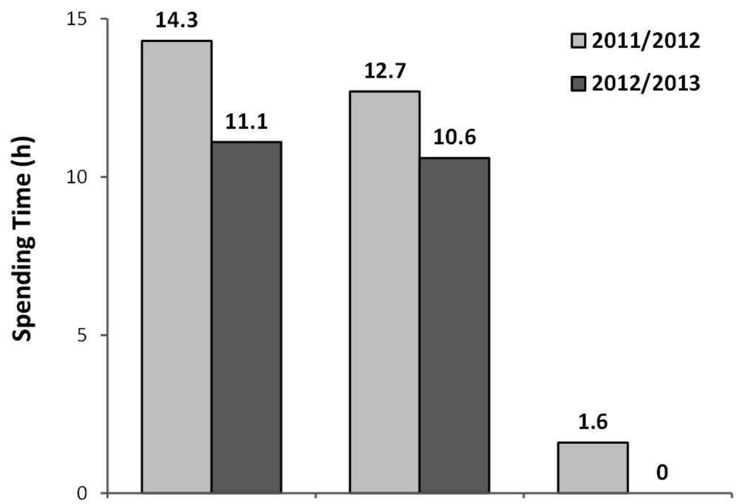
Table 1. Self-assessment (average) about performance on group activities

Academic Year	Number of students enrolled	Frequency of student respondents	
		Activity 1	Activity 2
2011/2012	28	27 (96%)	23 (82%)
2012/2013	47	28 (60%)	29 (62%)

In the first activity "(1) Preparing and teaching a class", the ratio was of roughly two thirds. In the second activity "(2) Simulation, reporting and presentation of a business environment", the difference was smaller than in the activity 1, reaching a ratio of three quarters.

Spending Time in Performing the Activities

Concerning spending of time by the students in performance of the tasks to achieve the outcome results, in group activity 1 (figure 2), and on average, the spending time (hours) indicated by the various groups was not significantly divergent between the two academic years. Still, the results show a slight decrease of spending time in the activity in year 2012/ 2013, either by coordinator member of each group or in relation to all the group members. Nevertheless, on average, the groups tend to exhibit a positive deviation between the average spending time by the coordinators and by the other members of the groups, respectively.

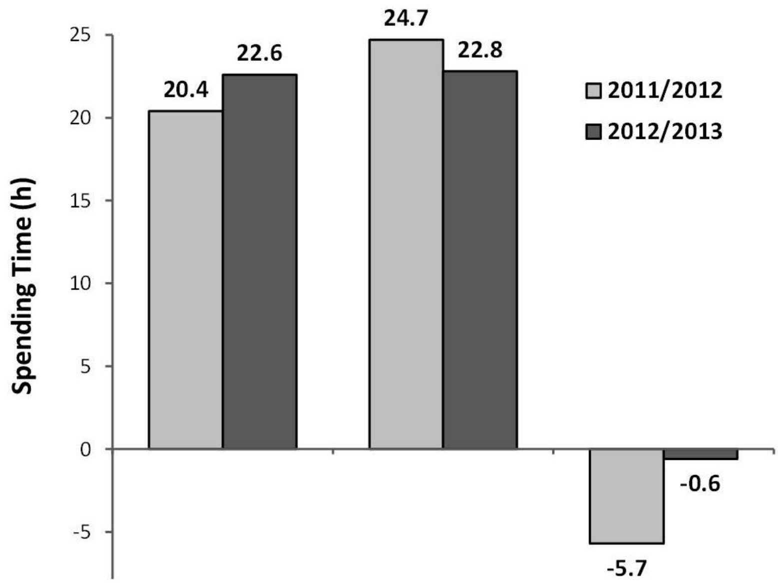


	Coordinators	Groups	Coordinators - Groups
2011/2012	14.3	12.7	1.6
2012/2013	11.1	10.6	0.0

Figure 2. Spending time (average) in activity (1) preparing and teaching a class.

The result shown in figure 2 seems to demonstrate that the student coordinator played its role responsibly, while there is scope to add that given the negligible difference, the groups worked with a very fair effort among its members.

Regarding group activity 2, students' responses seem to indicate that the environment of interaction and collaboration was similar to the activity 1 (figure 3). Here too, the average spending time as indicated by the various groups was similar in the two academic years. A slight increase in the spending time in the activity by coordinator member of each group in the year 2012/2013 compared with the previous academic year, but a slight decrease in the time spent in the activity with respect to all the members of the groups to the same order time. However, contrary to what was found in the results about activity 1, on average, the groups tend to exhibit a negative deviation from the average spending time by the coordinators and by the other members of the groups, respectively.



	Coordinators	Groups	Coordinators - Groups
2011/2012	20.4	24.7	- 5.7
2012/2013	22.6	22.8	- 0.6

Figure 3. Spending time (average) in activity (2) simulation, reporting and presentation of a business environment.

The result shown in figure 3 leads us to conclude that due to this activity, based on principles of need and committed involvement of interaction between the various members of the groups, this attitude was actively developed by students. Remembering that this activity was based on the trial management software, available via browser, allowing the simulation of a business environment in which students were key parts of it for your success.

Thus the results are justified by demonstrating, by the students, not the clear distinction of roles formally assumed. Nevertheless, it is important to note that the complexity of activity 2 justifies the need for more time to complete the mission, as indicated by students, compared to activity 1.

Assessment of Performance in Activities

In regard to performance of the students on execution of the tasks proposed in the group activities, and using a scale of 1 to 5, on average, the groups self-assessed with a level equal to or greater than 4 (good or very good). However, there was no significant difference in the results between coordinators and other members of the groups, nor between academic years (table 2).

Table 2. Final grades (average) of students in assessment components

Academic Year	Activity 1		Activity 2	
	Coordinators	Groups	Coordinators	Groups
2011/2012	4.3	4.4	4.4	4.3
2012/2013	4.3	4.1	4.4	4.2

Thus, we can conclude with some confidence that the activities involved the students actively and collaboratively in the teaching and learning process.

Global Learning Assessment

The final grade of each student was calculated based on two types of components: written test (2 components) (60%) and group activities (2 components) (40%). In the end, 28 and 47 students, respectively, enrolled in the academic years 2011/2012 and 2012/2013 and assessed by this teaching and learning and assessment methodology, mostly passed the curricular unit (table 3).

Overall, in both components the results were generally positive.

Table 3. Frequency of students who answered the questionnaires

Academic Year	Assessment Component	
	Written tests	Group activities
2011/2012	14.4	14.6
2012/2013	10.5	14.1

However, in the academic year 2012/2013, a proportionately lower result was found in the written and individual component relative to the activity group component.

In our view, the results support evidence that collaborative teaching and learning environments lead students to a more active involvement in the process, and suggest that, in this way, better academic outcomes can be achieved.

Other Considerations

As observed, the relative frequency of respondents to the questionnaires was significantly lower in year 2012/2013 (around 60%) over the previous year (over 80%). This, we think is justified, in part, by increased sample size in the most recent year (47 students), in contrast to the previous year (28 students). With a group of students significantly larger in enrollment and the consequence of which had to be arranged in two classes, with classes running at different times and by different teachers, it becomes harder to appeal to the receptivity of students to answer to the questionnaires.

However, given the analysis of the results, the previously report does not appear to compromise the results and arising conclusions.

It also highlights the fact that these students represent very heterogeneous profiles, mixing different age groups (20 to 50 years) and different time availability (roughly half indicated attend the course under a student-employee registration system). Moreover, as this is a curricular unit of the last semester of the course, most students held, at the same time, their internship programs in companies with cooperation agreements with the university.

Despite the heterogeneity and limitations mentioned in the preceding paragraph, the students were receptive and motivated in the performance of various proposed activities, supported by different teaching and learning methodologies.

Another important conclusion is the perspective of the role of collaborative tools on the level of the workgroups: less pragmatic tasks are probably more readily prepared by the groups, while those more practical, not only require more time, but more importantly, require discussion within the group.

Conclusion

Students have different attitudes about the teaching and learning process, different levels of motivation and different responses to the environment and academic practices that are submitted. This study already allows us to give some ideas for discussion.

Notably, and in line with Judd et al. (2010) or Yukselturk (2010), the collaborative nature of learning seems to lead the student to greater participation and more active presence during the process.

Another idea that arises is that students seem to identify the need to regulate their own learning; a paradigm already proposed by authors such as Pinto and colleagues (2013).

Finally, another aspect deserves our reflection: using elements similar to those that are perceived by students as part of their future professional activity, which leads them to positions of greater commitment to learning.

References

Albright, M. J. (1999) Teaching in the information age: a new look. *New Directions for Teaching and Learning.* 1999: pp. 91-98.

Ally, M. (2004). Foundations of educational theory for online learning. In: T. Anderson and F. Elloumi (Eds.), *Theory and practice of online learning*, Athabasca University Press, Athabasca, Canada. pp. 3-31.

Anderson, J. and Weert, T. (2002). *Information and communication technology in education*. Paris: UNESCO.

Blasco-Arcas, L., Buil, I., Hernández-Ortega, B., and Sese, F. J. (2013). Using clickers in class. The role of interactivity, active collaborative learning and engagement in learning performance. *Computers and Education*. *62,* 102-110.

Bonwell, C. C. and Eison, J. A. (1991). Active learning: creating excitement in the classroom. *ASHEERIC Higher Education* (Vol. 1). Washington DC: George Washington University.

Clifford, V. and Montgomery, C. (2014). Challenging conceptions of western higher education and promoting graduates as global citizens. *Higher Education Quarterly*. *68*, 28-45.

Curşeu, P. L. and Sari, K. (2013). The effects of gender variety and power disparity on group cognitive complexity in collaborative learning groups. *Interactive Learning Environments*. *38,* 1-12.

Felder, R. M., Brent, R. and Carolina, N. (2009). Active learning: an introduction. *Active Learning*. *2,* 1-5.

Fyrenius, A., Wirell, S. and Silén, C. (2007). Student approaches to achieve understanding - approaches to learning revisited. *Studies in Higher Education*. *32*, 149-165.

Grau, V. and Whitebread, D. (2012). Self and social regulation of learning during collaborative activities in the classroom: The interplay of individual and group cognition. *Learning and Instruction*. *22*, 401-412.

Jimoyiannis, A. (Ed.) (2012). *Research on e-learning and ICT in education*. Springer eBooks.

Judd, T., Kennedy, G. and Cropper, S. (2010) Using wikis for collaborative learning: assessing collaboration through contribution. *Australian Journal of Educational Technology*. *23,* 341-354.

Kaufman, D., Sutow, E. and Dunn, K. (1997). Three approaches to cooperative learning in higher education. *The Canadian Journal of Higher Education*. XXVII: 37-66.

Lehtinen, E. (2003). Computer-supported collaborative learning: an approach to powerful learning environments. In: E. de Corte, L. Verschaffel, N. Entwistle, and Merrieboer (Eds.), *Powerful learning environments: unraveling basic components and dimensions,* Pergamon, Oxford, UK. pp. 35-51.

Ludvigsen, S. and Morch, A. (2007). Computer-supported collaborative learning: pedagogical and technological scaffolding. In: *International Encyclopedia of Education* (3rd Edition) (Vol. Learning a). Elsevier.

McKeachie, W. (1972). Research on college teaching. *Educational Perspectives*. 11, 3-10.

Morais, N., Batista, J. and Ramos, F. (2011). Caracterização das actividades de aprendizagem promovidas através das Tecnologias da Comunicação no Ensino Superior Público Português. *Indagatio Didactica*, *3*, 7-18.

Nor, N. F. M., Hamat, A. and Embi, M. A. (2012). Patterns of discourse in online interaction: seeking evidence of the collaborative learning process. *Computer Assisted Language Learning*. *25,* 237-256.

Panitz, T. (1997). Collaborative versus cooperative learning: a comparison of the two concepts, which will help us to understand the underlying nature of interactive learning. *Cooperative Learning and College Teaching. 8*, 3-13.

Pinheiro, M. M., Sarrico, C. S. and Santiago, A. R. (2011). Effects on the students' personal competencies of the usage of PBL methodologies in professional reality simulation environments: students, teachers, graduates and employers´ perceptions. *International Science and Technology Conference (ISTEC2011),* pp. 290-296, Istanbul University, Istanbul, Turkey.

Pinheiro, M. M. and Simões, D. (2012). Constructing knowledge: an experience of active and collaborative learning in ICT classrooms. *The Turkish Online Journal of Educational Technology*. *11*, 382-389.

Pinheiro, M. M. and Simões, D. (2013). Collaborative eLearning methodologies: an experience of active knowledge in ICT classrooms. *The 7th International Conference on Virtual Learning ICVL.*

Pinto, M., Nogueira, F., Coelho, D., Balula, A., and Moreira, A. (2013). Tracing the use of communication technologies in Portuguese higher education towards teachers' professional development. *Indagatio Didactica*. *5*, 75-95.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*. 93, 223-231.

Ribeiro, J. and Fuentes, S. S. (2013). Inclusión educativa a través de las TIC. *Indagatio Didactica*. *5*, 148-160.

Schleicher, A. (Ed.) (2012). *Preparing teachers and developing school leaders for the 21st century.* OECD Publishing, Paris, France.

Sife, A. S., Lwoga, E. T. and Sanga, C. (2007). New technologies for teaching and learning: Challenges for higher learning institutions in developing countries, A. S. Sife, E. T. Lwoga and C. Sanga, Sokoine University of Agriculture, Tanzania. *International Journal of Education and Development using ICT*. *3*, 57-67.

Silén, C. and Lars, U. (2008). Self-directed learning - a learning issue for students and faculty! *Teaching in Higher Education*. *13*, 461-475.

Sirkemaa, S., Box, P. O. and Pori, F. (2007). Implementing information technology in the learning process. In: *6th WSEAS International Conference on E-ACTIVITIES,* Tenerife, Spain, pp. 263–267.

Stahl, G., Koschmann, T. and Suthers, D. (2006). Computer-supported collaborative learning: an historical perspective. In: *Cambridge handbook of the learning sciences*, pp. 409-426. Cambridge University Press, Cambridge, UK.

Tasir, Z., Abour, M. E. A., Halim, N. D. A., and Harun, J. (2012). Relationship between teachers' ICT competency, confidence level, and satisfaction toward ICT training programs: a case study among postgraduate students. *The Turkish Online Journal of Educational Technology – TOJET*. *11*, 138-144.

Unesco. (1998). Summary of the world conference on higher education for the twenty-first century: vision and action. From *http://www.unesco.org/education/educprog/wche/declaration_eng.htm*.

Vajargah, K. F., Jahani, S. and Azadmanesh, N. (2010). Application of ICTs in teaching and learning at the university level: the case of shahid beheshti university. *The Turkish Online Journal of Educational Technology – TOJET*. *9*, 33-39.

Vivet, M. (1996). The classroom as one learning environment of the future. *Journal of Universal Computer Science*. *2*, 663-678.

Volet, S., Summers, M. and Thurman, J. (2009). High-level co-regulation in collaborative learning: How does it emerge and how is it sustained? *Learning and Instruction*. *19*, 128-143.

Wild, M. and Quinn, C. (1998). Implications of educational theory for the design of instructional multimedia. *British Journal of Educational Technology*. *29*, 73-82.

Williams, C. (2002). Learning on-line: a review of recent literature in a rapidly expanding field. *Journal of Further and Higher Education*. *26*, 263-272.

Yukselturk, E. (2010). An investigation of factors affecting student participation level in an online discussion forum. *The Turkish Online Journal of Educational Technology – TOJET*. *9*, 24-32.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 8

USING WEB 2.0 TECHNOLOGY TO SUPPORT AND ENHANCE COLLABORATIVE ACTIVITY OUTSIDE OF THE TAUGHT CURRICULUM IN HIGHER EDUCATION

Jonathan L. Scott, Sumit Mistry, Bernard J. Moxham and Stephen M. Rutherford*

School of Biosciences, Cardiff University.Sir Martin Evans Building,
Museum Avenue, Cardiff. CF10 3AX, UK

ABSTRACT

Engaging students actively with learning is a key concern across the Higher Education sector There is an ongoing drive to involve students as active partners in the learning experience, rather than as passive consumers. Collaborative activity between students is a key tool in enhancing engagement, a sense of partnership and a sense of ownership of their learning. Collaborative activities have a proven track record of supporting student learning within formal teaching situations. However, collaborative learning also has a significant role to play outside of the formal taught curriculum.

Computer-supported collaborative learning (CSCL) is well-established as a powerful pedagogic tool. Information and communications technology (ICT) may be used effectively, within teaching sessions or group assignments, to enhance student understanding and engagement, and to develop critical and evaluative skills. However, the collaborative experience does not need to be limited only to taught activities or scheduled assignments. Students naturally engage in collaborative study on an informal basis. With the advent of web 2.0 tools of collaborative technologies, and social media, there is a novel opportunity for the enhancement of collaborative learning outside of the classroom.

This chapter will discuss the impact of Web 2.0 technologies on student study and collaborative activity, within the formal modular structure, and exterior to it. Here, we discuss the impact of a collaborative approach we have been developing, named ‘Shadow Modules’. By this approach, collaborative activity outside of the classroom may be enhanced by the use of technology, not only in supporting the activity itself, but more

* Corresponding author: Email: RutherfordS@cf.ac.uk.

importantly, in the sharing of the outputs of collaborative study with a wider community of learners.

By working collaboratively in learning activities that parallel (but are not part of) the taught module curriculum, it is possible, therefore, for students to become active partners in the learning experience, rather than be mere passive consumers of knowledge. By sharing the outputs of collaborative work more-widely, students become proactive drivers of the learning of their peers, and become involved in the planning and development of the curriculum. Collaborative activity can therefore serve to develop communities of practice in learning. Thus students have the potential to enrich their learning experience, and that of their peers.

Keywords: Computer Supported Collaborative Learning, CSCL, Collaborative Learning, Communities of Practice, Engagement, Web 2.0, Social Media, Facebook.

INTRODUCTION

The adoption of modular systems, as well as financial or political pressures leading to increased student numbers, have had a significant effect on the pedagogy of science in Higher Education (HE) in the UK. As class sizes increase the logistics of providing personalised contact between students and academic tutors becomes increasingly problematic. As a result, small-group contact and active discussion are limited in many degree courses, especially in science, and are often replaced by didactic teaching. Consequently, these factors may have a negative impact on the quality of the student experience by enforcing an emphasis on didactic teaching, which is not always appropriate (Biggs & Tang 2011), at the expense of more communal activities which build a strong community of practice (Wenger et al. 2002) in the HE setting. As personalised contact with academic tutors becomes less frequent, there is an associated threat that the students themselves will become further disengaged from their course materials and their learning. With the recent introduction of high tuition fees for HE in parts of the UK, the UK HE sector is experiencing the development of a more-consumerist attitude in students (Tomlinson, 2014). Thus, in the current climate of HE in the UK there is a risk that students will increasingly become passive consumers of knowledge rather than partners in learning and practice (Tomlinson, 2014). This is especially true of the sciences where the importance of information and factual inquiry is emphasised in the pedagogy, rather than the more-discursive focus, seen in the humanities.

There is considerable evidence that collaborative learning is beneficial to student learning outcomes and to their development (e.g. Dillenbourg et al., 1996). Bruner (1985) suggested that collaborative learning improves learners' approaches to understanding by providing many different interpretations and viewpoints on a problem or situation. This theory has been supported by many studies showing a benefit to students who engage in collaborative activity. Gokhale (1995), for example, showed that there was a significant increase in students' critical thinking ability after engaging in collaborative learning strategies. As critical thinking is a fundamental skill in HE, this is a key observation. Collaborative thinking is fundamental to the various models of situated knowledge and socially-constructed learning, such as those proposed by Vygotsky (1978), Lave and Wenger (1991), Wenger et al. (2002) and Rogoff (2003). These models emphasise the role of the learner as being a part of a community of practitioners of varying levels of competence and understanding. Thus learning and understanding are gained through social interaction, and discourse is essential for development. If learning is developed through the activity and interaction of learners, then emphasis should focus on creating social contexts for learning, rather than the context-independent accumulation of knowledge exemplified by didactic teaching. Social constructivist models aim to support situated cognition by the development of communities of practice (Wenger et al., 2002) and by facilitating commonality of understanding, interdependency of learners and an infrastructure of learners and experts (Lave and Wenger 1991; Rogoff 2003). Vygotsky's model of the "Zone of Proximal Development" (ZPD, Vygotsky 1978), proposes that a learner's cognitive development is highly dependent on direct interactions with more capable and/or knowledgeable other, an expert. However, it is also important to note that knowledge creation does not just involve an interaction between two individuals, and it is not entirely a one-way process of the learner gaining benefits from the expert (Prawat & Floden, 1994). Knowledge creation is not an individual experience but a shared one, and knowledge comes about through discourse and negotiation. This agrees with Mercer's revision of Vygotsky's ZPD as the "Intermental Development Zone" (IDZ) (Mercer 2000, Mercer and Littleton, 2006). The IDZ model emphasizes the importance of discourse and of challenging dialogue between learners. As learners solve a problem through dialogue, their perspectives continually change and the IDZ is constantly adapted and revised as a result. Without this active and challenging discourse, the IDZ will collapse. With the actions of dialogue and discourse, the reforming of the IDZ empowers learners to achieve beyond their own perceived abilities. Collaboration between learners, therefore, is crucial to allow them to exceed their current levels of understanding and to encourage metacognition. In order to support learning it is therefore important to develop mutually-supportive communities of learners who can interact with, but are not exclusively dependent on, an identified expert.

Not all group-based activity is effective collaborative learning. Dooly (2008) attempts to define the important distinction between collaborative and cooperative learning. Cooperative learning is focused more on the coordinated division of labour for a task, and involves less of the active negotiation and joint meaning-making seen in collaborative activity. In collaborative activity, participants work through the same issues jointly, and by direct interaction negotiate a shared understanding. Thus the group interaction is more of a network than a linear interaction. In the absence of a clearly-defined expert, students soon identify experts within their peers for individual aspects of the syllabus and key skills or proficiencies (Orsmond and Merry 2012). As students from HE typically have a variety of backgrounds and knowledge or skills bases, this mixing of backgrounds is a highly significant concept for collaborative activity in HE.

Didactic teaching is still the most common model in the UK HE sector, particularly for the sciences. Although alternate approaches focused around small-group, problem-based learning (PBL) and student-led inquiry are gaining in prevalence. A meta-analysis performed by Hattie (2008) showed no clear benefit to either didactic or problem-based pedagogies in terms of the development of understanding and the retention of knowledge. In particular it is unclear which pedagogies foster deep learning approaches and independent learning. But with ample evidence that collaborative learning is beneficial, regardless of the overriding pedagogy of the institutions (traditional or PBL) there may yet be a continued growth of smaller-group activities. The HE sector in the UK has been shifting towards a more student-centred pedagogy for several years (Harden and Crosby, 2000), though one could argue this shift is progressing at a glacially-slow pace. Faced with increased student numbers in HE and limited resources, it is unlikely that this change will accelerate significantly. Wheeler et al. (2008) observe that the role of the teacher in HE is changing, with the teacher becoming more of a facilitator than an instructor. The challenge for the HE sector is how to facilitate student-led inquiry, and realise its benefits, in class sizes that may include several hundred students.

One means of addressing increasing student numbers is to adopt e-learning strategies to replace contact time. However, the risk in driving this approach for logistical rather than pedagogic reasons may mean that HE institutions become hostages to fortune from this strategy (Bayne and Ross, 2013). Sugand et al. (2010) feel that, for the use of technology-enhanced education to succeed there needs to be a proper balance between informal and formal learning scenarios. Sugand et al. suggest that this balance is still elusive. Many technological solutions, particularly the use of a Virtual Learning Environment (VLE), lack flexibility and utility in most HE institutions (Newland et al. 2006; Sharpe et al. 2006) and fall short of being true e-learning. Garrison and Anderson (2003) described two key drivers for e-learning adoption, the need to 'up-skill' the population (digital literacy) and the need for accessible and flexible access to education to meet the lifelong-learning agenda. This framework relies heavily on both the awareness and competence of both staff and students to use these tools (Kitsantas and Dabbagh 2011). In addition to this caveat, surely a community of sharers and collaborators must exist first before these tools can reach their potential in the educational domain.

These caveats of awareness and skill aside, however, there is ample evidence to suggest that the use of technology to support collaborative learning is beneficial (for example, Stahl et al. 2006*;* So and Brush 2008). Computer supported collaborative learning (CSCL) has the potential to facilitate peer support and interaction with a module tutor (either online or in person) and provide students with adequate support during the learning process (Lipponen, 2002; So and Brush 2008).

One potential aid to collaborative inquiry is the use of e-learning and communicative technologies. In the UK there is a general sector-wide drive to support the improvement of both student and staff 'digital literacies', such as adoption of web 2.0 collaborative technologies (Stahl et al., 2006). Web 2.0 technologies include interactive social platforms, such as social media tools (such as Facebook and Twitter), video and rich-media sources (such as YouTube), virtual worlds (such as Second Life), blogs, and discussion forums. Ebersbach et al. (2008) show that social networks and social media are proving to be fertile and useful terrains for the development of learning collaborations. As a result, many of these platforms have been adopted, to varying degrees of success, as tools for learning and teaching in HE (Boulos et al., 2006, de Freitas, 2008, Kitsantas and Dabbagh 2011, Nevgi et al., 2006, Soller et al., 2005, Rasta and Laferrière, 2007, Wheeler et al., 2008 and Zheng et al., 2013, as examples), and all of them have great potential for enhancing the impact of collaborative learning.

Through the use of collaborative technologies, CSCL can also provide support for students outside of formal tutor-student situations and, most significantly, has the potential to greatly-expand the scope of a learning community, especially when social media are integrated into the learning process (Dabbagh and Kitsantas, 2012). CSCL has the potential to benefit and support the learning of a range of learners of differing learning styles, knowledge bases and levels of confidence. If Web 2.0 technologies are utilised as tools in the CSCL process, then participants learn not only how to use the technologies, but appreciate the contexts in which they are most appropriate. In this activity, students are often more ideally-suited to lead the community of practice than (often less computer-literate) academics. Scott et al. (2013) suggest that the students can therefore take a leading role in developing the pedadogy of the module's curriculum by taking an active lead in curating existing learning resources, or developing new ones. Students and staff therefore have the potential to act in partnership in CSCL – more so than in a normal didactic hierarchy. As a result, different individuals in the learning community assume the role of Vygotsky's 'expert' under different circumstances. All participants therefore, be they students or academics, are collaborators in a shared learning experience, rather than consumers and providers of knowledge.

Shadow Modules

There is ample evidence of the benefits of collaborative learning and CSCL within the formal teaching context (Stahl et al., 2006). However, our interest is how this paradigm may be applied to learning outside of the formal taught curriculum. HE aims to develop independent and critical learners, and so places a high emphasis on student-led study outside of formal classes. Collaborative learning is just as important (arguably more-so) in the external learning space, as it is within the formal teaching setting. We recently described (Scott et al., 2013) the development a pedagogic framework we have termed 'Shadow Modules' which aims to use the paradigm of CSCL to support peer-learning, peer-teaching and the formation of communities of practice in learning, outside of the formal curriculum. Shadow Modules are informal learning groups that run in parallel to the formal classes for a taught module. By being student-led, but associated with a formal learning structure, Shadow Modules potentially support students in gaining ownership of their learning through informal face to face learning in study groups, supported by online ICT tools. The key aim of Shadow Modules is therefore to build a stronger, mutually-supportive community of learners.

A key concept for Shadow Modules is that by utilizing Web 2.0 ICT solutions, the students are able to share the output of these learning communities, with the wider learning group across the module. The benefit offered by using ICT for this dissemination of resources is that outputs from the Shadow Modules are permanent, and therefore, cumulative, over successive years. Another benefit of the Shadow Module approach is that the students in the Shadow Module are able to contribute to the development of the module and the curriculum, as well as the pedagogies used in the teaching of the material. We have observed that Shadow Modules tend to naturally take three formats – peer teaching groups, online support and discussion groups and face-to-face collaborative groups. Here, we focus on the latter format, which is the most collaborative methodology.

Outline of the Collaborative Shadow Module Process

The common format for module design and delivery in higher education is one where delivery and content is driven by the lecturer or course leader (see figure 1). The full lines in figure 1 show the workflow of a typical module, where the lecturer decides upon the intended learning outcomes, the means of delivery, the methods and timings of assessment, etc. There is very little opportunity for students to share in this design process. The Shadow Module concept aims to facilitate feedback from students into many of these areas (dotted lines in figure 1), with students helping to impact upon the development of learning materials and support content and impact upon the delivery method and the lecturers themselves. The Shadow Module process is summarised in figure 2. The focus of this chapter is on the (b) option of Shadow Module activity, that of a face-to-face collaborative group. Under this model, the volunteer student Shadow Module Leader(s) (SML) arranges times and venues for the group to meet, and might liaise with the academic module leader over the general content of the sessions. Students meet to discuss subjects and collaborate together on a shared output using a collaborative technology (such as Google Drive, a wiki, a Prezi presentation). The most commonly-used medium was the documents feature of Google Drive, a cloud-based facility for developing a shared document where many users can update the same online document simultaneously in real time. The SML then decides on future content or tasks for the group, referring back to academic staff if necessary. Any output from the Shadow Module sessions is made available to all students within the module and participants either create their own learning and revision resources or identify resources from open-access material on the internet. A benefit of the collaborative approach is that the group of students will critique these resources as a natural part of the open discussion. The production of notes and resources is therefore self-regulating and self-verifying for accuracy.

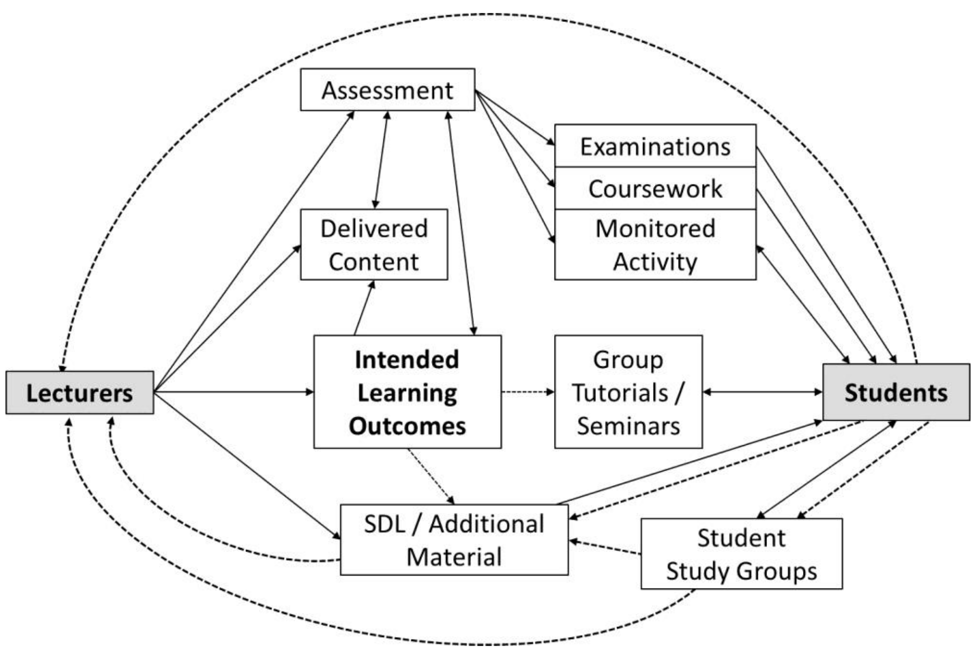


Figure 1. A model of module design in HE. Flow diagram of the hierarchy of development of learning activities in a module. Solid arrows show lines of direct influence where one constituency informs the development of the next. All of these lines of development are directed towards the student, and in only a few cases is there any direct feedback from the students to the learning activities they are involved in. The dashed arrows represent the potential influences that students could have on the process, including feeding back to the development of SDL and additional reading, as well as an impact on the lecturing staff themselves in shaping the curriculum/intended learning outcomes and the way the curriculum is presented.

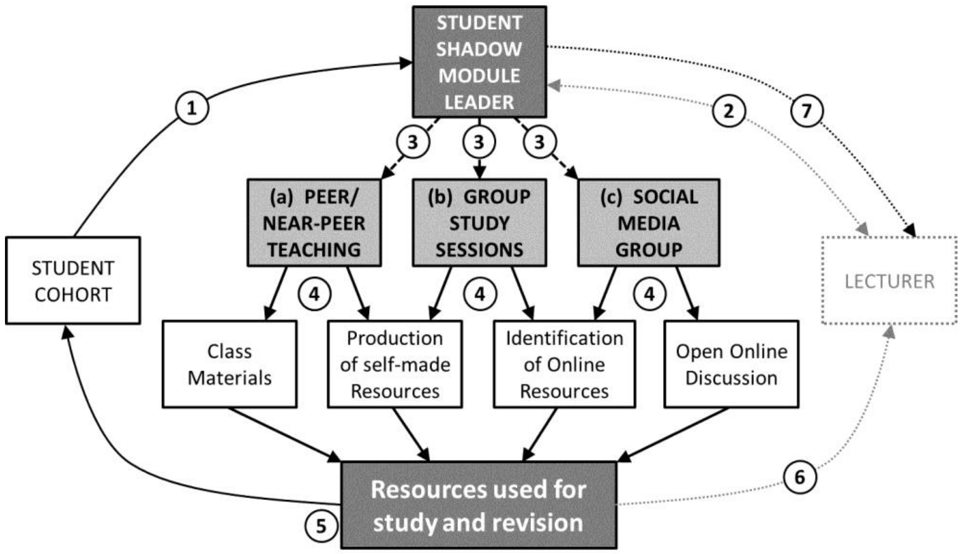


Figure 2. The Shadow Module process. A flow diagram illustrating the workflow in a typical Shadow Module. (1) A student Shadow Module Leader (SML) volunteers from the student cohort. (2) The SML liaises with the lecturer or module leader to discuss a broad framework for the Shadow Module. (3) The SML then organizes the structure, which may be either (a) a Peer/Near-Peer teaching approach, (b) A series of collaborative group meetings or (c) A discussion forum hosted on a social media site. These activities produce several output types (4) which are then shared with the Shadow Module group and the student cohort as a whole (5) via cloud-based collaborative media or the VLE. The outputs and experiences of the shadow module group (6) and the SML (7) reflect back on the lecturer, who then may often revise the teaching approach or curriculum based on this feedback.

Research Questions

This chapter aims to assess the impact of Shadow Modules on students, and whether or not Shadow Modules address a need within the student body and are beneficial. Our key research questions are: Do students naturally form collaborative groups of their own accord? Do students utilise interactive technology effectively to support their learning? Do Shadow Modules have a positive impact on the student experience and student module outcomes? We have taken a mixed method approach of quantitative surveys and content analysis of free-text comments to address this issue. We find that Shadow Modules potentially address a gap both in student collaborative behaviour, and in the embedding of technology-enhancement into their education. We show that Shadow Modules are received positively by students, and have the potential to be beneficial to student modular outcomes.

METHODS

The work was undertaken within the School of Biosciences, at a Russell Group (research-focused) University in the UK. Undergraduate students in this institution were typically of ages 18-21 and generally of high academic ability ranges for the HE sector. Survey analysis was performed using a paper-based survey using a 5-point Likert scale (1 = Never, to 5 = A lot). Ethical approval was obtained for the survey.

Questions asked were as follows:

"How do you tend to work during the taught semester?" and **"How do you tend to work closer to exams?"**

Independently (at home)
Independently (in the library/university)
In pairs
In small groups (3-10 people)
In larger groups (more than 10 people)

Please indicate how often you use the following to support your study:

Virtual Learning Environment	News Articles
Research Papers/Reviews	Blogs
Forums/Discussion Boards	Wikipedia
Facebook	YouTube
Other Social Networks	Khan Academy
Textbooks	iTunes U
Podcasts	

Surveys were delivered to Year 1, Year 2 and Final Year students in the 2011/12 and 2013/14 academic years. Statistical analysis of the survey data was performed by unpaired t-test and ANOVA. The P-values for tests are indicated in the text.

Qualitative data was collected through an online survey of Shadow Module participants during the 2011/12 academic year. Due to the small number of respondents it was possible to perform a content analysis of these data by eye.

Analysis of student marks was undertaken by comparing student performance on a single Final Year module repeated across two cohorts of students (2010/11 and 2011/12 cohorts). In order to address variations in academic ability between students, the module mark was normalised against the overall degree average for each student. A ratio of 1 therefore indicates that the module performance was equivalent to the degree performance. A number greater than 1 indicated better-than-average performance for this module compared to the overall degree result (which included the remaining modules in years 2 and Final Year). The data shown are the means of two cohorts means for highly engaged students *vs* the class mean. Statistical significance was derived using a t-test.

RESULTS AND DISCUSSION

Do Students Naturally Engage in Collaborative Learning Outside of the Classroom?

Given that collaborative learning is widely held to be a positive approach to learning, we were interested to see to what extent students engaged in collaborative activities of their own accord. As part of a longitudinal study we surveyed bioscience students to identify prevalent levels of engagement with collaborative learning either during the taught semester, or in preparation for end-of-module examinations. Students were surveyed in the 2011/12 and 2013/14 academic years.

Figure 3 compares the frequency with which students study on their own, in isolation (at home or in student accommodation), on their own in a shared learning space (such as a library) at the University, or in pairs, small groups (3-10 individuals) or larger groups (10+

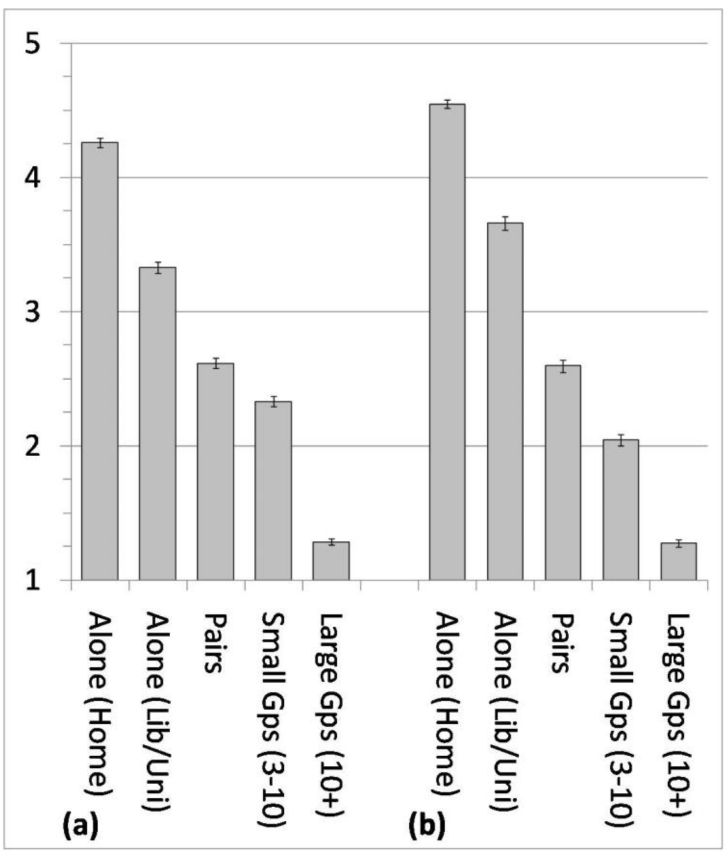


Figure 3. Comparison of student study behaviour during semester and revision periods. Histogram of student responses to the questions: (a) "How do you tend to work during the taught semester?" and (b) "How do you tend to work closer to exams?". 1 = "Never", 5 = "A Lot". The error bars represent standard error of the mean (n = 770).

individuals). The data compare the prevalence of these either within the taught semester (figure 3(a)) or during revision and examination periods (figure 3(b)). During both periods of the semester there is a significant difference in approaches to learning (P=<0.01 for either dataset). Students generally prefer to study alone, and studying at home is more common than studying in a communal space. Studying in pairs or small groups is less common than studying alone (P=<0.01), and while studying in small groups is significantly less common than studying in pairs, the difference is not dramatic. This suggests that students do sometimes study collaboratively, either in pairs or in small study groups. What is dramatic is that students almost never, of their own accord, study in larger groups. This is unsurprising, as larger groups are difficult to co-ordinate, but our experience suggests (Rutherford and Scott, 2012, Scott et al., 2013) that studying in these larger groups is beneficial to students. This suggests that the scaffolding afforded by Shadow Modules is likely to be beneficial to students. When comparing activity against semester-time study, the prevalence of independent study during examination and revision time increases significantly (P=<0.01). There is a drop in the amount of small group activity (P=<0.01), but no significant change in the frequency of students studying in pairs or larger groups (P=0.74 and P=0.79, respectively).

Student Engagement with Web 2.0 Technology

One of the potential benefits of Web 2.0 technologies is the availability of resources that can support learning. Web 2.0 technology facilitates several potential avenues for learning, either interactively with peers (such as social media or discussion forums) or with multimedia sources of information that support different learning styles (for example, podcasts, blogs and video repositories such as YouTube, iTunesU and Khan Academy). As with the survey above, bioscience students of all years were surveyed in 2011/12 and 2013/14 on their use of ICT resources in their studying. Again, there are subtle trends within the data, but these are sufficiently minimal to be able to look at the broad differences as a single data set.

The results of this analysis, shown in figure 4, suggest that even though Web 2.0 technologies are prevalent for students to use for learning, the most-used tools are non-interactive sources such as textbooks, academic articles and reviews, and the lecturers' notes on the VLE. Use of Wikipedia is also prevalent, although students in general are aware of its limitations from information literacy training at school and university. The Web 2.0 technologies are significantly less prevalent (P=<0.01) than the non-interactive technologies when it comes to their use for learning and study. Only Facebook and YouTube are used by students with reasonable regularity for supporting learning, and even these are not used frequently. Interestingly Web 2.0 sources with a direct academic focus (iTunesU and Khan Academy) are used significantly less than the more-generic YouTube.

These results suggest that students do not, generally, use group collaboration and interactive technology to support their learning. Therefore it is necessary, if these approaches are to be used, as with the Shadow Module approach, for the activities to be scaffolded to a certain degree. This relies on the assumption that collaborative work and use of Web 2.0 technology is a beneficial approach. We therefore wished to identify if students a) found the Shadow Module approach beneficial or detrimental to their learning, and (b) if this collaborative approach had a visible effect on their performance.

Student Response to Shadow Module Activities

When surveyed about the utility of the Shadow Module approach, the participants involved in the Shadow Modules were generally positive about their experience and found them useful to their learning (reported in Rutherford and Scott, 2012). Students who participated in Shadow Modules were given a series of open-ended questions regarding their Shadow Module experience.

a) What did you find most useful about the Shadow Module sessions?
b) How do you feel the shadow module sessions have impacted on your study time?
c) What would you do to improve the Shadow Module sessions?

The free-text responses from this limited survey (n = 36) were coded manually into a series of categories (summarised in Table 1).

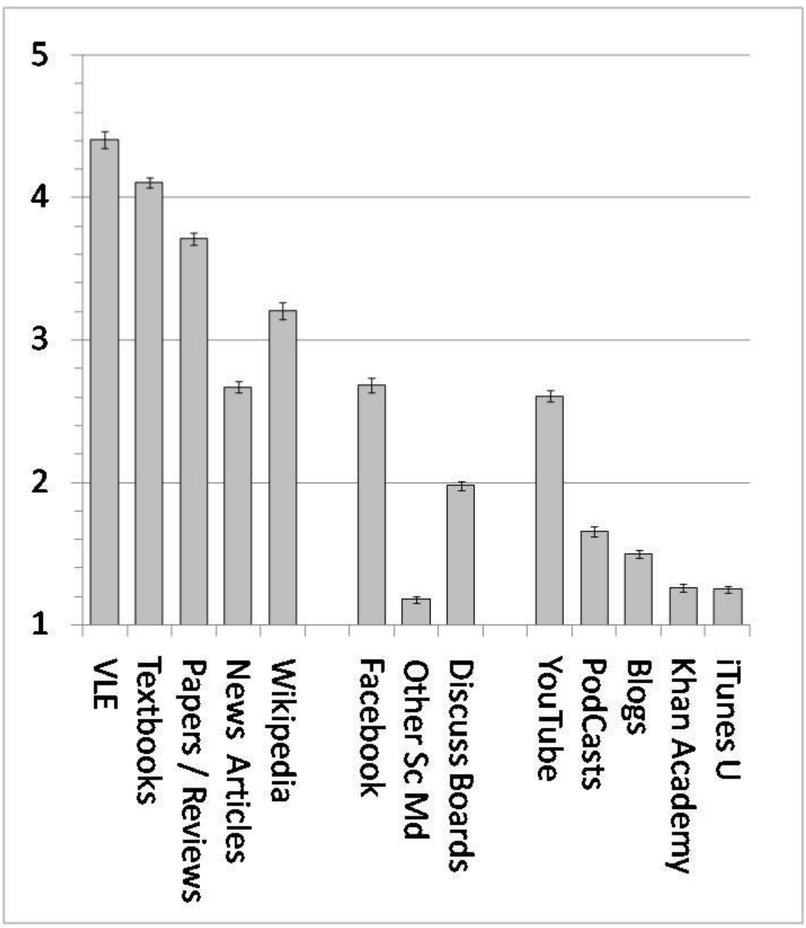


Figure 4. Comparison of students' use of technology to support learning. Histogram of student responses to the request: "Please indicate how often you use the following to support your study". 1 = "Never", 5 = "A Lot". The error bars represent standard error of the mean (n = 770).

Table 1. Content analysis of student comments regarding Shadow Module impact

(a) What did you find most useful?	
Group discussions over curriculum topics	12
Revision and practicing exam questions	8
Collaboration in activities (e.g. reading papers)	6
Peer-support for academic skills (e.g. Literature research, scientific reading)	5
Use of collaborative technology	2
Ability to interact with Lecturer/Tutor	2
(b) How do you feel the shadow module sessions have impacted on your study time?	
Had a positive effect, reducing time	20
No impact	5
Slight negative impact	2
Negatively impacted	3
Not answered	4
(c) What would you do to improve the sessions?	
Lecturer in attendance	5
Better promoted/Increased attendance	4
Improved ICT resources	4
More focussed subjects	4
Planning of prior reading/prep	4
Formal timetabling of sessions	4
Longer sessions or longer-running programme	4
Encourage more discussion	4
More-comfortable environment	2
No improvement needed	4

Comparison of categories of student free-text comments made in a survey of the impact of Shadow Modules on student learning and study activities (n=36). Numbers given are total numbers of comments.

The most commonly-cited benefits were the opportunity to discuss material and share expertise. In particular it was deemed beneficial to develop a shared-understanding of challenging tasks (such as reading complex research papers), as well as identifying individuals to help with key study skills and revision techniques. These are classic benefits of a collaborative approach to learning (Dillenbourg, 1999, Dooly, 2008). It is notable that in table 1(a) the majority of the comments on the benefits of the sessions relate to deep learning approaches of studying, understanding and development of ideas, rather than to surface-learner concerns of examination preparation and revision, supported by a several free-text comments, such as:

> "People who participate in the sessions are willing to learn and have their own theories, opinions and ideas, discussing these fuels motivation and interest"

> "It has helped me focus and provided an opportunity to discuss everything which is really the best thing about [the shadow module sessions] - the talking, it helps to synthesise all the information and ideas."

> "[Shadow module sessions] definitely helped me look deeper into work that can be included in each topic",

This finding is encouraging as the primary aim of the Shadow Modules was to enhance the collegiate nature of the academic group so that the students were active participants in the subject and not simply consumers of a product.

A key transferable skill required of graduating students is the ability to work and communicate in teams. It was encouraging, therefore, that the collaborative aspect of the Shadow Modules appeared to work well (table 1(a)) and that the Shadow Module sessions enhanced their confidence in working with others.

> "Working with other people has helped me understand and learn material by discussion and getting hints, tips and feedback from other students."

> "Help from other students, helps to understand the topics better and give a good idea of how to go about extra reading."

> "The sessions helped me to overcome my lack of confidence in communicating my knowledge and speaking up in front of others."

> "Ideas and knowledge you put forward are often appreciated and interest others, thus fueling confidence in your knowledge and therefore more able to communicate it."

The key aim of the Shadow Module is to facilitate peer-support in learning and students generally felt that the sessions facilitated them obtaining advice, support and feedback from peers. The Shadow Modules have a potential, therefore, to facilitate the formation of communities of learning even in a climate where modularisation and high student numbers potentially stifle discussion and collaboration amongst the student cohort.

A major concern with introducing a study approach such as Shadow Modules would be that it had a negative impact on students' study time and overall workload. However, the majority of students (table 1(b)) felt that the collaboration with peers in the Shadow Module made their studying more efficient and therefore had a net reduction on their time spent studying. This benefit is also a key benefit identified for collaborative learning.

The negative aspects of the Shadow Modules were confined largely to logistical issues (comfort of the physical working space, organisation; table 1(c)) rather than to questions of pedagogy. We did note that there were limitations to the extent by which the Shadow Module approach facilitated students exploring the subject area in a truly undirected way. Instead, it seemed that some students required, or at least requested, a reasonable amount of guidance (at least initially) from an academic (table 1(c)). However, when challenged by a lack of academic involvement, the students responded well and were not disadvantaged by its absence (Scott et al., 2013). Indeed, it might be considered beneficial to the free flow of ideas and questions to have the academic absent-from, or distant-to, the process. It is important that the Shadow Module groups become truly innovative and semi-autonomous to the core syllabus, rather than simply being academic-led tutorial groups adding to student and staff workloads (Scott et al., 2013).

It was noted that students were generally readily willing to collaborate and upload notes to a shared space during the session, but were less likely to share their independent work outside of Shadow Module sessions. However, they were more likely to be sharing resources in the social media space, or with smaller groups of friends. This may suggest a divorcing in the minds of the students between ‘formal’ learning session and continuous learning outside of formal situations. The utility of the collaborative tools might be a cause of this, or it may simply be a sociological approach to compartmentalising activity between social interactions and formalised learning. As a result, activity on the shared resources was limited between sessions. This emphasises the importance of also building virtual social spaces around the learning, such as using social media, so that these barriers can be broken down. When provided with the means to do so, the more-engaged students were prolific in adding extra notes, links to research papers or raising and/or answering questions.

Observations on the Shadow Module Process

Within the Shadow Module sessions, students engaged (of their own accord) in the following activities:

- Brainstorming;
- Topic review and discussion;
- Self-devised spot-tests;
- Discussion of specific challenging topics from lecture material;
- Collaborative reading and summarising of scientific papers;
- Creating shared notes on key curriculum topics;
- Essay planning;
- Peer-marking;
- Constructing shared resources for group learning and revision (summaries, flashcards, flow diagrams, mind-maps, annotated diagrams, quizzes).

In a typical Shadow Module collaborative session several activities were occurring in parallel. For example, in an Anatomy-focused Shadow Module, these activities included collaborating towards a shared document, as well as collaborating towards a diagram to follow up from a practical anatomy session, with one student recording the output on the whiteboard using a camera phone.

The outputs of the Shadow Modules were extensive, with shared notes created on Google Drive running to several pages (in some cases 20 pages or more) for one Shadow Module. Another Shadow Module by contrast focused their work into a single visual presentation using the Prezi software to compartmentalise the information and provide a logical path through it. Shadow module outputs can therefore vary considerably in their detail and scope but, in all cases, the scope was considerable and the detail equally so. Examples of outputs, shown in Figure 5, include mind maps (A, C) quick sketch diagrams (B, D) as well as carefully drawn schema (E-F). Some materials were scanned-in, others imported as photographs. The clear finding of all of the Shadow Modules was that the students themselves are a considerable, and largely under-used, resource for the development of learning materials for a module.

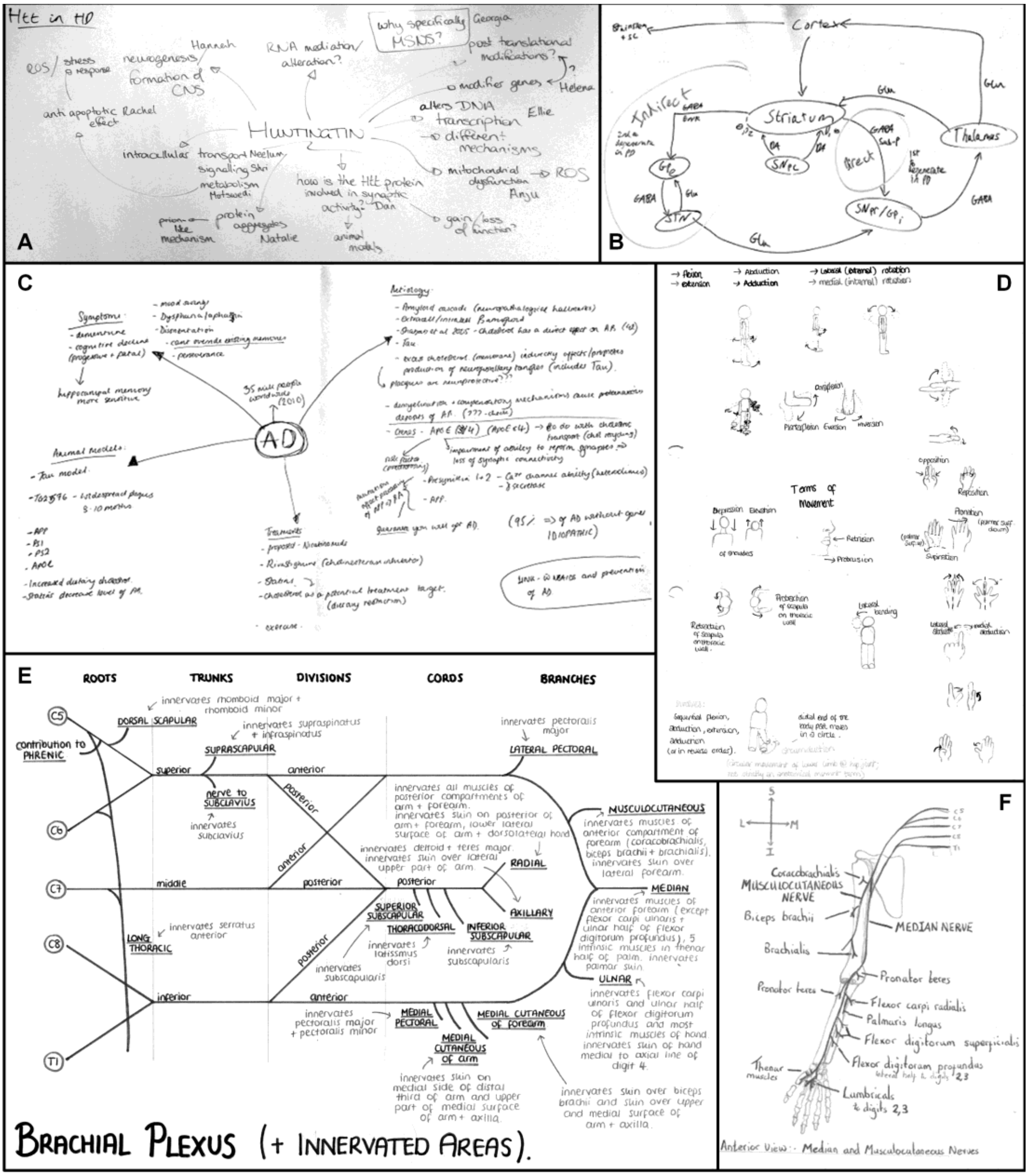


Figure 5. Example of outputs from Shadow Module sessions. Examples of diagrams and mind maps designed during Shadow Module group sessions or devised by students and uploaded to the shared document supporting the Shadow Module. A, a mind-map of the activity of Huntingtin protein; B, principal pathways involving the cerebral cortex; C, pathology of Alzheimer's disease; D, terms of movement of a limb; E, innervation of the brachial plexus; F, median and musculocutaneous nerves of the arm. A-C represent diagrams created during the group session, D-E are hand-drawn diagrams scanned and uploaded to the shared document outside of the group session.

The level of autonomy and independence of the Shadow Module groups was variable, and at times possibly limiting to the process. The level of input required from the SML required to run the shadow sessions varied from module to module. In a year 2 Anatomy Shadow Module, the Shadow Module Leader needed little to no input. In some cases it was necessary to start a warm-up exercise, led by the SML, to get students going. It was also noted that new participants to the Shadow Module process were often quiet at first but did improve in confidence over time, joining in with group discussion freely. It would be useful to perform a long-term study on the autonomy of the Shadow Modules including students who had engaged in these activities in a module taken in a previous year. It is likely that familiarity with the format will increase engagement and the efficiency of the process.

Use of Web 2.0 Technology

Standard technologies were used in a variety of ways to facilitate the collaborative process. For example, data-projectors could be used to overlay images on a whiteboard which were then annotated by the group. Smart-phones could then be used to capture these outputs and upload them to a shared collaborative workspace. The emphasis was on content and quality of information, rather than presentation.

Students used their own laptops, smart phones and tablet PCs to source information. The importance of using non-IT-based approaches should not, however, be overlooked. It was found that the most powerful technologies within a face-to-face Shadow Module collaborative session were a whiteboard, pens and a camera phone with internet capability. These were undoubtedly the most effective methods for brainstorming, stimulating discussion and collaborating during discussions.

The use of Web 2.0 technologies were of more use after the face-to-face sessions, to co-ordinate collaboration and curation of resources (both student-made and pre-existing resources) and to share them with peers. The use of technology to produce shared outputs was a major benefit of the Shadow Module sessions over smaller, informal, learning groups. The use of resources such as Google Drive (a cloud-based platform for working on shared documents), Wikis and Study Blue (an online application for building flash-cards) was found to enhance the overall collaborative experience for the students and provided a good means by which resources could be shared both during and outside of Shadow Module sessions. Technology is therefore important in sustaining, disseminating and improving these resources, but is not integral to their development.

The Need for a Versatile Collaborative Community Space

One severe limitation in the running of collaborative working was the limitation of the collaborative technologies themselves in the online space. The main collaborative tool used was Google Drive, which was an excellent collaborative tool but did have several logistical limitations. Moreover, the major limitation to the approach was the constraint of being required, by necessity, to run much of the process through the university's VLE. The VLE was particularly problematic for sharing multimedia resources (such as videos and audio files) and for ongoing discussion-board activities. The inflexibility of a monolithic system such as an institution's VLE emphasised the need for a more robust, interactive and usable community virtual learning space.

As a result of this inflexibility and lack of a user-friendly online discussion space, our later trials of Shadow Modules used an extant social networking site (Facebook) to co-ordinate activities and run discussions outside of Shadow Module sessions. Engagement with this tool was variable, but was certainly more widespread than the discussion forums available within the VLE. The content of these discussions cannot be analysed, due to the nature of these discussions lacking informed consent for use in research. However, it was interesting to note that in all cases where social media spaces were created to support Shadow Module activity, the social space was still utilised even after the module had been examined, as a social discussion space, as well as an academic one. It is clear, therefore, that the establishment of communities of practice within Shadow Modules is linked to the establishment of social communities outside of the academic workspace.

Student Engagement

The level of student attendance at the Shadow Module collaborative sessions was variable, but generally low, rarely more than 10-20% of the module group as a whole. However, a principal purpose of the Shadow Modules was to provide shared resources that were used by all students, so an important question is whether the peers of the Shadow Module attendees were also supported positively by the materials developed. The impact of these sessions on the cohort as a whole would be difficult to measure, however it is possible to infer the use made of the resources by charting when the resources were accessed. Figure 6 shows the use of the Shadow Module resources on two modules. The general level of engagement with the materials was steady in figure 6(a), but with a visible peak immediately prior to the day of the examination (the exam date is marked by an arrow). This is not surprising, as it may reflect a strategic approach towards learning which is perhaps endemic within the wider student population (Biggs and Tang 2011). It is not possible to identify the individuals making these accessions of the Shadow Module materials, and so it is not possible to identify if they were from students who had or had not participated in the sessions. However, the total number of accessions is sufficiently large to confirm that a high proportion were from students who were not engaged with the collaborative sessions. There was also a small amount of use of the resources after the date of the final examination, which may suggest that a small proportion of the students were engaged with the subject at a deeper level and not simply for the aim of passing a unit of study. The engagement with the resources in figure 6(b) was more evenly-spread throughout the course of the module. This engagement is possibly reflective of the deep-learning style of the shared resource created for this Shadow Module, focusing on the subject matter rather than exam preparation (which was the focus for the resource charted in 6(a)).

Of key importance to the Shadow Module approach is the longevity of the resources developed. Using shared resources through ICT platforms, the output of the Shadow Module sessions remains by default long after the students who created them have moved on. The resources are therefore available for subsequent years to either use or to build upon and enables students to become engaged in the development of the module itself. It is debatable whether the ideal approach is to offer the current Shadow Module group access to previous years' resources, or to encourage them to work independently. Whichever the approach taken, the outputs can still be made available to the group as a whole in order to support understanding of the topic and as aids to revision or to support additional reading for a subject.

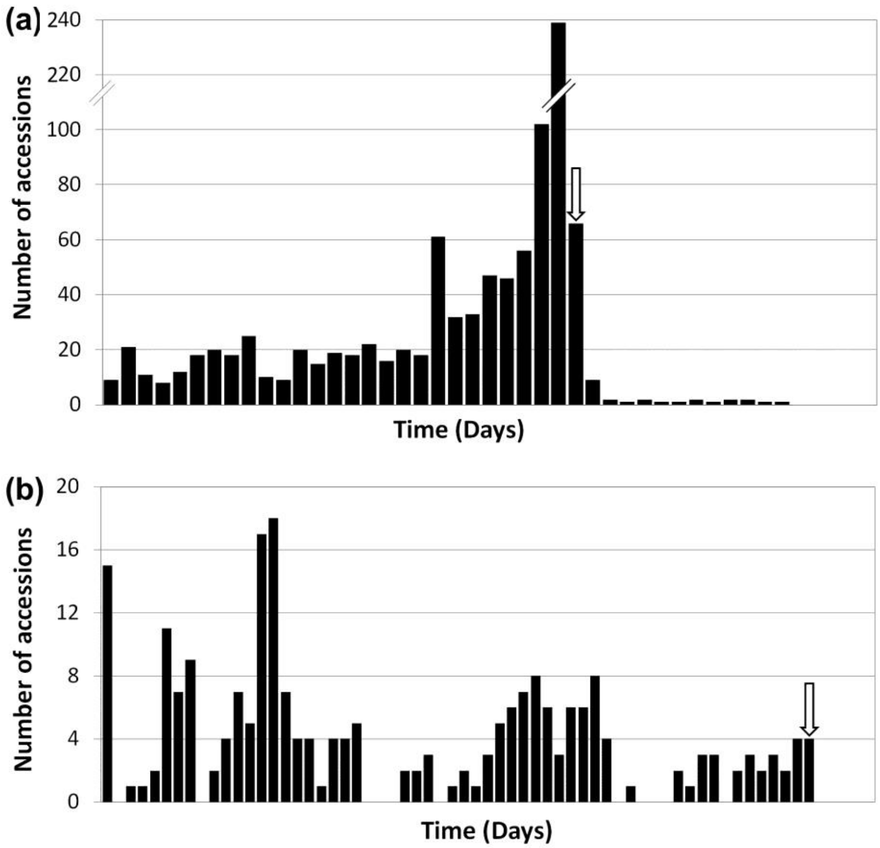


Figure 6. Student engagement with Shadow Module outputs. Time series noting the number of accessions of the shared outputs for the Shadow Modules of two Shadow Modules (on (a) biology in society and (b) neuroscience) for the period leading up to the module examination (date of each examination shown by an arrow).

Impact on Student Module Outcomes

The primary purposes of the Shadow Module pedagogy are to encourage collaborative activity and increase engagement and deep learning, rather than to improve the students' grades *per se*. However, clearly there would be a direct benefit of the Shadow Module activities if there was a resultant increase in the students' grades. Figure 7 illustrates the module marks for two cohorts of a Final Year module on the role of the biosciences in society, comparing those involved a Shadow Module study group against the class average. Students were defined as either highly engaged (5 or more Shadow Module sessions attended) or of low/non-engagement (fewer than 5 sessions, or no sessions, attended). The average module marks for these two groups were compared to the class average. There was no significant difference in the overall degree marks for the students who were highly-engaged, compared to their peers (data not shown), suggesting that the Shadow Modules do not specifically recruit the higher-achieving students. However, within this module, their module marks did show a significant increase (P=0.05, figure 7) relative to the rest of the class. In order to account for any difference in overall academic ability of the students, the module mark for each student was normalised against the student's overall degree result. It is not possible to attribute this solely to the impact of the Shadow Module, but the result does imply that the Shadow Module had a significant positive impact for these students. This analysis also does not take into account the positive benefit that may have been received by non-attending students who accessed or used Shadow Module resources, which is not possible to measure. Increasing the module grade was not the primary aim of the Shadow Modules, but does appear to be a beneficial outcome.

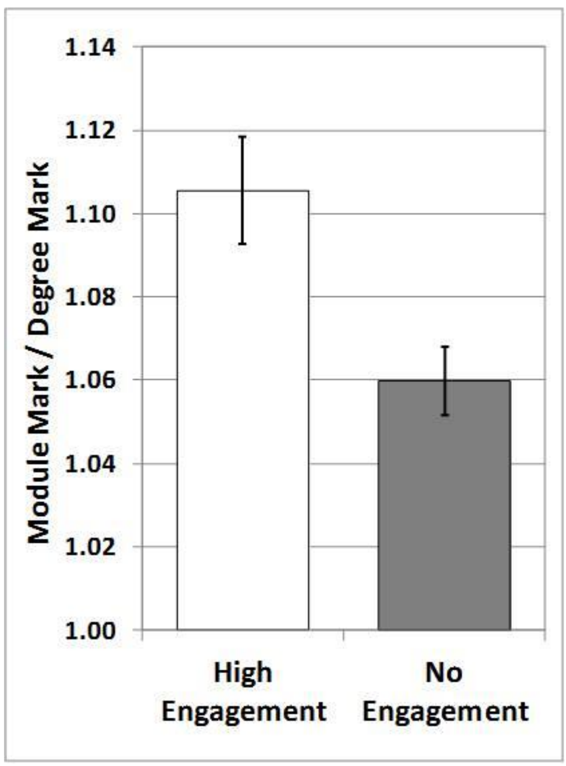


Figure 7. Impact of Shadow Modules on module outcomes. A comparison of the module outcomes for students who were highly-engaged with the Shadow Modules (attended 5 sessions or more; white bar) compared to the remainder of the module cohort (grey bar). Data were collected from two successive academic years of the module and Shadow Modules were run. Student overall module mark was normalized against their overall degree mark. The data were analysed using an unpaired Student's t-test (2d.f., P=0.05). The error bars represent standard error of the mean.

CONCLUDING REMARKS

This study suggests that students naturally engage in collaborative activity outside of the classroom, but that this activity is not overly-frequent and is generally focused towards working in pairs and smaller groups. The pre-eminent studying strategy for students in this study was a solitary approach, working in an isolated environment. Whilst solitary work is required in some instances, and desired in others, it may not be the most effective means of studying. It would be interesting to inquire whether this solitary approach is undertaken out of need or desire, or simply out of habit. When students entered a revision period, rather than a taught period, there was a slight, but significant, shift towards the independent learning approach. The prevalence of small-group working during revision periods was reduced, but interestingly the prevalence of studying in pairs remained the same. It is tempting to speculate that the dynamics of study-pairs are more stable than those of small groups, and are therefore more likely to endure under more-pressurised conditions of exam-time.

It is equally interesting that students in this study tended to utilize traditional technologies for study, such as text books, academic papers and lecturer notes on the VLE. Web 2.0 tools were far less frequently used for study, although evidence suggests from other data in the longitudinal study (Mistry, Scott and Rutherford, in preparation) that students use Web 2.0 technology almost ubiquitously for communication and organisation during their studies. Students are therefore versed in the use of Web 2.0 technologies, but are not yet open to using them for supporting their studies. Clearly, for an academic subject in HE, one would expect textbooks and research papers/reviews to be prevalent. However, the overall lack of the use of technology is interesting. Especially the suggestion that when technology is used, the preference is for non-specialist sources (such as Wikipedia and YouTube) over more-authentic sources (such as iTunesU and Khan Academy).

The Shadow Module approach has the potential to address both of the gaps identified above – the lack of large group collaboration and the limited use of technology to support learning. Shadow Modules had a positive impact upon the students' learning experience. While involvement in the Shadow Modules was limited to only a portion of the overall student cohort, materials produced were prolific and could be shared across the cohort. Students valued the opportunity to collaborate freely with each other and share resources, understanding and experiences. Students felt that the Shadow Module sessions were valuable to their ongoing learning and revision for examinations. Students also felt that the Shadow Module activities enhanced their interest and engagement with the subject and made their study time more efficient. There were limitations to the impact of the Shadow Modules, due possibly to the prevalence of students' strategic approaches to study. The Shadow Module pilot suggested that students are keen to engage in collaborative activity, benefit greatly from it, and are an untapped resource for the development of teaching and learning media. The evidence generated for this project was both quantitative and qualitative, although both were limited by the small number of students taking part, and the small number of Shadow Module pilot groups. Despite these limitations, there are sufficient data to suggest that the outcomes from the Shadow Module approach are worth pursuing and the pedagogy will have a positive effect on the students' learning experiences. The collaborative nature of the Shadow Modules will be of particular benefit to students in the development of employability skills for teamwork and leadership.

We propose that the most ideal format for a Shadow Module is one that has some, but limited, input from the supervising academic(s). Perhaps limiting the academic role to occasional brief visits to the Shadow Module sessions to answer questions or offer guidance, or to give limited feedback on resources that have been developed. There should be at least one SML, possibly a student from a previous year's Shadow Module, who can guide the group in at least the initial stages of the process, and curate the information and resources produced. The sessions are best organised and discussed through social media rather than a VLE. Basic technology (computer access, wi-fi access, whiteboards and projectors) need to be supplied, and students should be encouraged to bring their own materials (such as laptops, tablet PCs and smartphones). There should be no formal direction for the Shadow Module. Instead, the Shadow Module should evolve organically following the needs and eccentricities of its members. The outputs of the process, however, should be shared with all students on the module, regardless of their level of involvement in the Shadow Module groups themselves.

The key observation from this study has been that students readily form communities of learning and communities of practice on their own. In a purely informal setting these are usually small groups of friends or working colleagues, but they have the potential to be much further-reaching. By the use of collaborative technologies, these communities of practice can be expanded considerably and can include both highly-engaged and highly-active individuals, as well as more passive or predominantly observational individuals. These communities of practice are dynamic, and vary in their size and activity, but generally focus around a core number of individuals who are prolific in the materials they produce. Such a mutually-beneficial arrangement allows for some students to further their engagement with the material while others benefit from the outputs of their peers. The approach also allows for feedback into the formal teaching that the Shadow Module supports during the running of that module, rather than after its completion. The outputs of the Shadow Modules can form the basis for class discussions, areas of development by the lecturer or even specialised help sessions or tutorials. In the long term the Shadow Modules can help influence how specific subjects are taught and how the curriculum is shaped or presented.

One possible limitation to the Shadow Modules could be the extent to which they are student-driven. Indeed, there was a general feeling among students that the Shadow Modules would benefit from more structured sessions and more support for Shadow Module Leaders from the academic staff. However, the extent of involvement by the academic should be considered carefully, as it is important to strike a balance between structure/support and spontaneous student activity in order to facilitate the most effective environment for collaborative and investigative learning. This is in keeping with the findings of Nergi, et al. (2008) who showed that the teacher was important in their role of supporting the collaborative learning activity, but that too much involvement could stifle the learning process.

Several simple improvements could be made to improve Shadow Module outcomes. In particular, the number of modules running the shadow module sessions should be increased so that students become more familiar with the format and the benefits endemic in the activities. Changes in technology use could improve outcomes of the Shadow Module pedagogy. There should be more shared physical spaces made available that are dedicated to casual shadow activity, which are large and dynamic enough for the varied learning and teaching modalities encountered in Shadow Module sessions. The virtual shared spaces need to be user-friendly and simple to navigate.

A further potential concern with the Shadow Module-authored resources is the potential for the inclusion of incorrect or inaccurate material that could be misleading to students using the resources. This in turn could therefore require oversight by the academic delivering the formal teaching. However, the identification of inaccurate information is, in itself, a key learning activity for the students, as there is erroneous or misleading information in text books and research literature. The collaborative nature of the Shadow Modules, and the ability for all participants to edit the collaborative resources, means that the group as a whole may undertake peer-review of the resources developed. Wheeler et al., (2007) emphasise the importance of self-regulation in what they term "Folksonomies" (student-derived taxonomies). Learners in a group will naturally criticise and categorise information (including their own) in a hierarchy (taxonomy) of their own making, based on their agreed assessment of the veracity and utility of that information. Wheeler et al. emphasise that the higher the number of students, the better and more critical is the assessment. Therefore, the act of sharing resources serves also to ensure (or at least encourage) their accuracy. In the Shadow Module structure, the critical assessment activity will also contribute to the information literacy skills of the Shadow Module participants.

There is a clear demand for a dedicated, and socially-centred, online community space that can act as the central hub for student activity in Shadow Modules. This space should be managed by the HEI and could act as the base of communication between students, as well as for feedback from academics and peers (Wilkinson, 2011). Currently, the only versatile and usable spaces for this are popular social media sites. Currently the predominant social media platform used in HE teaching is Facebook, which not all students or staff may wish to use, as this social medium is felt by many to be their social space, rather than a learning space (Bayne and Ross, 2013). Any collaborative space would need to form a unified repository for resources, with the ability to integrate with other HEIs for potential inter-institutional collaboration. This platform could also be a means of improving the level of academic input in the Shadow Module without impeding on the progress of students in Shadow Module sessions. Although there are web 2.0 tools in VLEs, they do not provide the flexibility of 'socially centred' web tools and could benefit from (for example) Facebook-like group features such as a module wall, events and comments which can easily embed rich media (e.g. videos, PDFs, images).

Motivated and engaged students and academics, equipped with the right tools and knowledge of how to use these tools effectively, are a cornerstone to the process. Students are likely to require help adjusting to the pedagogy, partly in terms of how to organise and run the sessions, but also in terms of how to interact in an informal manner with a large number of peers for collaborative learning. Similarly the students can reflect their learning back on the academic and working in partnership with the academic will enable the taught module to be more directed towards the generational needs of the students. Under the collaborative learning environment, learners gain self-awareness of themselves as "group members", which makes them reflect on their own importance and role within the learning community.

The major culture change highlighted by the activity seen in collaborative groups, such as in the Shadow Modules, is the importance of allowing the development of numerous communities of practice within higher education learning and teaching. Communities of practice do not necessarily need to be limited to one module, or even one department or school, if there is sufficient commonality between disciplines. With the global nature of social networking technologies, it is even possible to establish these communities on an international scale (Dabbagh and Kitsantas, 2012). The communities of practice can exist independent of the prevalent teaching mechanism of the institution, as they will complement practical or didactic teaching as well as student-led and PBL-based courses. The key here is the role of the lecturer/tutor in the process. For PBL, the tutor is a facilitator for the problem and also debriefs and concludes at the end of the learning unit. For didactic teaching, the lecturer is usually the sole provider of knowledge in the learning session. The aim of the Shadow Modules is for the students themselves to facilitate their own learning and debrief or evaluate their own outcomes, and therefore encounter a richer learning experience. The Shadow Modules are therefore relevant to all teaching methodologies in HE science.

The pilot study has suggested that Shadow Modules are a viable and useful activity and we intend to develop this pedagogy over the near future and to assess the long-term impact of the pedagogy to the student learning experience. Further work also needs to be undertaken to assess the sustainability of these structures in the long term. The Shadow Modules have the potential to be self-sustaining, but need to be embedded within a pedagogic structure that facilitates their continuity from year to year. Future implementation and research should enable the identification of the key pedagogical and technological features that make up a sustainable community of practice in this context.

It is clear, however, that collaborative learning is as beneficial to students outside of the formal classroom setting as it is inside. The impact of students assisting the learning of their peers has both immediate and long-term longevity. Students naturally develop their own learning groups and communities within their immediate social spheres. However they also have the potential to broaden the impact of these learning communities, to make the learning experience in higher education even more collegiate and mutualistic. With increasing pressures on resources and time for students and staff alike, the fostering of students developing communities of practice within the higher education environment is becoming increasingly important. When responding to these pressures by redesigning curricula, academics should seek to work with students, so that students become partners in learning rather than consumers of a product.

ACKNOWLEDGMENTS

This work was partially funded by a grant from the Higher Education Academy (Wales) Learning and Teaching Enhancement Fund 2011 (to SMR).

REFERENCES

Bayne, S. & Ross, J. (2013). The pedagogy of the Massive Open Online Course: the UK view. Higher Education Academy. York, UK.

Biggs, J. & Tang, C. (2011). *Teaching for Quality Learning at University*. London: Open University Press, 4th Ed.

Boulos, M. K., Maramba, I. & Wheeler, S. (2006). Wikis, blogs and podcasts: a new generation of web-based tools for virtual collaborative clinical practice and education. *BMC Medical Education*. *6*, 4.

Bruner, J. (1985). Vygotsky: An historical and conceptual perspective. Culture, communication, and cognition: Vygotskian perspectives, 21-34. Cambridge University Press. London.

de Freitas, S. (2008). Serious Virtual Worlds: A scoping study. JISC Report. From: http://www.jisc.ac.uk/publications/reports/2008/seriousvirtualworldsreport.aspx

Dabbagh, N. & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *Internet and Higher Education. 15,* 3-8.

Dillenbourg, P. (1999). What do you mean by 'collaborative learning'? In P. Dillenbourg (Ed.) *Collaborative-learning: Cognitive and Computational Approaches*, Elsevier, Oxford, UK. 1-19.

Dillenbourg, P., Baker, M., Blaye, A. & O'Malley, C. (1996). The evolution of research on collaborative learning. In: E. Spada and P. Reiman (Eds.) *Learning in Humans and Machine: Towards an interdisciplinary learning science,* 189-211. Elsevier, Oxford, UK.

Dooly, M. (2008). Constructing knowledge together. In: M. Dooly (Ed.) *Telecollaborative language learning: A guidebook to moderating intercultural collaboration online*, Peter Lang, Bern, Germany. 21-45.

Ebersbach, A., Glaser, M. & Heigl, R. (2006). Wiki: web collaboration. Springer-Verlag, Berlin, Germany.

Garrison, R. & Anderson, T. (2003). E-learning in the 21st century: a framework for research and practice. London: Routledge.

Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education. 7*, 22-30.

Hattie, J. (2008). Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement. London: Routledge.

Lipponen, L. (2002). Exploring foundations for computer-supported collaborative learning. In G. Stahl (Ed.), *Computer Support for Collaborative Learning: Foundations for a CSCL community. Proceedings of the Computer-supported Collaborative Learning 2002 Conference. Colorado, USA 7-11 January,* Hillsdale: Lawrence Erlbaum Associates. pp. 72-81.

Lave, J. & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

Kitsantas, A. & Dabbagh, N. (2011). The role of Web 2.0 technologies in self-regulated learning. *New Directions for Teaching and Learning*., *126*, 99-106.

Mercer, N. (2000). *Words and minds: How we use language to think together*. New York: Routledge.

Mercer, N. & Littleton, K. (2006). *Dialogue and the development of children's thinking*. Routledge. New York.

Nevgi, A., Virtanen, P & Niemi, H. (2006) Supporting students to develop collaborative learning skills in technology-based environments. *British Journal of Educational Technology*. *37*, 937-947.

Newland, B., Jenkins, M. & Ringan, N. (2006). Academic experiences of using VLEs: overarching lessons for preparing and supporting staff. In J. O'Donoghue (Ed.) *Technology supported teaching and learning: a staff perspective*, Information Science Publishing, London, UK. 34-50.

Orsmond, P. & Merry, S. (2012). The importance of self-assessment in students' use of tutors' feedback: a qualitative study of high and non-high achieving biology undergraduates, *Assessment & Evaluation in Higher Education*, DOI:10.1080/02602938.2012.697868

Prawat, R.S. and Floden, R.E. (1994) Philosophical perspectives on constructivist views of learning, *Educational Psychologist. 29*, 37-48.

Rogoff, B. (2003). *The Cultural Nature of Human Development*. Oxford: Oxford University Press.

Resta, P. & Laferrière, T. (2007). Technology in support of collaborative learning. *Educational Psychology Review*. *19*, 65-83.

Rutherford, S. M. & Scott, J. L. (2012). Encouraging student partnership in curriculum delivery and design by using freeware technology to facilitate collaborative learning *In*: D. Kelsey (Ed), Enhancing learning and teaching in higher education in Wales. HEA Publication. 28-32.

Scott, J. L., Moxham, B. J. & Rutherford, S. M. (2013). Building an Open Academic Environment - New Approaches to Empowering Students in their Learning of Anatomy. *Journal of Anatomy*., *224*, 286-295

Sharpe, R., Benfield, G., Roberts, G. & Francis, R. (2006). The undergraduate experience of blended e-learning: a review of UK literature and practice. http://www.heacademy.ac.uk/ assets/documents/research/sharpe_benfield_roberts_francis.pdf (Accessed October 2012).

So, H. & Brush, T. (2008). Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment: Relationships and critical factors.*Computers & Education*. *51*, 318-336.

Soller, A., Mones, A. M., Jermann, P. & Muehlenbrock, M. (2005). From Mirroring to Guiding: A review of state of the art technology for supporting collaborative learning. *Journal of Artificial Intelligence*. *15*, 261-290.

Stahl, G., Koschmann, T. & Suthers, D. (2006). Computer-supported collaborative learning. In R.K. Sawyer (Ed.) *Cambridge Handbook of the Learning Sciences*, Cambridge: Cambridge University Press. 409-426.

Sugand, K., Abrahams, P. & Khurana, A. (2010). The Anatomy of Anatomy: A Review for Its Modernization. *Anatomical Sciences Education*. *3*, 83-93.

Tomlinson, M. (2014). Exploring the impact of policy changes on students' attitudes and approaches to learning in higher education. Higher Education Academy. York, UK.

Vygotsky, L. S. (1978). *Mind and society: The development of higher mental processes*. Cambridge, MA: Harvard University Press.

Wenger, E., McDermott, R. & Snyder, W. M. (2002). *Cultivating Communities of Practice*. Boston, MA: Harvard Business School Press.

Wheeler, S., Yeomans, P. & Wheeler, D. (2008). The good, the bad and the wiki: Evaluating stuent-generated content for collaborative learning. *British Journal of Educational Technology*. *39*, 987-995.

Wilkinson, S. C. (2011). Using socially constructed technology to enhance learning in higher education. *Journal of Learning Development in Higher Education*. *3*.

Zheng, L., Yang, Y., Cheng, W. & Huang, R. (2013) Emerging approaches for supporting easy, engaged and effective collaborative learning, Journal of King Saud University. *Computer and Information Sciences*. *26*, 11–16.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 9

APPROPRIATION AND USE OF THE COLLABORATIVE LEARNING CONCEPT IN SCIENTIFIC PRODUCTION ON HEALTH

Maria L. Rangel-S**, Jane M. Guimarães, Ana de O. Barbosa, Nícia C. R. Riccio and Adroaldo Belens
Federal University of Bahia, Salvador, Bahia, Brazil.

ABSTRACT

Communication and interpersonal interaction processes have undergone numerous transformations with the evolution of telematic-based Information and Communication Technologies (ICT). The model traditionally known as mass communication, adds to other forms of communication where there is not only one transmission center, but instead rhizomatic architecture, in that mobile centers act alternately as transmitters and receivers of information. In the field of learning, this transformation is reflected in the possibility of expanding interaction between the different actors in the learning process, valuing what is currently known as collaborative learning (CL). This chapter aims to make a critical review of the appropriation and use of the concept of collaborative learning in scientific production on the bibliographic database at the Brazilian Federal Agency for the Support and Evaluation of Graduate Education (CAPES), between 2003 and 2013. The study seeks to elucidate the key areas of knowledge on this production; the topics addressed in articles in different areas of knowledge; the ownership and use of the concept of collaborative learning in scientific production on health, and its characteristics (distribution over the years, authors, research centers and media publishing). An integrated search was performed and sorted by relevance, generating 101 articles published in peer-reviewed journals between 2003 and 2013. A quantitative and qualitative analysis of this production was conducted, observing the temporal distribution and thematic areas of knowledge involved in a corpus of 83 articles on collaborative learning. Articles on health were analyzed in depth, considering the forms of

* Corresponding author: maria.lirangel@gmail.com.

appropriation and use of the concept, characterizing studies in their temporal and thematic distribution, and means of knowledge dissemination. The articles were classified in the following areas: education (school education, ICT and teacher training); administration; tourism; applied social sciences and humanities (psychology and family therapy); health (nursing, public health, bioethics, environmental health, eating disorders, neuronal rehabilitation, ICT, health education in schools, work, and health education); online journalism; engineering (electrical and civil); information design; economy; education and physical education (ICT and biomechanics). The analysis of the articles produced on health revealed a diversity of forms of appropriation and use of the concept, categorized as: appropriation of the concept (describes and operates the concept in the study); description without operation of the concept in the study; only refers to the concept (without description and operation); only operates, without reference or description. We also discuss the importance of the wider dissemination of the concept of collaborative learning among researchers.

INTRODUCTION

This study aims to analyze the forms of appropriation and use of the concept of collaborative learning in scientific production on health. The motivation for this stems from the authors' involvement in the use of distance education (DE) technologies in the area of health, within the context of implementing the Permanent Education in Health Policy at a public university in Brazil. This required professional efforts to appropriate concepts, ideas, methodologies and techniques that allow distance education based on pedagogical principles which is appropriate for the needs of training and professional qualification in the Unified Health System (SUS). This system requires training and professional qualification strategies which are focused on health work that are participatory, creative, and are able to mobilize and integrate technical, scientific and popular knowledge on health from the area of Education.

According to the title in The Lancet on health in Brazil, "Ultimately, the challenge is political, requiring continuous engagement by Brazilian society as a whole, to ensure the right to health for all Brazilian people" (Cesar Victora et al., 2011). Therefore, distance education is an important ally, in order to promote a necessary sociocultural transformation, contributing to expanding access to knowledge, information, health education and educating active subjects, who are able to promote the consolidation and strengthening of the Unified Health System.

With this perspective, collaborative learning emerges as a strategic concept in distance education practices, due to its potential to promote another type of education, which is distinguished and distanced from the information and prescriptive model prevalent in healthcare and that has a predominantly technical nature. This concept arises in education within the context of a recent contemporary society but little is known about the ways it has been used in different areas of knowledge and practices in general, and particularly in health. Addressing the scientific literature on the subject is a way to approach the reality of practically applying the concept. It is interesting to know how the concept has been applied, described and operationalized in this study, in order to evaluate its potential in distance education which is directed towards Permanent Education in Health.

PERMANENT EDUCATION IN HEALTH AND DISTANCE EDUCATION

Permanent Education in Health (PEH) has arisen in Brazil as a need for professional training in work-oriented health. It has also been reconfigured by a new society which is demanding a restructuring of the way of looking at the problems and objects of health, and the need for an interdisciplinary view of health work performed by multidisciplinary teams (Schraiber, 1997). The work process is the center for these reflections, which should be taken as input to reorganize health practices and services (Haddad et al., 1994; Ribeiro& Motta, 1996).

There are a number of difficulties that span the process of implementing PEH in Brazil, including a conceptual discussion, which may result in the displacement of the meaning which it was originally assigned. Hence, it is important to understand the conceptual distinction between permanent and continuing education (Motta, 1998). Although time and place are two aspects to which the terms refer on defining continuing and permanent education, according to Motta (1998), the term *permanent,* which is disseminated by the Pan American Health Organization (PAHO), involves changing the *modus operandi* of services, based on an analysis of social and economic determinants, and transforming professionals' values and concepts. In this sense, it proposed the professional's leading role, being placed at the center of the learning process. In turn, according to Ricas (1994) the term *continual* involves teaching activities carried out following graduation, with the goal of professional development by acquiring information using traditional methodologies.

Permanent Education appears in literature as a controversial term that focuses on various aspects, such as adult literacy, vocational training, professional development, and the education-work relationship (Rovere, 1994). The author makes an "operational" synthesis, defining Permanent Education in Health and education at work, for work and different services, with the goal of improving the population's health.

PEH was disseminated in Brazil through PAHO during the 1980s, with the goal of discussing professional training within the context of the health work process. It created the "Development of Human Resources Program" for educational activities to be placed on the government agenda as a priority. According to Haddad et al. (1994), training starts to be discussed, with the goal of seeking methodological options to use the educational processes generated by the situation of health work in different contexts.

Indeed, the complexity of health work has been mobilizing a set of efforts whose roots are in the Brazilian Sanitary Reform movement, which introduced the State's responsibility to organize training human resources in healthcare and to increase scientific and technological development, through SUS legislation.

The National Policy for Permanent Education in Health (NPPEH), established by Decree 198/GM/MS on February 13, 2004 (Brazil, 2004, p.1), defines work as a privileged place of learning, based on significant learning and the possibility of transforming professional practices. Therefore, "*bringing education closer to everyday life is the result of recognizing the educational potential of the work situation*" (Davini, 2009, p.45). Thus, this policy encourages critical capacity and non-compliance by those involved in the educational process, allowing for democratic practice and discussion on policy and practice, and stimulating actions that may modify and reorganize services.

Thus, daily health practices, where work is carried out, allow for the development of different technologies, the production of scientific knowledge and establishment of relations between a wide range of professionals and users (Schraiber, 1997, pp. 28-30). In an enlarged conception which refers to the area of work, permanent education is employed as a strategy to change health practices. Therefore PE cannot be understood solely in its pedagogical dimension, as it involves careers, working conditions and policies to value workers, etc. It is therefore a strategy that considers work as an educational principle where learning and teaching are incorporated into daily work on health that has been used as a space for testing educational technologies, particularly in the distance education format, in training processes for those in higher and secondary education.

The complexity of healthcare work has generated needs involving a network of relationships which span various purposes. One of the foci of this discussion is the training process that involves a set of strategies which are able to widen information and trigger processes of change that can reconfigure institutionally consolidated practices.

NPPEH aims to promote dialogue between education and work, emphasizing the logic of in-service education from a link between SUS managers and training institutions. In order to comply with the law, the State is expanding its functions and powers to respond to new demands and develop training and permanent education activities, built jointly by the institutions providing services and healthcare trainers. This involves taking advantage of the educational opportunities offered by the organization, developing and operating health services, but remaining aware of the improbity of reducing health and education to the exclusive logic of producing services (Paim, 2002).

The central issue of NPPEH is linking educational actions to the real context of the workplace, breaking with fragmentation and achieving "*organic relationships between education and actions and services and between teaching and health care*" (Brazil, 2004 p.2). The challenge posed is developing strategies to train individuals who are more committed to changing the healthcare model. From this perspective, distance education has been increasingly required in the national setting as a new path or possibility, as education is called to contribute to surmounting the lack of training in various areas of knowledge and promote access to education in the more remote regions. However, this intention will only be achieved in so far as the use of distance education is possible, while considering the premise of PEH. Therefore, it is necessary to reflect on the conceptual and technological options of distance learning and the principles that should guide it to conduct educational/training activities within the perspective of PEH.

COLLABORATIVE LEARNING

With the evolution of telematic-based Information and Communication Technologies (ICT), society has experienced various transformations which directly or indirectly influence every aspect of human life. These changes in society could be understood as sociotechnical transformations which promote the appearance of a new culture, which Pierre Lévy (1999) calls cyberculture.

Cyberculture has arisen from an overlap between technique, society and culture, in which the transformations attained cannot be understood by a simplistic view of cause and effect.

Agreeing with this overview, André Lemos defines cyberculture as "the sociocultural form which emerges from the symbiotic relationship between society, culture and new technologies based on micro-electronics" (Lemos, 2003, p. 12). Cyberculture, conditioned by techniques, opens up a series of possibilities which can be used in the sense of authorship and sharing and also allows for a new form of interactive immersion in and with information.

The principal characteristic of cyberculture is the possibility of networked communication, from which a number of authors, such as Manuel Castells (2006), suggested the title "networked society" to characterize contemporary society. Networked communication is made viable by the existence of a world computer network, internationally known as the Internet or "network". Forms of communication prior to the Internet are characterized by mass communication: a transmission center and producer of information which is disseminated, without the possibility of intervention by receivers. Thus, being much more than mass media, the Internet is an environment which brings interactive resources together. The generalized connection of cyberspace has the release of the transmission center of information which was previously dominated and controlled by the forms of mass communication as one of its main factors. Potentially, for the first time in history, any individual is able to generate/receive information (in any format) for/by any person in any place around the world, favoring the creation of groups with common trends and goals, in practices of collaboration and co-authorship, which have an influence on the form of knowledge production in contemporary times (Riccio, 2010).

The power of expression present in cyberculture, both on an individual and collective scale, and the growing number of subjects who are placed not only as receivers but also as producers, begin to form a "community of independent learners, dedicated to personalized paths, but are systematic practitioners of collaboration" (Pretto and Pinto, 2006, p.25).

Educational processes face new challenges in this setting; ICT provides the possibility of intensifying the teaching-learning process, highlighting characteristics such as autonomy, authorship and collaboration by the subjects involved, in order to enhance activities using collaborative practices. The transmission model of education, consistent with the characteristics of mass communication, also prevalent in contemporary times, begins to evolve towards a more interactive and participative proposal, heading towards what has been configured as a collaborative learning model. According to Dias (2001), the culture of interactive participation "is developed when all the group members, including the teacher, are taking part in a joint effort" (Dias, 2001, p.25), in which the idea of participation is involved in the way of thinking, discourse, knowledge and learning, and therefore implementing immersion processes within the contexts of knowledge construction. According to Lévy (1999), interactivity could be understood as the possibility of subjects actively participating, intervening in the process with actions, reactions, becoming the receiver and issuer of messages which gain plasticity and allowing for their immediate transformation. In other words, interactivity creates new paths, new trails and new possibilities, asserting the subjects' processes and choices.

In accordance with Torres et al. (2004):

> Collaborative learning is a teaching strategy which encourages the student's participation in the learning process, making learning an active and effective process. It is a set of educational approaches which are also called cooperative learning or learning in small groups. (p.3)

However, for a number of authors there is a distinction between the terms "collaboration" and "cooperation", which leads to an understanding that the expressions collaborative learning and cooperative learning are not synonymous. For example, Panitz (1999) makes a comparative study between the two terms and argues that:

> Collaboration is a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning, and respect for the abilities and contributions of their peers; cooperation is a structure of interaction designed to facilitate the accomplishment of a specific end product or goal through people working together in groups (p.3).

On the topic of collaborative learning, Panitz continues as follows:

> Collaborative learning is a personal philosophy, not just a classroom technique. In all situations where people come together in groups, it suggests a way of dealing with people, which respects and highlights individual group member's abilities and contributions. Authority is shared and there is acceptance of responsibility among group members for its actions. The underlying premise of collaborative learning is based upon consensus building through cooperation by group members, in contrast to competition in which individuals compete against other group members. CL practitioners apply this philosophy in the classroom, at committee meetings, with community groups, within their families and generally as a way of living and dealing with other people (pp.3-4).

In our understanding and considering the cybercultural context, what is sought in collaborative learning, is a communication model where we do not have just a transmission center, but networked or rhizomatic architecture in such a way that the mobile centers act alternately as issuers and receivers of information. Thus, the subjects take part in the teaching and learning process alternately as centers for this process and collaborate towards a collective construction of knowledge based on respect for the knowledge and abilities of all those involved.

METHODOLOGICAL ASPECTS

This study uses the method and techniques of quantitative and qualitative research. A bibliographic search was carried out on the CAPES journal database, as it is a virtual library which brings together and makes available national and international scientific production to educational and research institutions in Brazil. Among other attributes, it has a collection of more than 35,000 journals, 130 referential bases and 11 bases dedicated exclusively to patents.

An integrated search on the subject of "collaborative learning" was carried out on December 11, 2013. This search, ordered by relevance, produced 101 articles published in peer-revised journals between 2003 and 2013. 18 articles were discarded; 17 of these due to duplicity and one as it was not related to the theme. However, 83 articles remained for analysis on the theme. The abstracts were submitted for reading and categorizing, while observing the areas of application and year of publication.

The articles were classified according to the following areas: education (teacher training/cyberculture teaching, ICT in schools, social pedagogy and distance education/types of collaborative practices); administration; tourism; applied social and human sciences (psychology and family therapy); health (nursing, public health, bioethics, environmental health, eating disorders, neuronal rehabilitation, ICT, education for health in schools, work and education in health, education in health); online journalism, engineering (electrical and civil); communication; law, linguistics and applied informatics. This was followed by a qualitative and quantitative exploratory analysis of a corpus comprising 20 articles classified in the area of health. These articles were qualified according to the following sub-themes: Collective health (1), Health policy (1), Environmental health (1), Phonoaudiology (1), Physical education (1), Work and education on health (1), Bioethics (1), Education in health (2), Nursing (4) and Psychology (7).

Finally, an exploratory qualitative approach of these articles revealed diversity in the forms of appropriation and use of the concept of collaborative learning. Therefore the articles were categorized as follows: appropriation of the concept (describes and operates the concept in the study); description without operating the concept under study; only refers to the concept (without a description and operation) and only operates, without reference or description.

RESULTS

General characterization of the use and areas of applying the expression "collaborative learning" in the scientific production studied

Eighty-three articles were found which were indexed under the description "collaborative learning" on the database. These present the following general characteristics:

A) Percentage Distribution

In figure 1, which presents the percentage distribution for the 83 articles found by year of application, a growing trend for publishing articles indexed under the description "collaborative learning" is observed. There was only one article each year in 2003 and 2004 (1.2%). Three articles were published in 2007 (3.6%) and there were 16 (sixteen) articles (19.3%) the following year (2008). This percentage increased to 22.9% in 2010, with 19 articles, and the largest number of publications was identified in 2012, with 21 articles (25.3%).

B) Area of Application for the Term "Collaborative Learning"

On taking the use of the term collaborative learning in relation to the areas of knowledge from the 83 articles selected as a reference for analysis, it was verified that the area of Education presented the highest percentage (34.9%) for use of the term, followed by the areas of Health (24.2%) and Administration and Management (18.1%), as shown in figure 2.

Attention should be paid to the fact that Communication and Journalism presented the lowest percentage (1.2%) within the other areas.

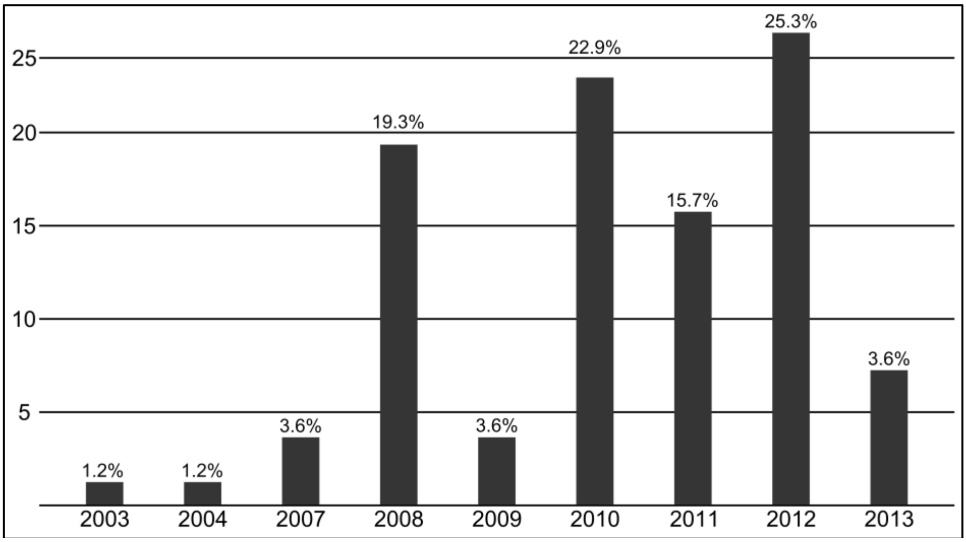


Figure 1.Percentage distribution of articles by year of publication

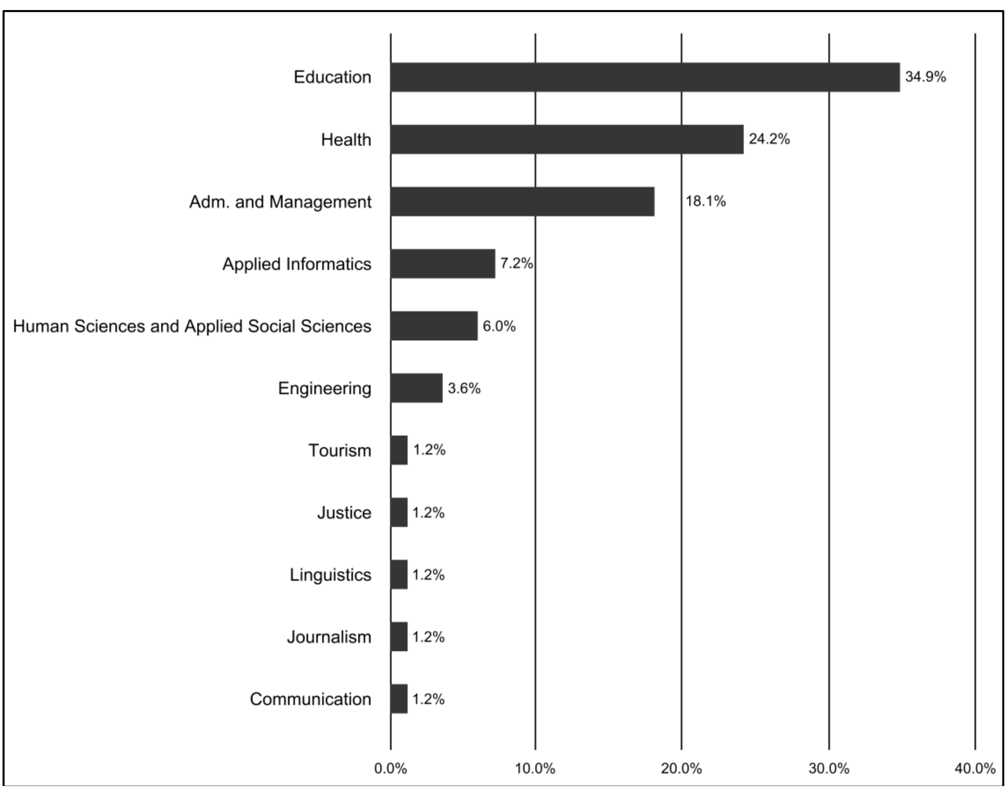


Figure 2. Percentage distribution of articles by application area.

These findings could be related to the level of incorporating information and telematic-based communication technologies (ICTs) in the distinct fields of knowledge, considering that the application/operationalization of collaborative learning is sometimes measured by technological resources, in addition to language. Thus, Gutierrez (2002, cited in Ruiz-Moreno et al., 2008, p889) highlights:

> The need to train teachers to use technological resources in order to enhance the teaching-learning process and, consequently, professional training in various areas. The area of health in particular constitutes one of the sectors of the greatest impact for ICTs in the fields of education, healthcare and research.

The term “collaborative learning” was used in 20 articles within the scope of Health, mainly within the areas of Psychology (35%), Nursing (20%) and Education in Health (10%), as figure 3 demonstrates.

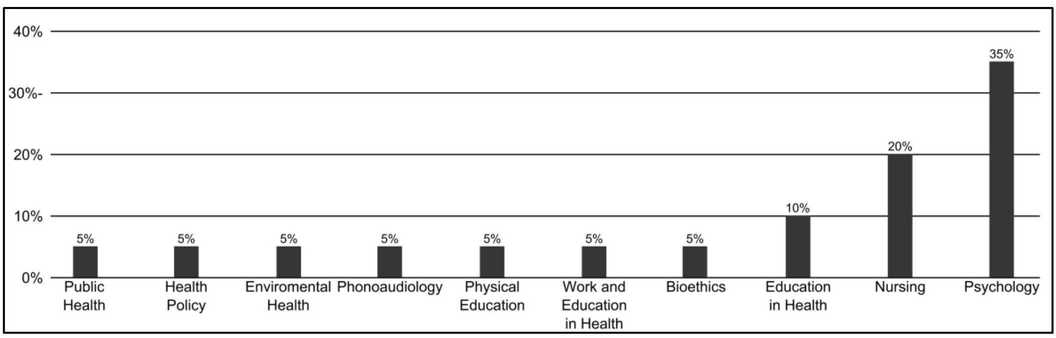


Figure 3.Percentage distribution of articles by healthcare subthemes.

C) Types of Studies and Objects of Application

With regards to the types of study in the articles analyzed, they include accounts of experiences. The majority of these are on incorporating ICT in graduation and post-graduation courses in health, in order to enhance the teaching-learning process or, to a lesser extent, the practice of education in health in secondary education.

In relation to the objects of applying the concept of collaborative learning in the corpus analyzed, the data shows use of the term associated with content such as training managers, family and group therapy, cerebral palsy, educational practices/teaching biomechanics, cardioversion and defibrillation and bioethics, among others. They also show the strong presence of virtual learning environments (Moodle, discussion lists, Eurek@Kids and Teleduc) or other technological resources (cybertutor and biomec) which mediate the collaborative learning process.

D) The Advantages and Disadvantages of Collaborative Learning as a Tool

In this aspect, the data analyzed reveals a consensus with regards to the advantages and limits/challenges of virtual educational practices. The following are indicated as advantages: valuing affection in the teaching-learning process; flexibility of space and time for study; the student's autonomy as the subject of the learning process; promoting interaction and multiple authorships; developing interpersonal abilities and encouraging critical thinking (Rangel-S.et al., 2012; Cogo et al., 2010).

The following can be identified as limits/challenges to virtual educational practices: the need for training (teachers and students) in order to use technological resources; difficulty in accessing the Internet; the teacher's physical absence; difficulty in administering the multi-synchronous temporality of virtual environments and training experiences in traditional teaching models (Rangel-S. et al., 2012; Ruiz-Moreno et al., 2008; Cogo et al., 2010).

Forms of Appropriating the Concept

With respect to describing the term collaborative learning from the corpus analyzed, it can be verified that the term under analysis is referred to, in three studies, as a process which involves information exchange and interaction between peers/subjects/actors belonging to a group/community. The aim is to explore, enhance, re-write and share contents/meanings/ understanding and thereby construct knowledge (Ruiz-Moreno et al., 2008; Sanches and Lopes, 2008; Duarte and Rezende, 2008).

Considering an understanding of the concept of collaborative learning, its use and forms of appropriation, figure 4 presents three categories for classifying articles related to the area of health: (1) appropriates the concept, describes and operates in the study; (2) describes the concept without operating in the study; and (3) only uses the concept without reference or description.

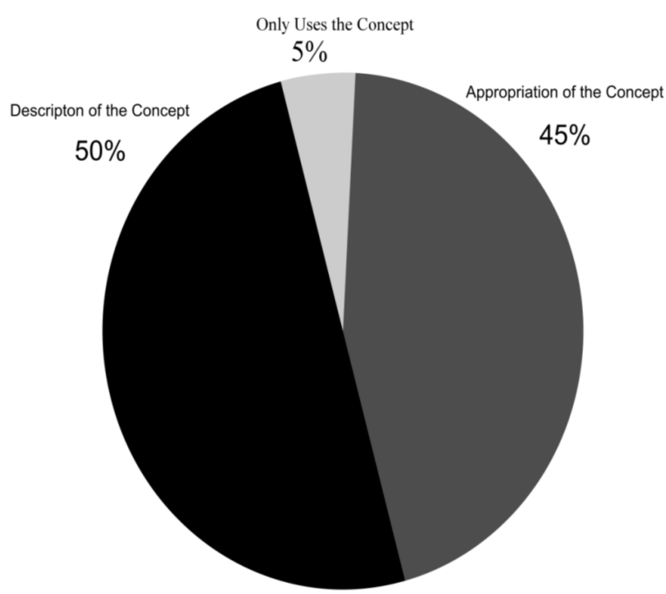


Figure 4. Percentage distribution appropriation and use of the concept.

In accordance with Torres (2007), collaborative learning can be defined as a learning methodology in which the people involved in the process learn together by working in groups and through peer exchange. In a collaborative methodology, learning is an active process which takes place through collaborative construction between peers; the group members' roles are defined by the group itself; authority is shared; the teacher is a facilitator and partner in the learning community and complements the author.

Appropriates the Concept, Description and Operation

Following an exploratory qualitative analysis of the 20 articles classified in the area of health, 15 are theoretical-empirical and 5 theoretical. With regards to appropriates the concept, description and operation**,** thirteen articles werefound. Among these, interactivity through technological mediation and the body of virtual tutors as a strategy to achieve CL is regularly valued. According to Morales-Bueno and Gómez-Nocetti (2009), applicability of the CL concept incorporates aspects related to the perception of students involved in its study, regarding the influence of interaction with colleagues and teachers. An indication that CL involves interactivity was initially observed in this work.

To Lévy (1999), interactivity represents a participative message, which is accomplished using a number of devices that are able to transform the subjects involved in the communication and, simultaneously, as issuers and receivers of the message, changing the concept of communication. In this context, interactivity plays a fundamental role in the teaching and learning process. Distanced by physical space and time, teachers and students use interactive devices which guarantee interaction, sharing ideas, commenting on or adding the teacher's or colleagues' interventions, in addition to the possibility of greater autonomy for study. Also for the author, interactivity is a growing possibility to transform the subjects involved simultaneously in the communication as issuers and receivers of the message, with the evolution of technical devices.

Cogo et al. (2010) studying nursing students' opinions on pedagogical practice on vital signs, established learning based on problems presented in the form of digital educational objects. This research suggests that the potential of distance education may be positively surprising if the subjects involved in the teaching-learning processes experience mediation which values intersubjectivity and collaborative learning. This approach favors the formation of learning communities at all levels. However, in evaluative research, Sanches and Lopes (2008) show that for a course using a distance education format in health, the choice of a Virtual Learning Environment (VLE) which allows the construction of knowledge and collaborative learning is assessed positively by students. According to Prado (2012), a VLE optimizes the teaching-learning process and communication between students and teachers.

Within the context of hospitalizing children, for example, the use of VLE via collaborative intervention is a possibility for innovation in hospital pedagogy. Its offers new opportunities which are more suitable to patients' needs, although as Torres (2007) highlights, technology alone, which is constantly evolving, does not guarantee the pedagogical evolution necessary for these children's schooling process.

Collaborative learning has communication as an interface and allows for autonomy and the development of new skills with the students' interaction, participation and cooperation in knowledge construction. From the theoretical-methodological perspective of a socio-cultural approach, learning in health education requires active student participation, awakening reflexive and problematizing skills.

For this, Cogo et al. (2010) explain that implementing collaborative learning processes requires: (1) respect for autonomy when defining needs; (2) that the different areas of the public experience multiple training possibilities and socialize knowledge through information access or formal, permanent education processes. The authors understand that collaboration is inserted in these cooperative processes and that cooperating means collectively building knowledge, this being a state which is extremely difficult to attain. According to the authors, as it is a possible pedagogical goal, teaching activity should create favorable environments and provides the opportunity for more meaningful learning in healthcare.

Thirty-two students from a nursing degree course and those from an Online Course in Humor and Personality Disorders, which is part of a Psychiatric Nursing course, participated in a quantitative study. Silva et al. (2011) when presenting an association between sociability and leadership levels, indicate that some students need greater encouragement from the trainers and tutors when they take part in this type of learning. Sociability is a factor related to the subject's ease in establishing relationships and a collaborative, good humored, sociable and pleasant attitude with his colleagues. To the authors, synchronous[1] (chats) and asynchronous[2] (forums) interactive devices are fundamental in CL.

The interactivity and sociability indicated in the article cited above, become essential elements in the CL process. Thus, Duarte and Rezende (2008), in a study which took an IT laboratory for a Physical Education graduation course at a Brazilian public university as its setting, on one hand also presents an experience which strengthens the category of appropriating the concept, description and operation in the study: "we have discovered that collaborative interaction in pairs of students with a hypermedia system may present different structures, [...], "persuasive dialogue" or "internal dialogue"." (p. 399). On the other hand, it enriches study by adding these two concepts: "persuasive dialogue" or "internal dialogue" which, according to the authors, are related to the intersubjectivity established between the students associated to support from the hypermedia system which favors internalization mechanisms.

Braga et al. (2010), in a study which presents the preliminary results of adapting an educational system called "The Fifth Dimension" (*Quinta Dimensão*), in which social interaction is a means to generalize information and a base for skills development, shows that on creating an idioculture to promote development in children with cerebral palsy, everyone's development benefited. Therefore, they reinforce the idea that cooperative learning, based on social interaction, is an important tool for the development of children with brain injuries and may be conducted in a pleasant, enjoyable and challenging way.

For Torres (2007) in his study on learning in hospitalized children, it is also through interaction and communication that overcoming one of the major difficulties in the schooling process in hospitals of keeping students motivated becomes possible. Two of the required principles derive from this: on one hand the rejection of authoritarianism for pedagogical conduction with hierarchical and unilateral motivation; on the other is attaining socialization not just by the learning but, principally when learning. The author makes a criticism of

[1]Synchronous Communication is understood as taking place simultaneously in real time (Moodle/UFBA).

[2] Asynchronous Communication allows for messages to be posted, which contact other course members, in so far that they have access to this resource. Trailblazers of distance education: Synchronous and Asynchronous Communication (Moodle/UFBA).

generalizing the idea that any activity developed together, encouraged by a final aim that leads to specific acquisitions, is a collaborative learning situation. Centralization of responsibility for the students' learning and co-responsibility for colleagues' learning processes favor learning.

A further example presented by Carvalho (2008) in Portugal, is a web project in which university students were responsible for children's education, where they experienced an exchange of identities with university students and feelings of a connection with cultural communities, to which they would not usually have access. Carvalho's example reinforces Rasera and Guanaes' idea (2010), which analyzes a family's therapeutic process from the complete transcription of recorded video sessions, and based on social poetics, seeking to identify outstanding moments in the therapeutic process experienced by the therapists and families. These authors indicate that in clinical practice the therapies influenced by constructionism also comprise a diverse set of approaches, with their own theories, methods and intelligibilities; CL is highlighted among these proposals. In an analysis by these authors, it is shown that learning is an active process in collaborative methodologies, using collaborative construction among peers, authority is shared and the teacher is a facilitator. With regards to appropriating the concept, description and operation, as per the articles analyzed, a valuation of interactivity takes place with technological mediation and mediators and, therefore, becomes a strategy to achieve CL.

Describe the Concept without Operating in the Study

Six articles were found in the second category analyzed: "describe the concept without operating in the study". The majority of the publications review literature and display some theorizing on CL in health training and practices. An effort to present the concept is observed but the studies do not explain their operationalization in practice.

According to Faria and Taveira (2011), the collaborative relationship between a psychologist and his clients is a facilitator for successful intervention results. In a similar vein, Barreto and Souza (2013) highlight that collaboration between users and knowledge producers would subsidize the development of more effective communication between these actors and mobilize them for the common practice of translating integrated knowledge. Thus, initiatives which encourage knowledge production in a collaborative manner are fundamental and there is integration between the actors involved in this process.

A further interesting experience is in relation to the courses offered in a distance education format. For Yunta et al. (2008) it is advantageous to offer these virtual training courses in bioethics, based on a cooperative learning platform, with new teaching resources and using a new educational model. This model is centered on the student, as a collaborative learning process, whose basic premise is the construction of a consensus through cooperation.

Conversely, Ruiz-Moreno et al. (2008) consider that education with autonomy, freedom, cooperation and solidarity may take place either with or without the use of new electronic mediation technologies. Such education values respect for someone else's opinion, in which everyone may freely express themselves, while understanding that the absolute truth on a specific subject does not exist but, instead, there is interaction of ideas. In this study, the authors understand that CL involves the construction of inter- and transdisciplinary knowledge. Weihs and Mertens (2013) exemplify that, in the field of environmental health, the type of collaboration which is established between the agents (who take part in knowledge production used in the distinction between inter- and transdisciplinarity), dialogue and dynamic collaboration substantially influence group activities.

Cole (2011) emphasizes that the collaborative model focuses on the psychologist as an education professional whose intervention takes place on a par with other education professionals. Therefore, the collaborative model, which is a global and interdisciplinary approach, produces the need to turn to new educational processes, or of restructuring the traditional processes of organizing the context and learning opportunities.

A further example presented by Blasca et al. (2013) signals that the change of focus of human resources in Health for Work and Health Education, signified extended training and permanent education. Holding workshop activities, a pedagogical strategy used in the study, became the differential, as it symbolized an exchange of experiences and dynamic and interactive learning. According to the authors, a network of collaborative learning may be applied to the benefit of primary health care.

Only Uses the Concept without Reference or Description

Finally, the “only uses the concept” category means that the concept is operated, without reference and description. Souza and Dos Santos (2012) present a collaborative concept as a social constructionist discourse which proposes defined actions with the collaboration of all those involved in therapeutic processes. In other words, what is to be considered the best possible participation in treating eating disorders can only be constructed in a collaborative and dialogical partnership between patients, families and professionals.

In the study, the authors seek to understand how the families construct justifications for taking part in a support group within the context of treating eating disorders. This group constitutes a space for listening and exchanges between participants. The coordinators for these activities seek to position the family as specialists in constructing the patient’s improvement and understand their role as facilitators in these conversations. Family participation in treatment was the triggering theme in the conversations. They gave their opinions following a suggestion made by a participant at a previous group meeting. Or, in other words, the topics were put forward spontaneously following the statements made by families seeking encouragement and mutual support.

The authors drew on the construction of meanings which have a place in linguistic exchanges, understanding this meaning as a dialogical construction. Therefore, they understood that human relationships produce language and understanding in a collective, continual, contextual, dynamic and complex process. They ended the study considering a challenge for professionals to trust the families to provide care to patients diagnosed with eating disorders, providing an opportunity for the family to participate in conducting the treatment. They understand the importance of speculating on actions defined with the collaboration of all those involved or, in other words, treatment can only be constructed with a collaborative and dialogical partnership established between patients, families and professionals.

Therefore, in this article the authors apply collaborative learning as a methodology which orientates an action, although it does not conceptualize it, merely constructing a methodological meaning of teaching-learning, on approaching dialogicity and sharing, among other aspects related to the theme.

CONCLUSION

Leadership from the area of education in scientific production on CL is evident in this study (which is expected), followed by healthcare, highlighting psychology and nursing.

There has been a growing use of the CL concept in research throughout the years, with expressive appropriation in studies (65%), displaying its power for providing answers to researchers' questions. The results indicate studies where appropriation, description and operation of the CL concept values interactivity through technological mediation and a body of virtual tutors, as a strategy for its accomplishment. Others describe the concept without operating it in the study but present some theorizing on CL in health training and practices. Therefore, these analytical efforts, even if they do not make operationalization explicit in practice, indicate its importance for validation purposes. Finally, a study operates CL without reference and description but recognizes the importance of a collaborative and dialogical partnership established between patients, families and professionals.

Within the scope of health, it is considered that CL is often referred to as a pedagogical model characterized by the presence/existence of a collaborative learning network which is supplied as a means for health education and promotion. Thus, the area of health is configured as one of the sectors which absorbs the majority of technological resources, whether in research, assistance or even incipiently, in the field of health education and work. The therapeutic use of CL is also observed in this study, in addition to the various initiatives for graduate level training of health professionals.

It is considered that the operationalization of CL in health is strongly mediated by virtual learning environments or other technological resources. However, it is possible to identify studies which have the aim of investigating collaborative learning mediated by language (discursive interaction) and technological resources.

The collection of transformations of various orders and appropriation of educational technologies indicate the importance of redefinition in the process of qualifying health systems and services, via the permanent education of employees. Thus, training activities which include teaching-learning in a collaborative form, which value knowledge and constructs this through exchange, could be a methodological study to offer education with a link between theory and practices, strengthening the relationships between science, research, education, society and work. However, education with autonomy, freedom, cooperation and solidarity could take place either with or without the use of new electronic mediation technologies, as it respects collective opinion, while considering the construction of a space where everyone can freely express themselves and interact with ideas and knowledge.

References

Barreto J.O.M. & Souza, N.M. (2013). Avançando no uso de políticas e práticas de saúde informdas por evidências: a experiência de Piripiri-Piauí. *Ciência & Saúde Coletiva*, *18*, 25-34.

Blasca, W. Q., Picolini, M. M., da Carneiro da Silva, A. S., de Campos, K., Pinto, G. F. R., Brasolotto, A. G., Alvarenga, K de F., Maximino, L. P. & Berretin-Felix, G. (2013). Bauru young doctor project: training high school students in hearing health. *Revista CEFAC: Atualização Científica em Fonoaudiología e Educação*. *15*, 1407-1417.

Braga, L. W., Rossi, L. & Cole, M. (2010).Creating an idioculture to promote the development of children with cerebral palsy.*Educação e Pesquisa*. *36*,133-143.

Brasil, Ministry of Health. Directive No. 198/GM/MS. Brasília: Ministry of Health, January 24, 2004.

Carvalho, R. G. G. (2008).The relational dimension of the intervention of psychology services in schools/ A dimensão relacional da intervenção dos serviços de psicologia nas escolas *Psicol. Reflex.Crit*. *21*, 119-124.

Castells, M. A. (2006).Sociedade em rede.9th edition.São Paulo: Paz e Terra.

Cesar Victora et al. (May 2011).Saúde de mães e crianças no Brasil: progressos e desafios. *TheLancet*, Saúde no Brasil..

Cogo, A. L. P., Silveira D. T., Pedro, E. N. R., Tanaka, R. Y. and Catalan, V. M. (2010).Aprendizagem de sinais vitais utilizando objetos educacionais digitais: opinião de estudantes de enfermagem. *Rev Gaúcha Enferm*. *31*, 435-41.

Cole, M. (2011). Reinventando las practicas educativas del pasado para lograr el éxito pedagogico del futuro. (Dossier). *Revista de Estudios Sociales*, *40*, 23.

Davini, M. C. (2009). Enfoques, problemas e perspectivas da Educação Permanente de Recursos Humanos emSaúde. In: Brasil. Ministry of Health.SEGETS. National Policy for Permanent Education. Brasília.

Dias, P. (2001).Comunidades de aprendizagem na Web. *Inovação*. *14*, 27-44.

Duarte, M. & Rezende, F. (2008). Construção discursiva nainteração colaborativa de estudantes com um sistema hipermídia de Biomecânica. *Revista Electrónica de Enseñanza de las Ciencias*. *7*, 399-419.

Faria, L.C.; Taveira, M.C. (2011). Avaliação do Processo de Aconselhamento Vocacional: Revisão da Literatura. *Psicologia: Teoria e Pesquisa*. 27, 93-101.

Guimarães, J. M. M. & Brennand, E. G. G. (2007).Educação à Distância: a rede eliminando fronteiras. 1. ed. João Pessoa: Editora Universitária, vol 1.

Guimarães, J. M. M. & Paim. M. (2014). Importância da formação de docentes em EAD no processo de educação permanente para trabalhadores do SUS na Bahia. Available at http://inseer.ibict.br/rbsp/index.php/rbsp/article/viewFile/193/pdf_10.Accessed: 06/02/14.

Haddad, J. Q., Roschke, M. A. C., & Davini, M. C. (1994). Educación permanente de personal de salud /. Washington, D.C.: OPS, 1994. p 247.

Lemos, A. (2003).Cibercultura: alguns pontos para compreender a nossa época. In: A. Lemos and P. Cunha (Eds.). *Olhares sobre a cibercultura*, Porto Alegre: Sulina. 11-23.

Lessa, G. M., Guimarães, J. & Paim. M. (2014).Modalidade EAD: contribuições da capacitação de gestores do sus, 2012. Available at: http://www.abed.org.br/congresso2012/anais/166a.pdf. Accessed on: 06/02/14.

Lévy, P. (1999). Cibercultura. São Paulo: Ed. p34.

Morales-Bueno.P & Gómez-Nocetti, V. (2009).Adaptation of the Manassero and Vázquez Attribution Motivation Scale.*Educación y Educadores*. *12*, 33-52.

Motta, J.I.J. (1998). Educação permanente em saúde:da política do consenso a construção do dissenso. 227 f. Dissertação (Mestrado em Educação e Saúde) – Núcleo de Tecnologias Educacionais em Saúde. Universidade Federal do Rio de Janeiro, Rio de Janeiro.

Paim, J. S. Saúde (2002). Saúde, Política e Reforma Sanitária. Salvador. CEPS-ISC.

Panitz, T. (1999). Collaborative versus cooperative learning: a comparison of the two concepts which will help us understand the underlying nature of interactive learning. *Cooperative Learning and College Teaching*. *8*, 5-7.

Prado, L. C. S. (2012). Virtual learning environment in nursing education: an experience report. *Revista Brasileira de Enfermagem*. *65*, 862-866.

Pretto, N.L. & Pinto, C. da C. (2006).Tecnologias e novas educações. *Rev. Bras. Educ. 11*, 19-30.

Rangel-S, M. L., Barbosa, A de O; Riccio, N. C. R. & de Souza, J. S. (2012). Redes de aprendizagem colaborativa: contribuição da Educação a Distância no processo de qualificação de gestores do Sistema Único de Saúde (SUS). *Interface (Botucatu).*, *Botucatu*. *16*, 545-55.

Rasera, E. F. & Guanaes, C. (2010). Momentos marcantesnaconstrução da mudançaem terapia familiar. *Psicologia: Teoria e Pesquisa*. *26*, 315-322.

Ribeiro, E. C. O. & Motta J. I. J. (1996). Educação Permanente como estratégiana-reorganização dos serviços. *Divulgação em Saúde para Debate*. *12*, 39-44.

Ricas, J. A. (1994). Deficiência e a necessidade: umestudo sobre a formação continuada de pediatras em Minas Gerais. Belo Horizonte. Doctoral dissertation.Faculty of Medicine in RibeirãoPreto.University of São Paulo, São Paulo. p232

Riccio, N. C. R. (2010). Ambientes Virtuais de Aprendizagem na UFBA: a autonomia como possibilidade. Doctoral dissertation.Faculty of Education, Federal University of Bahia (UFBA). Salvador.

Ruiz-Moreno, L., Pittamiglio, S. E. L. & Furusato, M. A. (2008). Discussion lists as a teaching and learning strategy for postgraduate health studies. *Interface - Comunicação, Saúde, Educação*. *12*, 883-892.

Rovere, M.R. (1994).Gestion estratégica de la Educacion Permanente de Personal de Salud.Série Desarrollo de Recursos Humanos ,100. Organización Panamericana de la Salud. EUA.

Schraiber, L. B. (1997). Medicina tecnológica e prática profissional contemporânea: novosdesafios, outros dilemas. Doctoral dissertation. University of São Paulo, São Paulo.

Sanches L. M. P. & Lopes, M. H. B. M. (2008).Educação a distância sobre cardioversão e desfibrilação para enfermeiros. *Rev Bras Enferm*. *61*, 583-8.

Silva. M. (2006).Criar e professorarum curso online: relato de experiência. In: M. Silva (Ed). *Educação online,* 2nd edition, p550, Belcoes Loyola, São Paulo.

Silva, E. C. da; & Corradi-Webster, C. M. (2011). Competência social para interagir em ambientes virtuais de aprendizagem. *Invest y Educ Enferm*. *29*, 97-102.

Souza, V.L. & Dos Santos, M. A. (2012). Family members of persons diagnosed with eating disorders: participation in a group setting. *Psicologia: Teoria e Pesquisa*, *28*, 325-334.

Torres, P.L., Alcântara, P.R. & Irala, E.A.F. (2004).Grupos de consenso: umaproposta de aprendizagem colaborativa para o processo de ensino-aprendizagem. *Revista Diálogo Educacional. Curitiba. 4,* 29-145.

Torres, P.L. (2007).Online learning laboratory: a collaborative learning experiment with the use of the Eurek@Kids virtual learning environment.*Cadernos* CEDES. *27,* 335-352.

Yunta, E.R.; Herrera, C.; Stepke, F. L. (2008). Enseñanza Virtual de La Bioética. Desafíos. *Acta Bioethica., 14,* 47-53.

Weihs, M. & Mertens, F. (2013).Os desafios da geração do conhecimentoemsaúde ambiental: uma perspectiva ecossistemica. *Ciência & Saúde Coletiva. 18,* 1501-10.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 10

COLLABORATIVE LEARNING AND 3D TECHNOLOGY

Dragan Markovic, Irina Branovic* and Ranko Popovic
Singidunum University, Belgrade, Serbia

ABSTRACT

Collaborative Learning is a common term for a variety of educational approaches involving grouping and pairing of students for the purpose of practicing argumentation and critical thinking through interaction with peers. Although collaborative learning has been widely researched and advocated throughout the professional literature in the last decade, matching available tools with group learning activities and different student profiles is still a complex task.

A collaborative approach itself may be successful without adequate technology support. 3D technologies open a completely new field of ideas for collaborative learning, but they are rarely designed with formal education in mind.

Virtual worlds have received considerable attention as computer supported collaborative learning environments. These environments provide the illusion of a 3D space where people can interact with 3D objects populating the environment and also communicate with each other. Virtual 3D worlds are gaining popularity, particularly among the younger generations as a knowledge and social tool. However, virtual collaborative learning is even more demanding for learners as the virtual context involves new ways of communication and collaboration.

In this chapter, we give a review of 3D virtual collaborative educational models in use today, explain the factors that influence their acceptance as collaborative learning tools, and analyze the key issues concerning effectiveness of collaborative learning in 3D. Our findings suggest that psychological and social profile of learners plays a vital role in accepting 3D technologies. Therefore we propose a novel approach in designing computer science based 3D virtual classrooms consisting in orchestrating diverse learning scenarios with resources, embed in gassessment into students' experience, and developing a smart environment in which engaged and effective collaborative learning is fostered through group activities.

Keywords: computer-supported collaborative learning, 3D technology, virtual worlds

* Corresponding author: ibranovic@singidunum.ac.rs.

1. INTRODUCTION

3D environments, multiplayer games and virtual worlds continue to capture attention and interest of educators worldwide, who are hoping to harness their pedagogic potential. The development of these technologies provoked explosion of new ideas for collaborative learning, but they are rarely designed with formal teaching and learning in mind. As such tools are developed and become easier to integrate, understanding the adoption behaviors in collaborative learning is important because acceptance is a prerequisite for participation. In other words, it is necessary investigate the factors that influence students' decision to adopt the technology for learning.

The focus of this chapter is to analyse of means in which 3D virtual worlds can be used to facilitate collaborative learning, beginning with a review of collaborative learning and its basic elements. We present a critical look at uses of 3D environments in education that specify "collaborative learning" as a rationale, and finally analyze few exemplary cases from our own experience.

Collaborative learning requires working together towards a common goal. Various names are given to this type of learning: cooperative learning, collaborative learning, collective learning, learning communities, peer teaching, peer learning, or team learning. They all incorporate group work; however, collaboration is more than cooperation because it entails the whole process of learning. This may also include students teaching one another, students teaching the teacher, as well as the teacher teaching the students. More importantly, it means that students are responsible for each other's learning as well as their own and that reaching the goal implies that students have helped each other to understand and learn.

It is important to distinguish between group learning and collaborative (sometimes referred to as cooperative) learning. Group learning is a process that brings learners working together for mutual assistance, information exchange and discussion. On the other hand, for collaborative or cooperative learning the process must include the interaction, which includes the functions as follows (Okamoto, 2003):

- facilitate mutual assistance and confidence;
- be a source of encouragement;
- encourage the sharing of skills;
- aim at an efficient and effective processing;
- tend to criticize the proposals and opinions expresses;
- a view to achieving greater quality of work.

Cooperative learning is working towards a common goal and understanding the same material; collaborative learning is the use of different skills or expertise to complete a task. On the other hand, cooperative learning is a process meant to facilitate the accomplishment of a specific goal through people working together in groups. Although cooperation and collaboration seem to overlap, in the cooperative model of learning the teacher still controls most of what is going on in the class, even if the students are working in groups. Collaborative learning, on the other hand, is getting the students to take almost full responsibility for working together, building knowledge together, changing, evolving and improving together. In both collaborative and cooperative learning the knowledge is constructed, and transformed by students. The learning process is performed by activating already existent cognitive structures or by constructing new structures that accommodate new input. Learners do not passively receive knowledge from the teacher; rather, teaching becomes a transaction between all actors in the learning process (Dooly, 2008). Among the most noted advantages of the collaborative approach are higher student-teacher interaction, linking new and prior knowledge, better use of resources, changing the role of the instructor from mentor to co-learner, promoting risk taking and decision making and facilitating problem solving.

According to proponents of collaborative learning, the fact that students are actively exchanging, debating and negotiating ideas within their groups increases students' interest in learning and encourages them to become critical thinkers. Many researchers have reported that students working in small groups tend to learn more of what is being taught (Cooperative, 1999). Moreover, they retain the information longer and also appear more satisfied with their classes. It has also been argued that group diversity can contribute positively to the learning process because students are faced with different interpretations, explanations or answers about what they are studying and this forces them to review their own viewpoints. For these reasons, forming diverse student groups in the process of collaborative learning can be very beneficial in terms of the development of knowledge and experience.

If we are truly interested in preparing our students, then our way of teaching must reflect this. Whether it is through collaborative learning or otherwise, instructors must help their students learn to interact positively with people who are different from themselves and who may not think the same way as they do. This is especially true for online collaborative activity, which is the main focus of this chapter. Through collaboration, students may come to see the importance of taking responsibility for their own learning and feel empowered to do so while learning to respect the opinions and work of their online partners. Feeling confidence is a very important factor for ensuring that students will be willing to participate and contribute in online interaction; some researchers suggest that it may be a good idea to make sure that the learners have some prior experience in small online exchanges before getting involved in a full collaborative project.

The projects and activities in which the teachers ask the students to take part should reflect the current and future needs of the learner. This means learning to use not only the technological tools available today, but also to be made aware that advances and changes in technology can and should be embraced as new possibilities. One of these possibilities is using new technologies such as 3D environments. Analysts of the future job market already speak of the need for future workers to be able to adapt to these types of work environments.

Numerous benefits have been described for collaborative learning (CL); the paper (Laal and Ghodsi, 2012) summarizes them into four major categories of social, psychological, academic, and assessment. In particular, the first three of these are defined as:

- **Social benefits:**
  - helps to develop a social support system for learners;
  - leads to build diversity understanding among students and staff;
  - establishes a positive atmosphere for modeling and practicing cooperation;
  - develops learning communities.

- **Psychological benefits:**
  - student-centered instruction increases students' self esteem;
  - cooperation reduces anxiety;
  - develops positive attitudes towards teachers.
- **Academic benefits:**
  - promotes critical thinking skills;
  - involves students actively in the learning process;
  - improves classroom results;
  - models appropriate student problem solving techniques.

Learning is an active, constructive process during through which the learner builds new knowledge from previous knowledge. Understanding new knowledge is a process involving the transformation of the learner’s mental representations. Learning is always situated in a given space, time and social environment. The environment includes both material components (documents, tools but also the classroom, resource centre or a learner’s home) and human components (other learners, fellows, teachers, educators, and parents; Keenoy et al., 2004).

Cooperation and collaboration are synonyms, meaning to act or work jointly for a common aim, however they have different nuances of meaning in the literature. Cooperative learning is sometimes defined as a relationship in a group of students that requires positive interdependence, individual accountability, interpersonal skills, interaction and processing. A distinction between “cooperative learning” and “collaborative learning” can be based upon the amount of pre-imposed structure, task-type, learning objective and group size. There are different definitions of cooperative learning in the available literature; for example, Bruffee (1993) defines cooperative learning as a process that helps students become members of knowledge communities whose common property is different from the common property of the knowledge communities they already belong to. Cooperative learning can also be described from the perspective of mutual engagement of participants in a coordinated effort to solve problem together, or as acquisition of knowledge, skills or attitudes that take place as a result of people working together to explore a topic or improve skills.

Conversely, examples of collaborative learning (CL) include group investigation, problem-based and project-based learning. In CL, the learner's knowledge construction can be shared by the entire group, that is the common knowledge significance construction is completed by whole group. Thus, collaborative learning can effectively improve the efficiency of individual learning. CL can also be defined as an approach in which groups of individuals work jointly on a well-defined learning task; Cuseo (1992) defines CL in terms of six procedural elements that distinguish it from other types of small-group learning:

- *intentional group formation*: The criteria used for deciding the composition of groups is predetermined and designed based on the learning objectives and/or the characteristics of students in the cohort;
- *continuity of group interaction*: CL groups sustain their discussion and interactions over a substantial or extended period of time, so as to allow for continuity and to create sufficient opportunities for building rapport and social cohesion;

- *interdependence among group members*: This involves creating the perception of group members that they are linked in a way that one cannot succeed unless everyone succeeds;
- *individual accountability*: Members are accountable for their own performance as well as that of the group overall;
- *explicit attention to the development of social skills*: Instructors must take deliberate steps to foster social competencies, e.g. through explicit instruction on effective skills for communicating and relating to others or the provision of opportunities for students to reflect on and evaluate the social interaction process;
- *instructor as facilitator*: The role of the instructor is one of an expert peer or coach, who offers advice, encouragement and clarification while promoting reflective dialogue and critical thinking through the issuing of timely and relevant questions.

A cooperative group does not automatically improve the construction of higher skills and complex knowledge structures. In order to increase the possibilities for mutual understanding and social interaction, interaction tools are needed that are adequately related both to the new concepts to be learned and to the previous experience and knowledge of the students. Flexible methods should be available for the students, to help them externalize their preliminary ideas and make their thinking processes transparent to other people. The environment and the working methods should encourage students towards mutual reflection (Lehtinen et al., 1999). The environment includes both material components (documents and tools, but also the classroom, resource centre or a learner's home) and human components (for instance other learners, fellows, teachers, educators and parents). One of the main questions for the design of computer-based learning environments is whether such participatory discussion methods can be effectively orchestrated at a distance, and if so, how this might be done.

Different tools have been developed to facilitate students' cooperation and collaborative learning. Some of the computer applications have originally been planned to be used as tools for collaboration, but there are also many programs which have been found to be helpful for social interaction, although originally planned for solo learners. There is no established way to classify the different computer supported collaborative learning (CSCL) tools. In this review we have made some basic distinctions based on the type of technological and pedagogical solutions. Research, to which we refer in the next sections, has demonstrated how different technical applications can be used to facilitate collaborative teaching and learning, including special network applications for CSCL, different multimedia/hypermedia applications and experimental simulations. It is not only the features of the applied technology but especially the method of implementation of the technology supporting student collaboration.

Many educators tend to leave CL to chance, assuming that students will simply begin to work collaboratively and productively by virtue of the fact that they are placed together in a multi-user 3D virtual world with rich communicative capabilities. Such approaches often fail to recognize the need to explicitly and thoroughly engage with the concept of CL and the elements that so define it when designing learning tasks and activities.

Collaboration in small groups has been particularly recognized as both advantageous and appreciated by students. It has been shown that small groups enable students to identify and correct misconceptions more easily and quickly and to improve understanding of the topics being studied (Gaytan and McEwan, 2007). In addition, small groups are considered as more suitable for group discussions and equal contribution of group members and provide students with a better learning experience and ultimately greater academic achievement. Our experience in collaborative teaching also confirms that students prefer working in small teams over large study groups.

The use of virtual reality (VR), 3D graphics and gamification for learning is now being further extended by the provision of entire VR environments where learning takes place. This highlights a shift in e-learning from the conventional text-based online learning environment to a more immersive and intuitive one. Since VR is a computer simulation of a natural environment, interaction with a 3D model is more natural than browsing through 2D webpages looking for information. These VR environments can support multiple users, further promoting the notion of collaborative learning where students learn together and often from each other. The focus of this chapter is to demonstrate how these new technologies can be used successfully in a collaborative approach.

The organization of this chapter is as follows: we first define the nature of collaborative learning in order to develop a preliminary conceptual framework that identifies its key aspects. As a next step, we discuss the intersection between collaborative learning and 3D technologies in expansion today. We then present our methodology and a case study to prove our approach. We conclude with the preliminary evaluation of our study and directions for future research.

2. The State-of-the-Art in the Area of Online Collaborative Learning

Lehtinen et al. (1999) present the state of the CL scene during the 1990s, with presentations of the tools and environments present at that time. Following this track, Monahan et al. (2008) present a current state of e-learning, with an overview of course management systems (CMS), collaborative learning environments (CLE) and mobile e-learning during the last decade.

A recent paper by Gubera and Arguete (2013) examines the efficacy of collaborative courses (in-class, collaborative activities with no lectures) compared to traditional lecturecourses (in-class, instructor-led presentations) and concludes that collaborative techniques may be a way to enhance professorial lectures but should not be used to replace them entirely.

Work by Zheng et al. (2013) explores advances in collaborative learning approach caused by the development of social networking and the expansion of Web 2.0, and the differences of collaborative learning between the west and the east from the cultural perspective. The authors propose three new approaches for future computer-supported collaborative learning: orchestrating diverse activities with resources, embedding assessment into learner experience and infusing smart environment with group activities.

A paper by Theng and Mai (2013) presents interesting results and student feedback on the implementation of a group-based multimedia project in a classroom through designing a constructivist learning environment, and the use of web-based collaborative tools to support collaboration and communication. Authors conclude that with the use of the web-based communication tools, group members were attracted towards collaboration. Available tools have expanded students' communities, helped them be more socialized in developing shared information and to work closely to solve problems.

There is a range of papers dedicated to an adaptive and intelligent approach for collaborative learning. For example, Magnisalis et al. (2011) critically review the recently-published scientific literature on the design and impact of adaptive and intelligent systems for collaborative learning support (AICLS). The focus is threefold: 1) analyze critical design issues of AICLS systems and organize them under a unifying classification scheme; 2) present research evidence on the impact of these systems on student learning; 3) identify current trends and open research questions in the field.

The reviewed articles indicate that AICLS systems increasingly introduce Artificial Intelligence and Web 2.0 techniques to support pre-task interventions, in-task peer interactions, and learning domain-specific activities. Findings also suggest that AICLS systems may improve both learners' domain knowledge and collaboration skills. However, these benefits are subject to the learning design and the capability of AICLS to adapt and intervene in an unobtrusive way. Finally, providing peer interaction support seems to motivate students and improve collaboration and learning.

Rubens et al. (2011) also speculate that the Web 3.0 will help users to process and sort mass of information by utilizing AI. In the domain of e-learning, artificial intelligence will likely be used not only for assisting learners, but also for gaining a deeper understanding of the learning process.

Creating CL scenarios is particularly difficult for novice teachers who do not have experience in creating and carrying out collaborative tasks. However, well-designed computer tools can help teachers in the specification of these collaborative tasks. The CSCL community has developed scripts and authoring tools that help novice and expert teachers to design more effective and sound CL scenarios; a survey of the available tools and software for developing a scenario are presented in Isotani et al. (2013). Isotani et al. have worked to develop a comprehensive pedagogical framework which serves as the basic structure to describe theory based CL scenarios and their processes. In this context, ontologies provide the necessary formalization to represent collaboration, while learning theories provide the concepts to justify and support the development of CL scenarios that stimulate the occurrence of meaningful interactions. Such formalization facilitates establishing an engineering infrastructure that allows for

1) the creation of models that clarify how individuals learn in social environments;
2) a more systematic approach to designing pedagogically sound CL scenarios;
3) the development of intelligent authoring tools that support effective collaboration.

This pedagogical framework is known as the Collaborative Learning Ontology (or just CL Ontology). Through the use of ontologies and other Semantic Web technologies, this tool can use information from students and the environment to recommend theory-based settings that aim to guarantee the quality of the learning process.

There have been different attempts to apply pedagogy principles in various applications of collaborative learning; one such attempt is presented in Hernandez et al. (2006), where the authors detail the experience of using both scenario-based and collaborative approaches in a test laboratory, for the understanding of several Transmission Control Protocol (TCP) mechanisms. Students were arranged in groups that collaborate, with the help of supporting computational tools, following a predefined activity sequence that is designed according to commonly used strategies in collaborative learning. The combination of both the scenario-based and collaborative approaches also contributes to the acquisition of desirable skills linked to general competencies of engineers: scenario analysis/design, interpretation, communication, argumentation and discussion.

Evaluation results indicate that these approaches contribute to a better understanding of the applicability of the mechanisms, to a sharing of the workload, and to the fostering of important competencies and skills for engineers. Also, the chosen collaboration techniques for structuring the experience seem to have fostered collaboration in an effective way. Nevertheless, students have also pointed out the fact that this kind of experience implies a different way of working (possibly requiring from them more implication and a higher level of dedication) and that sharing "expertise" may sometimes produce the feeling that some concepts have not been understood properly.

3. Collaborative Learning and 3D Virtual Worlds

In this section we review 3D virtual collaborative educational models in use today, explain the factors that influence their acceptance as collaborative learning tools, and analyze the key issues concerning effectiveness of collaborative learning in 3D.

In technology-enhanced education there are currently two trends that are shaping the way educational institutions (especially higher education) use technology to support learning, most often when they follow blended learning approaches. On the one hand, Learning Management Environments (LME), such as Moodle, are employed in order to centralize the access to the learning activities. On the other hand, so-called "Web 2.0" tools (such as wikis, blogs, online collaborative tools such as Google Drive) are also becoming widespread in technology-enhanced education.

While digital games have been used in classrooms for decades, in recent years there has been a heightened interest in incorporating them into teaching, spawned by the influences of social media that are changing the ways we conceive education. Closely related to games is Virtual Reality (VR) technology, which offers an immersive learning environment and supports the visualization for the learner. However, the non-tangible nature of virtual objects introduces interaction challenge and sometimes creates the difficulty in a simple task manipulation. The evolution of Virtual Worlds to their current form has its roots in the rapidly evolving field of electronic games.

The term Virtual Learning Environment (VLE) can be used in very broad terms. The virtual component of VLEs usually refers to an online, internet, or web-based component. Virtual systems, by nature, are able to be accessed from remote locations. The learning component is the identifying difference between an educational environment and other environments such as Multi-User Virtual Environments (MUVEs).Using a 3D VLE in an educational setting needs to reinforce student learning. The potential to have a full course in a 3D VLE is possible, but a close look at the amount of content and assessments is necessary. The challenge here is to transplant characteristics of traditional collaborative learning (heterogeneous grouping, positive interdependence, positive face-to-face interaction, individual learning performance assessments, social skills, and the group process) into the remotely-operated 3D virtual environment. This includes expanding the social interaction and engagement between the students with more online communication and collaborative tools. Many learning approaches today have embedded collaborative learning activities and therefore there is a need to investigate the effectiveness of such collaborations with respect to student communication and interactions.

The term Virtual Learning Environments is used both to define not only static systems (that can provide learners progress monitoring and content downloading) and multi-user Virtual Worlds. We concentrate on virtual worlds that can advance teaching and learning processes through immersion, cooperation between users, realistic simulations and multi-channel communication. Currently available 3D Virtual Worlds are sophisticated platforms that support a set of human activities and interactions, enriching the way we learn, work and socialize. The adoption of Virtual Worlds has been facilitated through internet-based applications that allow for file sharing, virtual meetings, seminars/lectures and scientific experiments (deFreitas, 2008).

There is not a single concrete definition that encompasses all the characteristics of Virtual Worlds. These characteristics strongly depend on the point of view, but a common set includes those defined by Kotsilieris and Dimopoulou (2013), namely:

- Operation in Real-time (synchronous)
- Awareness of Space World’s size
- Persistence
- Networks of people
- Use of Avatars
- Immersion
- Interactivity
- Use of Objects (along) with scripting
- Support of various multimedia types
- Communication potential.

The shortcomings of collaborative virtual environments (CVE), such as a poor sense of presence and limited non-verbal communication, have been pointed out by several authors, such as Irani et al. (2008). However, CVEs are clearly successful for multiplayer games, and for organizing meetings, which has led educators to explore the potential of 3D virtual worlds as a CVE that might motivate collaborative learning.

Allison et al. (2011) identify the challenges which need to be met to support the use of virtual world technologies in the emerging open learning context and presents two case studies of moving from 2D web-based learning environments to 3D virtual world versions of the same topic. The authors compare available open-source and commercial virtual worlds (mostly, Open Sim and Second Life) and conclude that students have engaged to a high degree and have improved their understanding of the topics almost as a side effect of participating in a shared learning environment.

Some authors such as Zinnikus et al. (2013) design their own collaborative 3D environments. In this paper, a Web-based, distributed, service-oriented and extendable collaboration framework, Collaborate3D, which provides a shared visual experience for collaborators, was described. Collaborate3D provides collaborative workspaces with native support for communication, cooperation and coordination and enables a shared visual experience of the creation, modification and evaluation of a virtual 3D design. Another example of such approach is described by Hamada (2008), where the design of an Integrated Virtual Environment for active and collaborative e-learning in theory of computation is described.

The Collaborative Learning Environment with Virtual Reality described in Monahan et al. (2008) is a web-based multi-user 3D environment that can be used for real-time teaching and as a tool for students to communicate and collaborate with each other. Communication methods provided in the system can also act as a means of social interaction for students and their peers. The system consists of a series of webpages where prospective students can register to use the environment and returning students can login to the 3D environment. Upon login, a student is presented with a personalized webpage with information on the courses registered for. From this page, users can access the 3D learning environment and begin to take part in their course. The 3D environment is presented through a webpage which is split into two distinct sections. The upper section consists of the actual VR environment while the lower section provides a Graphical User Interface (GUI) with tools for communication.

When evaluated, collaborative virtual environments proved very successful. The majority of test users found the virtual environments intuitive and highlighted the social presence that they provide as a major advantage. In general, they found the presentation of the system and learning material visually appealing.

Various works can be found that tackle different technology aspects of virtual environments; for example, Tsiatsos and Konstantinidis (2012) explore how the effective design principles of popular video game franchises can be adopted and adapted in order to enhance the students' educational experience in 3D virtual Computer Supported Collaborative Learning (CSCL) environments.

Prasolova-Førland et al. (2007) argue that social awareness is essential for effective learning, and that 3D Collaborative Virtual Environments (CVEs) that have been proposed as a tool for social awareness support in an educational context as the natural environments are often not sufficient for this purpose. To overcome the shortages of 3D environments in this context, the authors propose to supplement 3D CVEs with mobile devices. They present the design and implementation of a system for social awareness support, which combines a 3D CVE and mobile devices (PDAs).

Matcha and Rambli (2013) report their exploratory study's finding based on the participants' behaviors while interacting with Augmented Reality based system in group learning environment. Recent research in this area showed that technology somehow hinders the communication and interaction of group members. Therefore, as suggested by many researchers, reintroducing the physical interaction could reduce these obstacles. Augmented Reality (AR) is the technology whereby the physical and virtual objects can co-exist in real time. The physical objects can be used to interact with the system. Physical objects were the main interacting material that group members referred to and used. These results suggested the importance of incorporating physical objects in collaborative AR based system. Furthermore, this study showed positive evidence to strengthen the raised conjuncture that AR could be one of the effective tools to support collaborative learning.

Work presented in Zurita et al. (2013) is the first attempt to describe the advantages of cloud computing applied for collaborative learning. Cloud technologies can play an important role supporting this type of learning, since it requires ubiquitous computing support, connectivity and access to data across various scenarios: on the field, in the classroom, at home. A software architecture schema which can be used as a basis for integrating existing cloud services into new applications supporting learning activities is presented.

Of particular interest to our research is the work of Tsiatsos et al. (2009) which reviews and compares the most promising collaborative virtual environment platforms, which have been used or proposed for supporting educational activities in terms of their potential to support collaborative e-learning. The most promising environment according to the results of this review is Second Life. Second Life is further examined by validating the platform's features, philosophy and policies, against some basic design principles for collaborative virtual learning environments, in order to better assess its design adequacy for online learning. Furthermore, this paper presents the features that we have implemented within the Second Life platform, in order to facilitate the collaborative e-learning scenario.

Sutcliffe and Alrayes (2012) report on two studies on collaborative learning in Second Life. The first is an ecological study of Second Life used in an undergraduate class, by observation, interviews, and limit surveys. Use of Second Life motivated students with good user experience, although they view it as a games technology. Second Life was used to prepare virtual meetings and presentations but not for online discussion, with Facebook providing collaborative support. In the second experimental study, the effectiveness and user experience with Second Life and Blackboard were compared, including a face-to-face control condition. There were no performance differences overall, although face-to-face was quicker and was preferred by users.

The use of 3D environments for teaching and learning in general, and collaborative learning in particular, is not without its problems and pitfalls. For example, in certain instances, the features and intricacies of a 3D environment or world may work to the educator’s disadvantage, distracting or discouraging students from attending to the key conceptual tasks in a collaborative learning activity (Jacobson et al., 2008). The need for navigation, exploration and object manipulation, and to use a particular type of user interface and/or hardware device to perform these tasks, may also impose an additional cognitive load on the learner.

4. MULTI-USER 3D COLLABORATIVE LEARNING ENVIRONMENTS

In recent years there has been growing interest in the use of multi-user virtual environments (MUVEs) as collaborative learning environments. MUVEs provide the illusion of a 3D space where people can interact, as a vatars, with 3D objects populating the environment and also communicate with one other; typical examples are Second Life, OpenSimulator, Active Worlds, and Open Wonderland. Table 1, adapted from Kotsilieris and Dimopoulou (2013), summarizes the aforementioned platform characteristics.

The spatial dimension and multimodal capabilities of MUVEs offer new possibilities for designing, deploying and enacting collaborative learning activities. The main objective of the 3D virtual collaborative model is to guide learners to perform a set of collaborative activities in MUVEs that lead to meaningful learning outcomes. However, just as in face-to-face environments, productive learning interactions among participants are not guaranteed and some mechanisms must be provided to foster collaboration (Ibáñez, 2013).

Table 1. A comparison of virtual worlds platforms. Adapted from Kotsilieris and Dimopoulou (2013)

	Active Worlds	Open Sim	Second Life	Open Wonderland
Open Source	No	Yes	No	Yes
Free of charge	As a visitor/Yes	Yes/Yes	As a visitor/Yes	Yes/Yes
Programming Language	C	C#	C++	Java
Avatars	Yes	Yes	Yes	Yes
Free Configuration	Yes	Yes	No	Yes
Features	Internet browsing, on-line voice chat, instant messaging etc.			
		Easy content creation, scripts development by end-users		Application sharing

Physical objects support collaboration both by their appearance, physical affordances, their semantic representations, their spatial relationships and ability to help focus attention. Real objects are more than just a source of information, they are also the constituents of the collaborative activity, especially in multi-participants setting.

We propose a novel approach in designing computer science based 3D virtual classrooms consisting in orchestrating diverse learning scenarios with resources, embedding assessment into students' experience, and developing a smart environment in which engaged and effective collaborative learning is fostered through group activities. This approach aims to overcome one of collaborative virtual environments major issues: communication.

Proposed approach is applied by the use of OpenWonderland (OWL) client-server toolkit for building 3D virtual worlds. OWL is highly modular and designed with a focus on extensibility Kaplan and Yankelovich (2011). Within an OWL scene, students can communicate with audio, share live applications and documents. This toolkit is chosen over other similar ones for several principal reasons:

- It is completely extensible; developers and graphic artists can extend its functionality to create entirely new worlds and add new features to existing worlds. Application design is modular so that it can be extended by developing plugins; this was the approach we followed in integrating our simulators into OWL and developing new plugins.
- It features tight integration of immersive, high-fidelity stereo audio. Participants in a scene can hear other people present in a virtual space at high sound quality. Since voices or other sounds become softer as you move away from them, OWL easily supports multiple, simultaneous conversations within the same virtual space, something not possible with current audio or video conferencing technology.

Besides its immersive and communication capabilities that enable the deployment of collaborative social spaces, OWL offers particular features useful in supporting collaborative learning collaboration (Ibáñez, 2013):

- The environment can be customized by designers' artwork and multimodal information can be included both statically and dynamically.
- The OWL scripting mechanism allows the interaction customization of 3D objects for learning purposes.
- OWL has capabilities to assign users to groups, along with a security mechanism that restricts interactions with assets according to group membership.

3D objects in OWL have a well-defined life cycle that includes the ability to save them for storage and reuse. OWL has a modular structure that enables extensibility and flexibility. Modules are pieces of Java code that envelope a feature or a functionality that can be plugged in into a core OWL project. This means that the focus was on developing tools for business collaboration such as file sharing and voice communication. On the other hand, OWL is far less sophisticated regarding the tools for creating content in-world, and it is limited to importing models built in external 3D modeling tools.

When designing a collaborative approach, we considered a variety of techniques appropriate for use within a higher education (group discussions, assigning discussion leader, forming clusters, buzz groups, jigsaw) such as those described in "The basic collaborative learning techniques" (Iowa State University). Specifically, we found that group discussions and three-step interview are the most appropriate for our case. In three-step interview, students interview each other, then report what they learn to another pair. This method helps students network with each other and develop communication skills. Having borrowed ideas from both grounding theory and past experiences, we proceeded with the process of developing collaborative virtual classrooms, which is described in the next sections.

5. Case Study: Collaborative Virtual Labs

5.1. Composite-Component Model

Design and implementation of virtual classrooms in our approach is based on a component composition model. Component composition technique can facilitate development of a reconfigurable and evolutionary system, providing efficient modular structure.

The starting point in defining labs is to import basic 3D objects-components, which can have both rendering and functional component. The library of basic components is then further extended by introducing new compositions. This process implies relating and combining new 3D objects (3D composition components) into levels, as well as adding new functionalities and tools. Interactive functionality is then added to each object and the procedure is repeated until the highest level of composition is reached. The library allows the user to move through different levels, to display different components of the same level, and to "disassemble" each composition to its constituent parts. Disassembling can continue down to the basic component. At the same time, every component is a part of higher level composition, and can be used for defining new compositions of objects. This approach allows for easy navigation through different levels of the model, which has been the starting idea in developing virtual educational model we describe. The model itself is scalable and adaptable to different uses and applications. Levels, or composites of 3D cells form a hierarchy, which is then used by instructors for creating sub scenes designed for different assignments. By rearranging the scene graph, instructors can define new sub scenes, and drag components to different levels. 3D objects in a particular assignment are defined by tutorials which contain lesson slides, animations, and simulations. Knowledge of a certain subject can be extended by studying components at the current level, the level below or the level above.

Figure 1 shows a typical scene graph in OWL tool with 3D objects forming the composite component hierarchy. This scene graph is displayed in a dialog form which shows the spatial relationships between objects and allows for rearranging the object hierarchy. The world (Internet) contains Network objects, which contains Computer objects, and so on. Capabilities can be attached to every object in the lower left panel of the figure 1; for example, an object in the hierarchy can be used for teleporting to other parts of the scene (portal capability), for playing audio or can be made "sit-able" by an avatar.

For example, the Computer object model, as can be seen from figure 1, might consist of the following data:

- 3D model (data about what Computer looks like)
- position (where Computer is located in the scene)
- scale (Computer dimensions inside the scene)
- behavior (interactivity and communication)

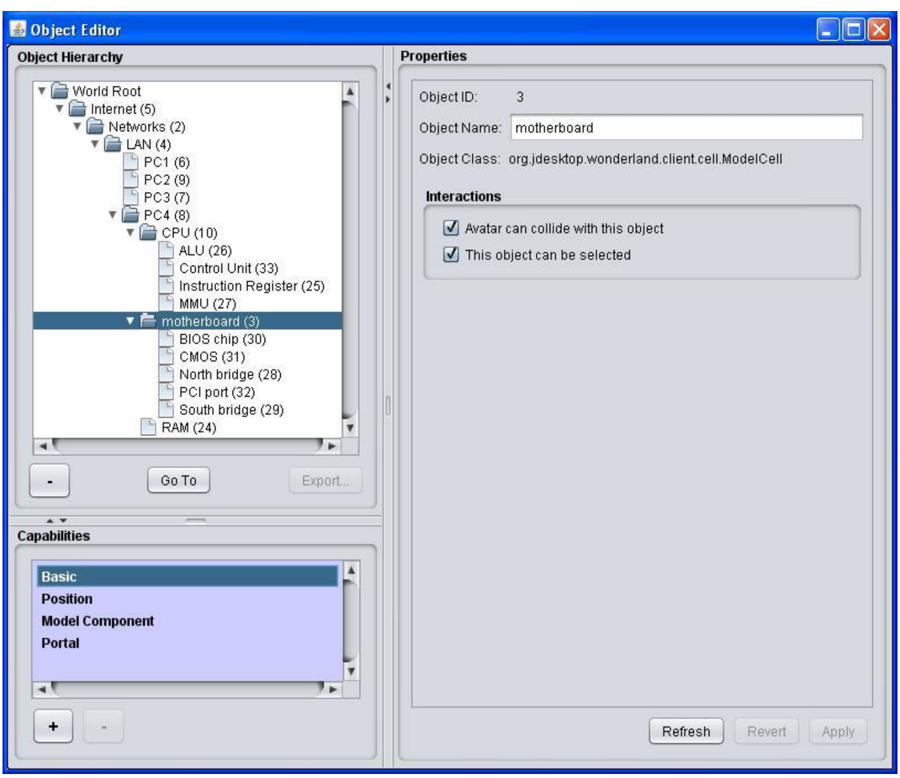


Figure 1. A typical scene graph dialog in Open Wonderland (OWL) which applies the idea of a composite-component approach to 3D scene generation. The Object Editor component of OWL shown in figure allows for rearranging the scene hierarchy (upper left panel), assigning capabilities to 3D components (lower left panel), and displaying object properties (right-hand panel).

5.2. Virtual Labs

In this section we describe several case studies which illustrate how collaborative approach can be applied to real-life cases of virtual classrooms. Specifically, we describe virtual world laboratories for sensor networks, digital forensics, and introductory computing courses. Finally, we describe how the idea was applied to an integration of various simulators in virtual 3D computer science classroom.

A major advantage, offered by the use of collaborative projects by organizing virtual classrooms, is represented by opening a stock of interactive media resources available globally. Students can explore areas of interest in an organized collective manner. The information found can be used for planning, problem solving activities, homework and essay writing. This way of organizing is essential for creating more student-centered learning environments of exploration and research, where the teacher takes other roles than sole provider of information.

The OWL environment is extended by adding the possibility of logging students' activities, for the purpose of discovering their behavioral patterns. Log file follows the learning process of every student. By analyzing the log file for a particular student, the instructor can identify his learning habits, and decide to change modules (i.e. merge or split groups, extend the assignments with new content, add new scenes, or apply another collaborative learning technique). Since students see the same lesson track at the same time, it is easier to cooperate on misunderstood concepts.

Prior to their participation in educational activities, learners have to be familiar with navigation rules in the virtual world. They must learn how to move their avatars within OWL by using keyboard buttons and how to interact with objects present in the lab scene. Since moving an avatar in OWL implies using keyboard shortcuts typical for gaming, this is usually easy for students who are already used to playing games; learners who are not accustomed to playing must put additional effort into this activity. To this purpose, we organize courses teaching the use of new technologies: 3D environments, tools, and simulators.

Most faculty who have included collaborative work in their courses agree that groups of between 4 and 6 students seem to work best, though depending on the task, larger groups (8-10 students) can function successfully. Determining how the groups will be formed can be more complicated, since ideally the groups should be diverse enough to include students with a range of intellectual abilities, academic interests, and cognitive styles (Cooperative, 1999).

In general, participation in virtual class is not mandatory; virtual sessions are organized in a scheduled time with instructor and a group of three or four students. Groups are formed at the beginning of a semester; our past experience teaches us that the better results in collaborative approach are obtained if we let students form the groups themselves. Teaching assistants track students' activities and communication in group work. Grading the group achievement overall is based both on the success of the final product and the group's assessment of its operations, and depends also on the type of course being taught.

In the following sections, we describe cases of virtual labs developed for different computer science courses. The first virtual lab we describe covers wireless sensor networks technology. The virtual lab teaches the fundamentals of wireless sensor design, the communication protocols used, and the application requirements of this technology. Teaching classes are closely integrated into laboratory exercises, where students are able to simulate various realistic wireless sensor network (WSN) scenarios.

Sensor networks provide a fundamentally new set of research challenges, including the design of new self-configuration protocols and distributed algorithms that are energy efficient, fault tolerant and scalable. The increasing interest in the domain of wireless sensor networks led to a real expansion of available simulators. Simulators supplement physical equipment in the classroom, allowing lecturers to demonstrate the interconnection between networking theory and relate it to virtual physical equipment. Simulators help students create a network with almost unlimited number of devices, encouraging practice, discovery, and troubleshooting. The simulation-based learning environment helps students develop skills such as decision making, creative and critical thinking, and problem solving.

Most of the commonly used simulators in the education are too complex for educational use. For this reason, we developed eWISENS (Zivkovic et al., 2014) as a discrete-event WSN simulator. It is designed for education, but can also be used for verifying and analyzing communications protocols Students can design a wireless sensor network in one of two ways. The first, self-learning, way allows the user to design various WSN scenarios on their own, and to explore WSN protocols at their own pace. The second way is focused on the laboratory exercises held on WSN course. The laboratory exercises are numerous:

- modeling a WSN in a geometric view, description of some well-known geometry structures (spanners, minimum spanning tree, relative neighbourhood graph, Gabriel graph and other mathematical concepts);
- protocols for two-dimensional and three-dimensional mesh topologies;
- data aggregation algorithms;
- the main aspects of security principles in WSN;
- energy-aware routing;
- energy management.

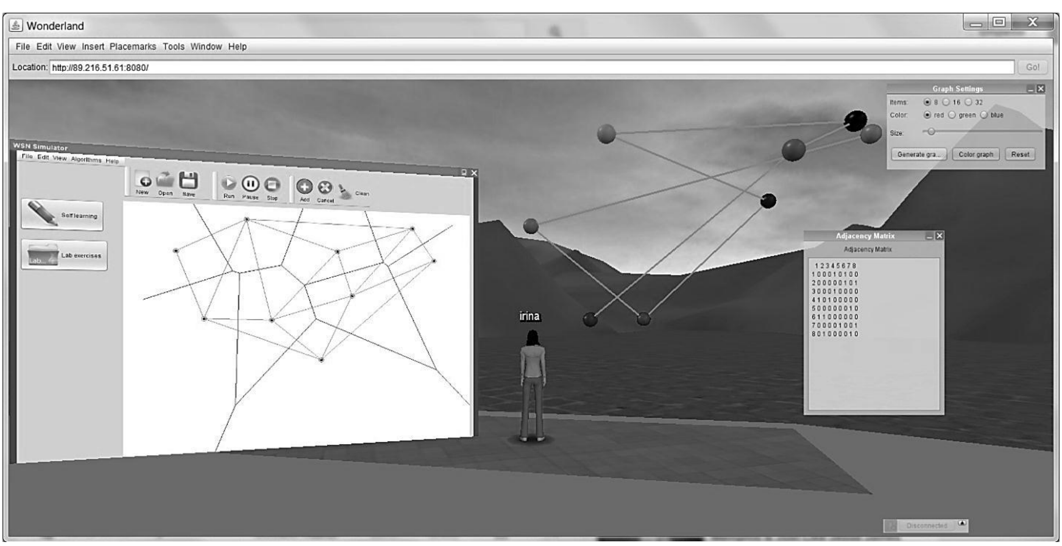


Figure 2. eWISENS simulator integrated into Open Wonderland and 3D representation of the same lab exercise in space.

The selection of the self-learning opens a blank canvas, where students can add arbitrary number of nodes and select various algorithms from the drop down menu item. Students can use the software system from their home computers and do practical homework, or explore their own scenarios. With eWISENS, students can understand complex WSN topics more easily through visualization. The use of the simulator confirmed that students benefit from it in terms of interest in the subject, confidence in the provided materials, and the ability to understand and use the presented techniques. This was the motivation to integrate eWISENS into Open Wonderland environment where instructors and students could create their own virtual networks with various topologies for teaching and learning the concepts of WSN. The fact that eWISENS is completely written in Java programming language facilitated its integration into OWL as a module.

Proved benefits of WSN simulation for education are further underlined by integrating eWISENS into a 3D environment. The first step in 3D-enabling the simulator was to import it into OWL as a 2D application; this approach is useful to get students used to 3D environment. Afterwards, selected functionalities of the simulator were developed as 3D representations. For example, the first exercise from the previous listing serves to introduce students to the sensor devices and devices capability, and to demonstrate how to model the sensors in the environment. It shows students how to deploy the nodes in the simulated environment, and how to interact with them. Students can consequently start exploring various scenarios in WSNs on their own. This exercise also includes elements of the graph theory and was ported to 3D. Figure 2 illustrates a typical scene in which there is 2D instance of the simulator on the left-hand side, and the representation of sensor network graph in 3D on the right-hand side.

Needless to say, a game-like design keeps students interested even though they are physically remote. Combined with peer cooperation, the real time visualization helps students fully understand the dynamics of the given exercise. Once the students see the same behaviour at the same time, it is easier to cooperate on misunderstood concepts. Users can explore our 3D space, analyzing eWISENS simulations from different locations.

Furthermore, we used the same setup to create a multi-lingual teaching environment for a WSN course (Khalifa et al., 2013). Students join the scene at a scheduled time; figure 3 illustrates a typical classroom session in which students run our simulator in Arab language, but can also practice running it in English and Serbian languages. This case is particularly interesting from the collaborative standpoint: we were able to create heterogeneous groups from students speaking different languages and make them collaborate successfully in the same classroom.

As a concluding example related to simulation labs, we present an example classroom in which a number of simulators in active use in education are integrated into a common virtual classroom (figure 4). Instructors can freely choose among different simulators to use for teaching: (digital logic design, processor cache, pipeline simulation, general computer system simulation, wireless sensor networks). Simulators can be added to a scene as independent objects in OWL, but more importantly, teachers are also offered separate functional modules extracted from each simulator in order to create a unique toolset suitable for the problem being taught. Conditions that every simulator must meet to be integrated in our classroom are that it is open-source, free for educational use and programmed in Java programming language with modular approach in mind. Importing simulators does not require code rewrite; instead, individual simulators (and their modules) are able to maintain their autonomy, thereby avoiding code rewrite.

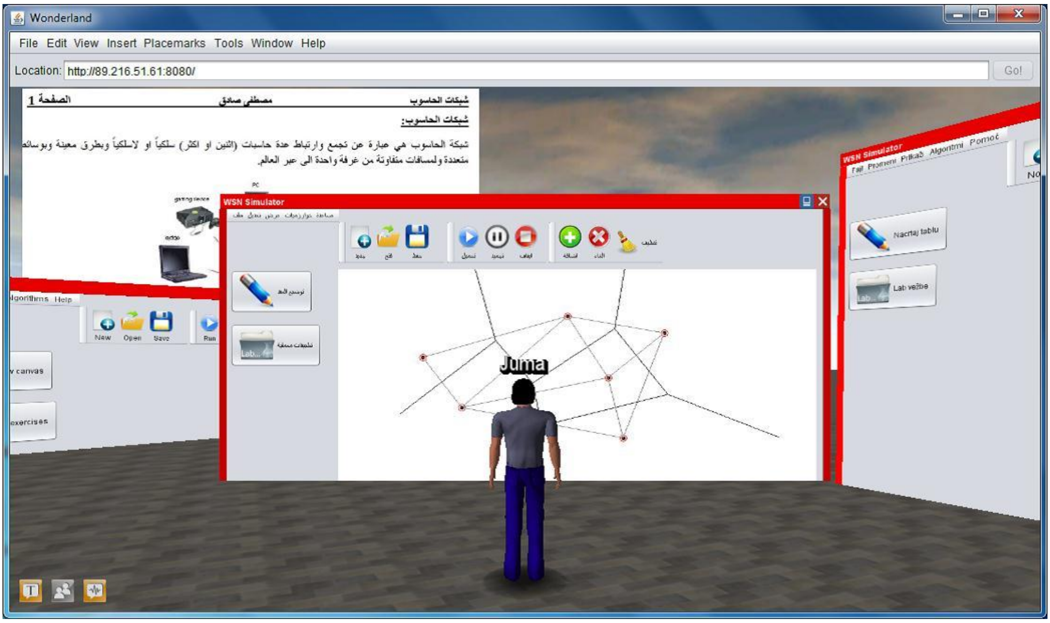


Figure 3. Multi-lingual wireless sensor network lab setup in OWL.

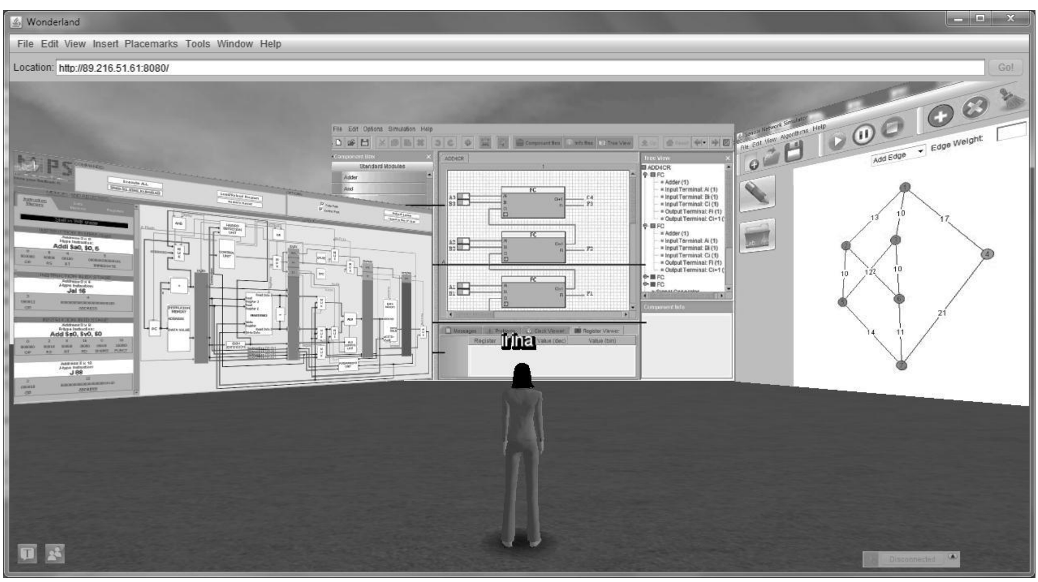


Figure 4. Different simulators integrated as modules into an OWL lab.

The next classroom we describe is designed for generic study of digital forensics (Franc, et al., 2014). Our 3D classroom is ontologically-described and implemented, using the composite-component model. Based on this, we have created our own educational model with multidisciplinary content, well-devised exercises that cover collection, storage, and handling of digital evidence and real world examples from recent past provides additional motivation for students.

The entire composite-component model is placed in a 3D Virtual Environment that allows for easy monitoring of all events (temporal and spatial), while at the same time providing an opportunity for learning, testing and student-teacher interaction. The composite-component model enables case and scene search, from the simplest to highly complex combinations, as well as storage of complete scenarios and their reuse. After each semester, the gained experience is incorporated into new syllabi and curricula.

Our collaborative virtual classroom for teaching digital forensics has the following characteristics:

- contains a set of rules that describe the behaviour of elements in an interactive, 3D environment;
- the formal ontology describes all elements contained within the environment;
- members of a group which uses the virtual 3D environment (students, professors) are also related to the ontology.

3D environment is organized as a digital forensics virtual lab, in which we first create the basic components - objects to be related, define new compositions, and finally place them all in a library. The ontology defines relations between all of the components and compositions. A scene is made up of many cases; several scenes can constitute a new case; combinations of scenes and cases are allowed (figure 5).

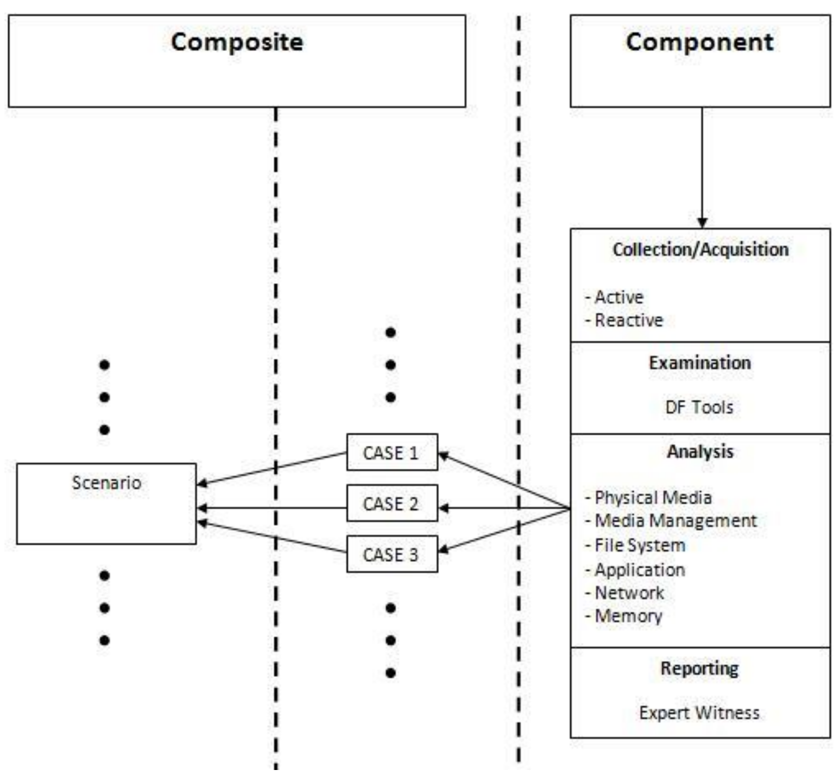


Figure 5. Composite-component model applied to a digital forensics case.

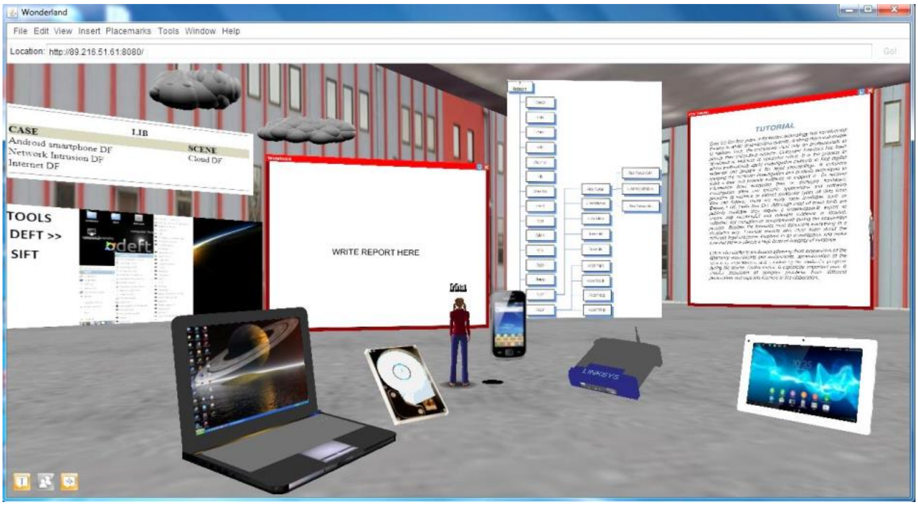


Figure 6. A typical digital forensics lab in OWL.

The appearance of the Open Wonderland exercise with all the components that make up a scene is shown in the figure 6. For example, a typical digital forensics exercise illustrated in figure 6 includes:

- acquisition of all computers and devices, as well as a command line tool that can be used for digital forensics analysis;
- forensic analysis of acquired data using available tools;
- analysis of networks and network services (Cloud - Internet, network and router forensics), using tools to analyze network traffic and trace analysis of Internet service usage;
- repetition of the previous steps in the virtual environment and checking if the same or similar solution exists in the Forensic Library;
- taking advantage of virtual environment for interaction – cooperation (given the fact that students work in groups);
- preparing the forensic report;
- saving the last scenario and report in the Forensic Library within virtual lab.

Finally, we describe the lab designed for general computer science courses in which the central, starting object is a composite model of a PC which can be virtually disassembled so that different structural components (CPU, memory, storage units, and buses) can be visualized and manipulated in carefully designed assignments. 3D model of the PC, together with other 3D models of hardware components (routers, network interfaces, computer network, and cloud system) is further used as a component in networking and net-centered courses (Brankovic et al., 2013). By their nature, assignments are modular and allow for studying hardware at different levels. Also, the composite nature of the model and assignments is very well suited for studying software execution at different levels (CPU instruction set, assembly language, high-level programming language, virtual machines, and web services).

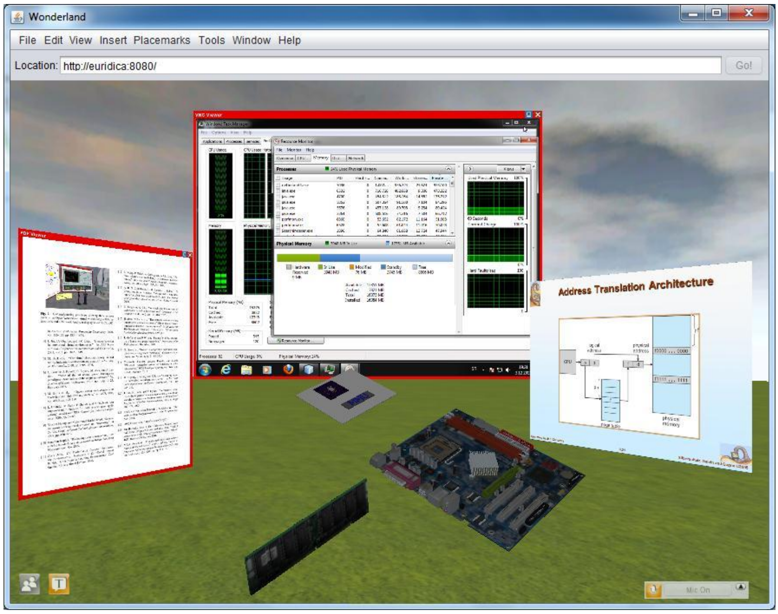


Figure 7. The appearance of the virtual lab for introductory computer science courses.

The idea of a component composite model is implemented by attaching portal capability to every 3D object (cell). By clicking on the composite component, the student is teleported to a different part of the scene where the component is disassembled, according to the scene graph model. Knowledge about the certain PC component can be further developed by studying components of the same scene level, but also by teleporting to the sublevel (figure 7).

The instructor develops the course content to support the students within the virtual environment. Support and scaffolding are additionally made available through the provision of various instructor-generated objects and structures, the coding of scripts, and the positioning of instructions at strategic locations. The instructor also facilitates classroom and group activities within the virtual classroom by furnishing guidelines and instructions.

As far as drawbacks are concerned, the initial setup of the virtual classroom requires investments in the hardware required to run a Wonderland server. On the other hand, Wonderland is completely free software, based on open source technology and sharing of resources. The instructors can include the existing teaching material into scenes; the additional effort is required only when there is no direct 3D representation of the concepts to be taught. Our experience shows, however, that the common impression of instructors and learners is that benefits of using 3D classrooms far exceed the efforts put into their creation.

6. Assessment

Cognitive assessment in collaborative and social learning requires a broad perspective about learning and the involved processes. Assessment processes have a significant effect on collaborative learning because they engage learners through accountability and constructive feedback.

Researchers have proven both the effectiveness of collaborative learning as an educational practice and the use of computers in aiding the acquisition of higher level cognitive and problem solving abilities. Combining collaborative learning with composite component approach exhibits many advantages compared to traditional teaching methods, although not directly assessable and measurable. For a start, we noticed increased student motivation and the willingness to experiment in a unique environment. The game-like design of the classroom keeps students' interest even though they are physically remote. Students and instructors who used virtual labs as an auxiliary means in teaching and studying both agree on the additional value of virtual environments as an educational tool, fulfilling needs for an environment for remote communication and collaboration.

In a competitive academic environment, where students have most often been rewarded for individual effort, collaboration may not come naturally or easily for everyone. In our particular case, we were interested to investigate whether psychological characteristics of learners have any impact on the success of collaborative learning in 3D environment. To this purpose, participants were asked to answer simple questions, such as:

- do they find the use of social networks acceptable;
- do they feel comfortable communicating with persons they don't know in the 3D space
- did their attitude towards the instructors in 3D environment change in any way respect to face-to-face communication.

Questionnaire results and teaching assistants' observations demonstrate that social, motivational, and emotional factors are central to the group activity. Persons that are asocial in face-to-face communication (e.g. do not use social networks at all) tend to keep the same attitude in virtual environments. Some students initially express skepticism about the value of group work, or feel that class time is best spent hearing from the instructor rather than working with students who, they believe, know as little as themselves. Others may feel that they have succeeded thus far on individual effort, and don't want to be encumbered by other students with different histories of success or different working methods.

Thus, psychological characteristics of group participants in collaborative approach have large impact on the learning outcome. The time taken to examine psychological profiles may be crucial to the success of collaborative projects. If the groupware is designed to replace learning activities by mere computer-mediated communication, it can even decrease the effectiveness of communication because of the limited repertoire of modalities.

In the future, we are planning to evaluate the different scene layouts which will take into account student's cognitive process, relevant features, and entertainment. Through such a study we can polish the design of virtual labs and generate new guidelines for educators.

CONCLUSION

One of the main challenges for the development of groupware and other technologies for collaborative learning is to create tools which can meet the motivational demands and particularly support the sharing of informal knowledge. An additional lesson we learned from our research is that groupware often requires that users carry out activities that do not naturally belong to their work, or else the tools do not help users to carry out their most frequent activities. Some of the activities we expect students or teachers to perform in the virtual world environment can be considered artificial or insignificant by them and thus difficult to apply as a natural part of the study process.

This chapter describes an initial evaluation which we carried out to determine the usability of 3D virtual worlds for collaborative learning and obtain user feedback. We designed virtual classrooms for different computer science courses and exposed learners to all features of the system. Overall feedback from students was positive; with the proper help, learners are guided towards greater autonomy and take on a greater responsibility for their own education if provided with useful, engaging, and relevant tasks to accomplish with their peers, as illustrated in this chapter.

Virtual worlds that implement collaborative educational methods offer an appropriate environment through which anyone can acquire qualitative knowledge, interact with other learners or educators and actively participate in knowledge evolution. Finally, it should be stressed that virtual worlds are not a substitute of existing educational technologies, but a useful means to support learners' engagement.

ACKNOWLEDGMENT

The work presented here has been supported by the Serbian Ministry of Education and Science (project grant no. III44006).

REFERENCES

Allison, C., Miller, A., Sturgeon, T., Perera, I. & McCaffrey, J. (2011). The Third Dimension in Open Learning. *Proceedings of 41st ASEE/IEEE Frontiers in Education Conference*, T2E-1-T2E-6.

Bruffee, K. (1993). Collaborative learning. Baltimore: John Hopkins University Press.

Cooperative (1999). Cooperative Learning: Students Working in Small Groups, Stanford University, From: http://www.stanford.edu/dept/CTL/cgi-bin/docs/newsletter/cooperative.pdf

Cuseo, J. (1992). Cooperative Learning vs. Small-Group Discussions and Group Projects: The Critical Differences. *Cooperative Learning and College Teaching*. *2*, 5-10.

deFreitas, S. (2006). Serious Virtual Worlds: A scoping study. JISC Report. From: http://www.jisc.ac.uk/publications/reports/2008/seriousvirtualworldsreport.aspx

Dooly, M. (2008). Constructing Knowledge Together. In: M. Dooly (Ed.), *Telecollaborative Language Learning, A guidebook to moderating intercultural collaboration online*. Peter Lang, Bern. 21-25.

Franc, I., Stankovic, I., Branovic, I. & Popovic, R. (2014). Ontology based model of digital forensic virtual lab and curriculum design. *International Journal of Engineering Education*, *30*, 1–13.

Gaytan, J. & McEwen, B. (2007). Effective online instructional and assessment strategies. *American Journal of Distance Education. 21*,117-132.

Gubera, C. & Aruguete, M. S. (2013). A comparison of collaborative and traditional instruction in higher education. *Soc Psychol Educ. 16*, 651–659.

Hamada, M. (2008). An Integrated Virtual Environment for Active and Collaborative e-Learning in Theory of Computation. *IEEE Transactions on Learning Technologies*. *1*, 117-130.

Hernandez, D.,Asensio, J. I. & Dimitriadis Y. A., (2006). Collaborative Learning Strategies and Scenario-based Activities for Understanding Network Protocols. *Proceedings of the 36th ASEE/IEEE Frontiers in Education Conference*, S2F-19 – S2F-24.

Ibáñez, M., GarcíaRueda, J. J., Maroto, D. & Kloos, C. D. (2013). Collaborative learning in multi-user virtual environments. *Journal of Network and Computer Applications*. *36*, 1566–1576.

Iowa State University. The basic collaborative learning techniques, Iowa State University. From:http://www.dso.iastate.edu/asc/supplemental/SIShowcaseCollaborative.pdf

Irani, L., Hayes, G. R. & Dourish, P. (2008) Situated practices of looking: visual practice in an online world. *Proceedings of CSCW 2008*, ACM Press. 187–197.

Isotani, S., Mizoguchi, R., Isotani, S., Capeli, O. M., Isotani, N., de Albuquerque, A. R. P. L., Bittencourt, I. I. & Jaques, P. (2013). A Semantic Web-based authoring tool to facilitate the planning of collaborative learning scenarios compliant with learning theories. *Computers & Education*. *63*, 267–284.

Jacobson, M. J., Kim, B., Lee, J., Lim, S. H. & Low, S. H. (2008). An intelligent agent augmented multi-user virtual environment for learning science inquiry: preliminary research findings. *Annual Meeting of the American Education Research Association (AERA)*, New York.

Kaplan, I. & Yankelovich, N. (2011). OpenWonderland: an extensible virtual world architecture. *IEEE Internet Computing*. *15*, 38–45.

Keenoy, K., Levene, M., deFreitas, S., Emans, B., Schoonenboom, J., Jones, A., Brasher, A., Waycott, J., Turcsanyi-Szabo, M., Bodnar, E., Pernin, J. P., Eyssautier, C. & Montandon, L. (2004). Collaborative trails in e-learning environments**.** Personalised and Collaborative Trails of Digital and Non-Digital Learning Objects, D22 (4.2), 1-62.

Khalifa, A., Zivkovic, M., Branovic, I. & Popovic, R. (2013). Internationalized approach to wireless networks simulation.*21st Telecommunications forum (TELFOR)*, Belgrade, Serbia, 869-872.

Kotsilieris, T. & Dimopoulou, N. (2013). The Evolution of e-Learning in the Context of 3D Virtual Worlds, *The Electronic Journal of e-Learning*. *11*, 147-167.

Laal, M. & Ghodsi, S. M. (2012) Benefits of Collaborative Learning. *Procedia - Social and Behavioral Sciences. 31*, 486–490.

Lehtinen, E., Hakkarainen, K., Lipponen, L., Rahikainen, M. & Muukkonen, H. (1999). Computer supported collaborative learning. *Environment*. *33*, 318–23.

Magnisalis, I., Demetriadis, S. & Karakostas, A. (2011). Adaptive and Intelligent Systems for Collaborative Learning Support: A Review of the Field. *IEEE Transactions on Learning Technologies*. *4*, 5-20.

Matcha, W. & Rambli, D.R.A. (2013). Exploratory study on collaborative interaction through the use of Augmented Reality in science learning. *Procedia Computer Science*. *25*, 144 – 153.

Monahan, T., McArdle, G. & Bertolotto, M. (2008). Virtual reality for collaborative e-learning. *Computers & Education. 50*, 1339–1353.

Okamoto, T. (2003). Collaborative Learning Technologies and e-pedagogy, *Proceedings of the 3rd IEEE International Conference on Advanced Learning Technologies (ICALT'03)*.

Open Wonderland Home Page: http://openwonderland.org/

Prasolova-Førland, E., Divitini, M. & Lindås, A. E. (2007). Supporting Social Awareness with 3D Collaborative Virtual Environments and Mobile Devices: VirasMobile. *Second International Conference on Systems*.

Rubens, N., Kaplan, D. & Okamoto, T. (2011). E-Learning 3.0: anyone, anywhere, anytime, and AI. In: *International Workshop on Social and Personal Computing for Web-Supported Learning Communities*. 1-11.

Sutcliffe, A. & Alrayes, A. (2012). Investigating user experience in Second Life for collaborative learning, *International Journal of Human-Computer Studies. 70*, 508–525.

Theng, L. F. & Mai, N. (2013). Web-based Collaborative Learning: Students' Feedback on the Communication and Interaction Processes. *2013 International Conference on Informatics and Creative Multimedia*, 221-225.

Tsiatsos, T., Konstantinidis, A., Ioannidis, L. & Tseloudi, C. (2009). Implementing Collaborative e-Learning Techniques in Collaborative Virtual Environments: The case of Second Life. *Fourth Balkan Conference in Informatics*.

Tsiatsos, T. & Konstantinidis, A. (2012). Utilizing Multiplayer Video Game Design Principles to Enhance the Educational Experience in 3D Virtual Computer Supported Collaborative Learning Environments.*12th IEEE International Conference on Advanced Learning Technologies*.

Zheng, L., Yang, Y., Cheng, W. & Huang, R. (2013). Emerging approaches for supporting easy, engaged and effective collaborative learning, Journal of King Saud University. *Computer and Information Sciences*. *26*, 11–16.

Zinnikus, I., Cao, X., Klusch, M., Krauss, C., Nonnengart, A., Spieldenner, T. & Slusallek, P. (2013). A Collaborative Virtual Workspace for Factory Configuration and Evaluation. *9th IEEE International Conference on Collaborative Computing: Networking, Applications and Worksharing*. 353-362.

Zivkovic, M., Popovic, R. & Nikolic, B. (2014). eWISENS: Educational Wireless Sensor Network Simulator, *International Journal of Engineering Education, 30*, 483–494.

Zurita, G., Baloian, N. & Frez, J. (2013). Using the cloud to develop applications supporting geo-collaborative Situated Learning, *Future Generation Computer Systems*. Future Generation Computer Systems. *34*,124–137.

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 11

MICRO-MESSAGING FOR COLLABORATIVE E-LEARNING SUPPORTING SMALL-GROUPS' COLLABORATIVE CREATIVE WRITING PROJECTS

***Niki Lambropoulos*[1,•] *and Margarida Romero*[2]**

[1]London South Bank University, London,
UK and University of Western Macedonia,
Florina, Greece
[2]Universidad Autónoma de Barcelona,
Barcelona, Spain

ABSTRACT

In recent years the use of e-collaboration learning systems is visibly expanding. There is currently a need for developing computer-supported learning tools for the enhancement of the students' organisation and learning processes. In this study, a group-awareness support can be considered to aid collaborative distance learning so to tackle the challenges created by the students' different locations and time zones. The system, called EuroCAT, is a Collaboration Awareness Tool aiming to enhance small-group students' organisation by increasing the group awareness information available in the shared interface through micro-messaging. An experiment was conducted to examine the efficacy of the system on psychology undergraduates' collaborative writing compared to the use of forums and chats. We worked on a collaborative, problem-oriented e-learning environment for small-groups on applicable knowledge. We observed 6 students, 3 in the experimental and 3 in the control group working on a collaborative writing task for one week.

The experimental group used the EuroCAT micro-messaging functionality and the control group used the Moodle discussion forum and chat. First, personal details were obtained to group the students; then, the students participated in the case study; finally a teamwork questionnaire was used to examine their perceptions on teamwork and compare it to what actually happened. In order to conduct the micro-messaging exchange analysis we developed a new method to include micro, mid and macro (3M) levels of text

• E-mail: nikilambropoulos@gmail.com.

analysis. This framework, along with the EuroCAT coding manual, supported our investigation in organisational and knowledge coordination as well as convergence. The results of the experiment showed: (1) there were no significant differences between students as the sample was too small; (2) analysis of the textual exchange indicated that the students who used EuroCAT merged organisational and knowledge convergence; the control group students used the forum mainly to organise the chats; both groups completed their collaborative writing task successfully; the chat facilitated richer collaborative learning discussions; (3) teamwork perceptions differed between groups; the experimental group seemed to have more group-oriented perceptions of their work even though the results from the analysis of the textual exchange did not fully support their claims. Limitations, implications and future research directions are also discussed.

INTRODUCTION

With the expansion of Web 2.0 technologies, computer supported social systems have been enhancing collaborative learning and professional online activities. Web 2.0 functionalities allow social information support in educational activities, and, in some cases, they display it on the shared user interface that is being seen by all the students. Mirroring group members' information is essential for online collaboration, such as who they are, what they do, their roles and responsibilities, status, presence or absence, or the state of various group processes that group members go through when working together (Jongawate et al. 2009).

In 1996, group awareness pioneers Greenberg, Gutwin and Cockburn (Greenberg et al., 1996) suggested that there are four types of group-awareness: informal, social, group-structural and workspace. Informal awareness refers to the general knowledge of who is around and what they are doing including one's self. Social awareness refers to presence and co-presence of individual team-members (Lambropoulos et al., 2012); this is the degree they perceive themselves and other as 'real'. Group-Structural awareness refers to the knowledge about activities and team-members' organisation. Workspace awareness refers to what's happening on the interface during team-members' interaction. According to Jongawate and his colleagues (2009), increasing the amount of group awareness cues increases the group's ability to complete the task effectively. Also, Slof et al. (2013) proposed that building visualizations evokes more meaningful discussion. This means that to call forth and create elaborate and meaningful discussions about the domain requires a representational tool that is in line with its users' capabilities and intentions, and also makes clear what its users can and should do with it. Such activity can beneficially affect team performance in complex learning-tasks.

Teamwork refers to the organisation and coordination of groups. Stahl (2008, 2009) suggested that considerable research has been done for individuals and communities in the purpose of learning. However, not much research exists for small-group interaction. Stahl proposes that a model for a small-group interaction would unpack what happens in the small-group unit of analysis. Therefore he provides a definition:

> When small-groups engage in cooperative problem solving or collaborative knowledge building, there are distinctive processes of interest at the individual, small-group and community levels of analysis, which interact strongly with each other. The science of group cognition is the study of the processes at the small-group level.
>
> Stahl, 2009

In this definition Stahl merges cooperative work and collaborative learning in the purpose of problem solving. There are clearly distinguishable boundaries between individual, small-group and community units of analysis in research, all of them highly interactive.

The experiment in this study addresses the importance of small-group awareness and awareness cues that facilitate group interaction, with great importance and impact attached to online collaboration. We worked on a collaborative, problem-oriented e-learning environment for small-groups on applicable knowledge; this was to co-create a vision statement for a new budget airline (Appendix A). The activities were scripted to a certain point, mostly providing the target as well as examples of expert solutions. Following Stahl (2008) it is assumed that meaning is created and shared in small-groups through the processes of interaction, communication and coordination. Some learners profit from such activities, however others are left behind (Weinberger et al., 2002). For this reason, we aim to shed some light on these areas by focusing on online discussions and small texts in particular. In this study, these talks are facilitated via micro-messaging incorporated in EuroCAT. EuroCAT is a Collaboration Awareness Tool aiming to enhance small-group students' organisation by increasing the group awareness information available in the shared interface including sending micro-messages; this is a feature that can potentially support the planning and organisation of activities for task-independent collaboration. We anticipate that such functionality can be incorporated to facilitate the group members' organisation and their work in the purposes of learning, and, in this case, collaborative writing. Therefore the research questions are:

(1) To what extent are organisational and knowledge convergence supported by awareness cues in group collaboration tools?
    (1a) Are there any differences between determined structures of small-groups processes between the use of chats and discussion forums, and EuroCAT message functionality?
(2) Are there any theoretical frameworks that can facilitate deep understanding of small-group discussion analysis?
    (2a) In what ways would any of these frameworks provide an in-depth understanding of conversational transitions between organisational discussion and knowledge-building?
(3) What are students' perceptions on teamwork compared to what actually happened in the experiment?

This chapter unfolds as follows: the first section refers to small-groups teamwork in Computer Supported Collaborative Learning (CSCL); in particular, it discusses organisation and knowledge convergence, the need for teamwork, as well as tools to enhance learning activities organisation and coordination. The next two sections propose the scientific and research frameworks required to analyse students' interactions. Then a case study is carried out to compare the effect on groups' collaborative writing between the EuroCAT micro-messages and forums/chats communication. The next section presents the results, then implications and study limitations are discussed. Finally, the last section discusses conclusions and future trends.

SMALL-GROUPS TEAMWORK IN CSCL

'*Small-group science*' is a current interest in Computer Supported Collaborative Learning (CSCL) aiming to support small-group functionalities and to increase individual and group learning (Stahl et al., 2006; Stahl, 2010ab). Stahl advocates that, even though shared "meaning-making" and "sense making" in CSCL have been found in small-groups learning interactions, there is no in-depth analysis of *how* this happens. He also suggests that such in-depth analysis of *interactional co-construction of group meaning* cannot possibly be observed in individuals or communities. Consequently, this experimental case study focuses on small-groups learning interactions for online collaboration. This section briefly presents the organisational and knowledge coordination and convergence in 'small-group science' in order to increase small-group learning.

Organisational and Knowledge Convergence in Small-Groups

Collaboration in the early stages of Computer Supported Collaborative Learning (CSCL) was defined as "*a process by which individuals negotiate and share meanings relevant to the problem-solving task at hand… a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem*" (Roschelle and Teasley, 1995:70). Such negotiation of shared meaning leads to knowledge convergence. However, coordination of learning activities as a longitudinal process is a prerequisite for knowledge convergence to occur. Knowledge Convergence occurs when two or more learners whose activities have an impact on those of their partners, in turn have an impact on their own activities (Rochelle, 1996). According to Fischer and colleagues (2002), there are two main aspects of knowledge convergence: process convergence and outcome convergence. Process convergence refers to organisational interaction and outcome convergence to learners' reciprocal influence leading to increased group cognitive similarity. In other words, organisational convergence occurs when two or more learners coordinate their teamwork activities to facilitate cooperation on a specific task.

Weinberger and colleagues (2002) worked on cue-based implementation of scripted co-operation and scaffolding for small-groups into an online learning environment to aid discussion. These authors suggested that cue-based scripted co-operation proved to support learners substantially well in comparison to open discourse. Stahl (2007) found that specific patterns occur in small-group interactions. For example, there is a gradual process of explication about what the students mean, how to use educational resources and tools; eventually, '*each participant acknowledges that they understand the others, at least well enough to continue what they were doing before they paused to repair their mutual confusion*' (p. 5). This process aids in aligning individual interpretations to a gradually shared meaning that is itself co-constructively achieving "group cognition". Lastly, Weinberger et al. (2010) found that scripted small-groups surpass individuals in their learning.

In conclusion, it appears that if students work in small-groups, they can increase their learning; however, their activities will need to be scripted as well as students to be aware of what their co-students are working on and planning to do.

Small-Groups Awareness of Teamwork

Technologies are needed in CSCL to help learners to identify, observe and assess their own actions (mirroring) and facilitate the tutors to support them (guiding) (Soller et al., 2005). Such need for teamwork while using a system requires group awareness and organisation of activities in order for the group to achieve organisational and knowledge convergence. Group awareness refers to the understanding of the activities of others, which provides a background for one's own activity (Dourish, and Bellotti, 1992). It covers the examination of behavioural, cognitive, and social context information on a group or its members (Bodemer and Dehler, 2010).

Groups and group-members' roles are significant components in CSCL scripts. For example, Strijbos and De Laat (2010) found some participative stances – Captain, Over-rider, Free-rider, Ghost, Pillar, Generator, Hanger-on and Lurker. These can assist meaningful description of student behaviour, stimulate both teacher and student awareness of roles and evaluate or possibly change the participation to collaborative learning on all levels (macro, meso and micro). For researchers, micro level is related to the role as task, meso to the role as pattern and macro to the role as stance. Grouping is based on specific criteria whereas roles refer to specific participants when assigning activities or allocating resources. A script describes the way students have to collaborate: task distribution or roles, turn taking rules, work phases, deliverables, etc. (Dillenbourg and Jermann, 2007). Kollar et al. (2006) suggest that collaboration scripts consist of at least five components: (a) learning objectives, (b) type of activities, (c) sequencing, (d) role distribution, and (e) type of representation. In order to make teamwork effective, team-members' roles have been found useful in organising their activities especially when group-members' activities have been previously scripted. The main task structure was scripted defining students' weekly tasks, tools used and expert examples.

In order to compare the students' teamwork perceptions and what actually happened in this study, our study was based on a questionnaire created by Martínez-Fernández and colleagues (2009) (Appendix B). Such generalized and successfully tested research instrument can bring forward students' responses on teamwork. Two major factors were taken into account: the independent work of each group-member and the unification of teamwork.

Tools have been used to facilitate small-groups teamwork, so the next section presents a brief overview of such e-collaboration systems.

E-Collaboration Systems for E-Learning

E-Collaboration systems are software for supporting communication, coordination and cooperation processes in groups (Riemer, 2009). Working for the European Research Centre for Information Systems (ERCIS), Riemer conducted a cluster analysis to classify them. The categories include:

- Group processes supported by the system according to levels of interdependency
- Types of communication as in multi-person communication
- Shared resources and features such as discussion forums
- Typical use of the system: to be used continuously everyday for ongoing activities or only situationally to support a specific group activity.

The role for the group consists of three categories:

- Primary systems to support the group members with all essential functions like E-Mail communication or calendar functionality
- Secondary systems that provide additional functions
- Awareness features supporting shared perceptions, based on four types of communication awareness following Greenberg et al. (1996), normal, social, group-structural and workspace awareness.

In online education, the current Learning Management Systems (LMS) can be classified under the above proposed categories. For awareness features and cues in particular, LMS do offer a variety of tools, as for example the profiles or the students activity logs. Due to practical reasons, the Moodle forum and chat were used along with the EuroCAT micro-messaging functionality in this research. EuroCAT micro-messaging aims to support the organisation and coordination of e-learning activities. This application is similar to twitter status; the e-learners post shorter messages compared to the typical discussion forums. However, the target is the planning and organisation of their e-learning activities.

Awareness cues in forums are related to information about the poster such as a photo, the name, the title and time of post, as well as any replies in threaded or nested forms. Awareness cues in chats are related to information such as a photo, time and name of the poster. In both forums and chats the text input is added by a reply based on additional functionality. The forums can provide non-linear presentation of the posts, however, the text lines in chats are linear.

Awareness cues in EuroCAT merge the attributes of the previous two tools and provide additional information. This includes nationality, users' reference and local time, the type of activities the students undertake on a daily basis, the collaborative writing stages, and a viewable daily/hourly timeline in which the micro-messages are visible (figure 1).

The next section is focused on small-group EuroCAT CSCL specific messaging functionality.

Group Awareness in EuroCAT Micro-Messaging

Bodemer and Dehler (2010) distinguish 3 types of awareness in CSCL: (a) behavioural, as in group activities, (b) cognitive, as in group knowledge acquisition, and (c) social, as in individual and group perceptions on the ways the group functions.

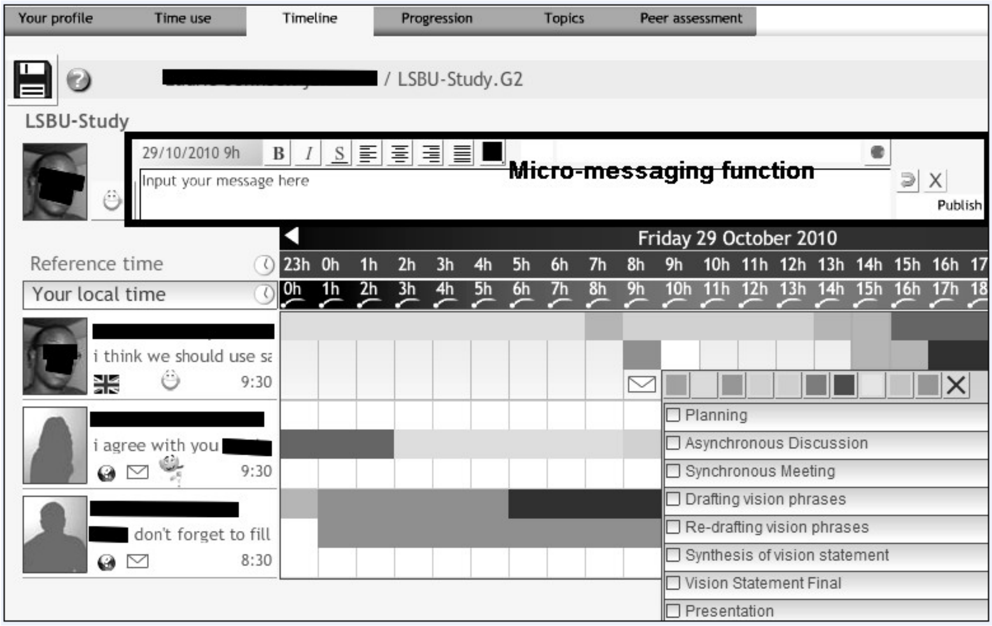


Figure 1. EuroCAT micro-messaging rich text functionality.

Bodemer and Dehler suggest that such awareness information formation and processing can create significant impact on the collaborative processes and outcomes as such. In other words, team effectiveness has an impact on team performance and collaborative learning. Furthermore, Fransen et al. (2010) proposed a list of several team effectiveness factors: team formation, team members' abilities and characteristics, role assignment within a team, decision making strategies, team leadership, and interdependency.

In this study the *focus is on the use of micro-messaging to support a scripted collaborative writing task.* As the study is a quasi-experimental one, the use of EuroCAT and other tools may reveal hidden aspects regarding tools' efficiency in collaborative writing. As CSCL involves a problem-solving task at hand (Roschelle and Teasley, 1995), collaborative tasks and activities need to be organized and planned (scripted) in order to support learners' engagement. According to Persico and Pozzi (2010), CSCL activities need to be considered an entity composed of three independent dimensions (3Ts): Time, Tasks, and Teams. Collaborative scripts facilitate such organisation by defining several variables of the organization process in a way that the students have to collaborate (Dillenbourg and Jermann, 2007). In this study the students were given the time (one week), the task (create the vision statement of a new budget airline, Appendix A), experts' examples and were called to assign their team roles themselves.

Although there is currently some research about the tools for micro-blogging in education (e.g. Grosseck et al., 2010), there is no research for micro-messaging tools. The latter offer different information as they are not status-oriented, but rather task oriented; in other words, they mainly aim to help users and learners to organise their tasks. For this reason, they can be categorised under both micro-blogging and e-collaboration tools.

Micro-blogging tools refers to a particular genre of computer-mediated communication and interaction revolving around the activities of the author and records of the day by supporting awareness cues (Oulasvirta et al., 2010).

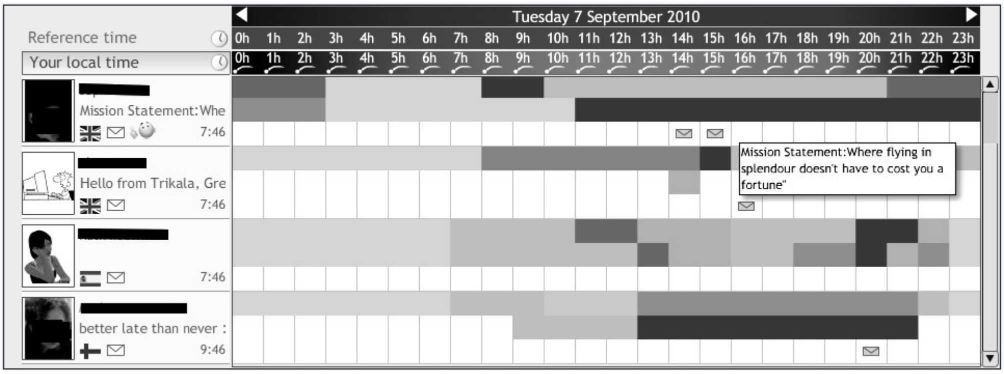


Figure 2. EuroCAT main timeline.

In EuroCAT such cues refer to time indicators of others' online statuses, locations, time zones, profiles, the team members, upcoming calendar events, discussion topics, learning objectives and coming activities. When a user posts, this message appears on the timeline (figure 2).

In figure 2, the micro-message is part of a series of awareness cues that help the students in collaboration awareness. Micro-blogging adds a time- and information- related awareness cues selected to be visible by the student. Oulasvirta and colleagues (2007) have conducted research on awareness cues for intra-group messaging. The results indicated that these automatic cues, while playing a secondary role in online communication, do support awareness by furnishing the interpretative background context. As the range of the tools on EuroCAT's shared user interface targeted at collaboration awareness, this part studies only the micro-messaging functionality and the ways it supports CSCL.

The students can post and publish messages; these appear later above the timeline using rich text format. In order to address micro-messaging communication effectiveness we needed new and coherent analytical frameworks to shed light into students' discussions.

MACRO, MID AND MICRO (3M) LEVELS OF DIALOGICAL ANALYSIS

The qualitative methodology used for text analysis is only part of the web content analysis; Herring (2010) expanded the paradigm of web-content analysis for theme, image, feature, link, exchange and language analysis. Exchange analysis here refers only to text analysis and is anchored in Stahl (2008, 2009a,b, 2010a,b) and Lambropoulos and Romero (2011). Following this line of research, we developed an intricate web of connections to support deep understanding of the intersubjective meaning-making process taking place among the items in the interaction record and items from the context that are made relevant in the discourse. These items may also be connected to our initial proposition on awareness cues. Stahl suggests that such items can be: the discussion flow; turn taking as opening possibilities for the next post arise; different types of continuities; types of communication problems; items related to the discussion or chat such as outside resources; terms; connections of threading, uptake, continuity, repair, reference and citation; referenced items, etc. Anchored in these suggestions, we initially used the following categories to describe our study as provided by Stahl (2009a,b):

1. *Group event*: the participants log on to the study for one week in October 2010.
2. *Temporal session*: the participants started the sessions with social greetings and goodbyes.
3. *Conversational topic*: the group explicitly opened and closed each asynchronous discussion.
4. *Discourse move*: the sequence of moves were identified and analysed in Atlas.ti.
5. *Adjacency pair*: The base interaction involving two or three utterances (elicitations and responses), which drives a discourse move between identified lines on Atlas.ti.
6. *Textual utterance*: words or sequences (text) posted by an individual participant, which may contribute to an adjacency pair identified in the qualitative analysis.
7. *Indexical reference*: An element of a textual utterance that points to a relevant resource or instruction; in this case, problem solving.

Stahl (2010) also suggested the importance of the online text linearity, as the posts appear one by one on a time sequence in a discussion topic. As a result, a relationship is created between two conversational speaking turns by two different people (adjacency pairs); there exists an interactional order, for example, a question followed by an answer. Patterns identified in adjacency pairs are currently of great interest to CSCL (Stahl, 2010a,b; Trausan-Matu et al., 2007; Lonchamp, 2007). Also, contrary to face-to-face discussion, online text is usually classified as linear on a chat, discussion forum or any other tool.

Also, Stahl (2011) suggests that there are three levels in CSCL discussion analysis; (a) focusing on coding individual utterances (micro-level); (b) assessing learning outcomes (macro-level); (c) analysing the group processes (mid-level). Therefore, Conversation Analysis (CA) refers to micro-level adjacency pairs while socio-cultural Discourse Analysis is concerned with macro-level. For Stahl, "*understanding these mid-level phenomena is crucial to analyzing collaborative learning, for it is this level that largely mediates between the interpretations of individuals and the socio-cultural factors of communities*". Also Stahl (2009) proposed three dimensions to reveal CSCL content and relational dimensions: (a) the temporal dimension of ordered events; (b) the problem space of shared knowledge; and (c) the interaction space of positioned actors. Consequently, the challenge is anchored in Stahl's (2006) suggestion that CSCL interactions should be analyzed at the group level of description, not just at the individual, as is done in other influential theoretical approaches in CSCL research.

Accordingly, Lonchamp (2009) proposed the dialog, the knowledge and the action levels in dialogical analysis. A task-independent dialogical model analyses communication/action traces, produced by the collaborative environment as "*generalized conversations*". Tool actions are generally accompanied by textual messages in which learners explain their initiatives identified and structured into generalised adjacency pairs. Even small details revealed at this fine-grained analysis level often play an important role in elaborating higher level interpretations.

Lastly, we found the work of Oulasvirta et al (2010) on a codebook for open coding content analysis particularly useful. Open coding is a technique for non-fixed taxonomyas categories are created and elaborated on the fly when deemed appropriate for describing the datum at hand. Consequently, we have worked on a new codebook to support the study.

In Lambropoulos and Romero (2011), we proposed three levels of sharing knowledge to achieve knowledge convergence: *consensus knowledge* as the lowest level referring to the minimum knowledge prerequisite, in this case provided by the script; *common ground* is the medium one referring to the mutual knowledge used to complement the necessary information to answer a task required for communication and collaboration; and *common knowledge* is the highest level of knowledge convergence referring to knowledge known by all groups and requires in-depth processing of the co-students' contributions. By adopting a collaborative knowledge-building perspective, it is possible to define the codes for each category as a codebook that can be used by other researchers. Lastly, there are task-dependent interpretations of why the collaborative learning processes unfold as observed.

The synthesis of these frameworks can provide a coherent analytical framework for discussion analysis in CSCL (see figure 3).

The three levels of macro, mid and micro levels (3M) provide the basic pillars of categorisation in collaborative discourse exchanges as shown in figure 3. The first pillar of macro analysis refers to team organisation and coordination. Textual information about the organisation and convergence of teamwork activities as well as group discussion structures (scripted or revealed) are under this first pillar.

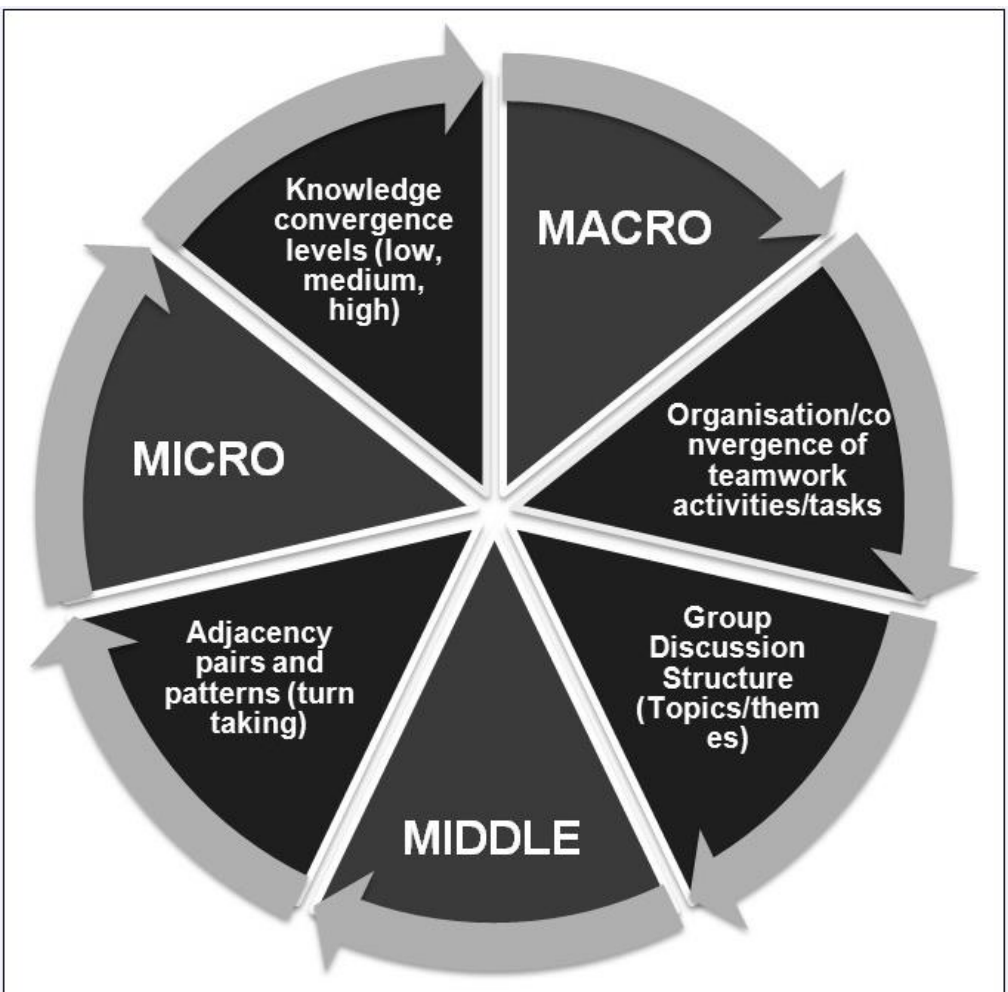


Figure 3. The CSCL Discussion Analysis analytical framework (3M).

The second pillar of mid analysis refers to the linear structure of the online text as the messages appear in a specific linear chronological order. Textual information in turn-taking as adjacency pairs and related patterns are under this second pillar. The third pillar of micro analysis refers to the actual knowledge organisation and convergence. Textual information following the low, medium and high knowledge convergence levels are under this third pillar. Therefore the categories for open taxonomy were anchored in this 3M framework.

The evaluation of the suggested frameworks and EuroCAT micro-messaging are discussed in the following section.

METHODOLOGY AND RESULTS

Six psychology undergraduate students participated in a quasi-experimental case study using mixed methodologies. Three students used EuroCAT and three used the Moodle discussion forum and chat to complete a scripted collaborative writing task within one week. After profiling, there were no significant criteria to group the students; as such, they were grouped randomly in the Racoon (experimental) and Tiger (control) groups.

The task was to create a vision statement for a new budget airline (Appendix A). They also had to define their own team roles and schedule times for synchronous activities, as for example synchronous chat.

The EuroCAT hourly backup functionality aids the conversational pairs to work as face-to-face discussion i.e. having more than one message overlapping under the same time slot. The advantage of online discussion/message (text-chat) is that learners have the time to carefully read the messages and reflect upon the meaning and their subsequent response. They are also visible for a specific amount of time depending on the course and the tutor.

The data collected were the team discussions on the online tools, the discussion forum and chat for the control group and EuroCAT for the experimental one. The participants also filled in a teamwork questionnaire (Martínez-Fernández et al., 2009). Lastly, more data related to the time online and use of tools were collected. The qualitative data were analysed with Atlas.ti and the quantitative ones with MS Excel. In order to analyse the data we have created a coding manual anchored in Lehtonen's Jaiko coding manual (*http://www.hiit.fi/u/oulasvir/codingmanual.pdf*). We followed Lehtonen's basic idea for structuring the coding manual; however, the basic categories were different to match our own research goals based on the EuroCAT message functionality (Lambropoulos et al., 2010, EuroCAT coding manual, 2010). The selection 'Other' for non-categorised text was similarly assigned.

We used Atlas.ti to conduct the qualitative analysis based on the previous framework as follows: first we categorised the exchanged messages according to the tool used (the Moodle forum, the Moodle chat and EuroCAT). Then we created codes for each of the levels and categories based on both existing frameworks as well as codes that derived from the context. We repeated the analysis four times until the codes were redundant and adequate to describe the suggested 3M framework. Then we proposed to a colleague of ours to use the framework in 25% of the text so to reach a level of agreement (inter-rater agreement to increase the qualitative analysis reliability); this feedback exchange continued until we reached an agreement 99% on the final 5% of the text. The results from this analysis are presented in the next section.

Case Studies Results

The study took place online between 24/10/2010 - 01/11/2010; all students were studying in the Psychology Department at London South Bank University. The demographics section questions were the same for both groups, on the questionnaire for the control group and on EuroCAT first screen for personalisation for the experimental group. The students were randomly grouped as there were no significant differences between them due to small participation. The participants in the control group were from the UK, Argentina and Ireland; all participants in the experimental group were from the UK; all participants were from the capitals of each country and English and ICT level of competence were advanced according to the definitions followed in the European Union.

For the control group, the internet connections were cable (N=3) and at home (N=1); for web presence they used Skype (N=2), Messenger (N=2) and Facebook (N=3); their motivation for e-learning was to 'Work/study from different places' (N=1), 'Work/study flexible times' (N=1), and 'University reputation' (N=1); two students were not working and one student was working 8 hours a day with semi-flexible timetable in a small company as an architect assistant; two students did not have to commute and one had an hour's commute.

For the experimental group, the internet connections were wi-fi (N=3), cable (N=1), at home (N=1) and at work (N=2); their motivation for e-learning was to 'Work/study from different places' (N=2), 'Work/study flexible times' (N=2), and 'Interested in certification' (N=1); one student was not working, one student was working 3 hours a day and the other 4 hours per day both with semi-flexible timetable in an educational organisation as one was a student ambassador and university work for both; two students did not have to commute and one had an hour's commute.

It is obvious that this study has limitations. There needs to be greater and extended research in time-series and longer periods so that the results can be generalised on a greater scale.

Qualitative Analysis: Results on Dialogical Analysis

The students in the control group used 2 tools to complete the given task: discussion forums and chats. The total number of words was 2,020. The forum discussion was 349 words; chat_01 was 1,177 words; chat_02 was 197 words; and chat_03 was 297 words. The students in the experimental tool only used the micro-messaging function on EuroCAT. The discussion data were collected from the EuroCAT server. The students' exchanged messages in a total of 629 words. Both groups successfully completed the task equally well. Also, the number of messages is shown in the next graph (figure 4):

In figure 4 it appears that the control group students used the forum the least (N=9, 6%), whereas the experimental group students used EuroCAT (N=18, 11%) and the chat control group students used it the most (N=129, 83%). The qualitative analysis for each group for each based on every 3M category will shed light in the ways the students used the three tools.

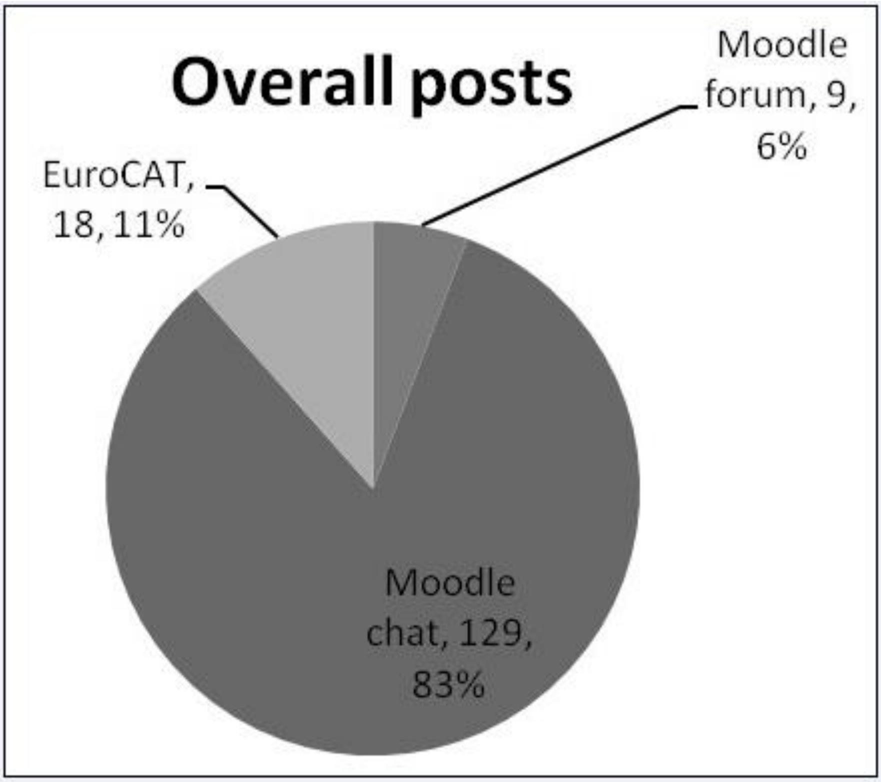


Figure 4. Overall posts in EuroCAT, Moodle forum and Moodle chat.

A. Macro Level - Category I: Team Organisation and Coordination Results

The first macro-level of analysis describes the team organisation and coordination results anchored in our enhanced coding manual. In the first category, the super-categories presented here are: social, person, time, team, task, technical and other. These super-categories are associated with organisational convergence and are presented in Table 1.

B. Macro Level - Category II: Group Discussion Structure

The macro-level of analysis presents the response structures (table 2).

C. Mid Level - Category I: Adjacency Pairs

The total number of adjacency pairs for the control group was 4 in the forum and 25 in the chats whereas for the experimental group it was 7; examples are shown in figures 5 and 6:

D. Mid Level - Category II: Transitional patterns

Transitional patterns refer to the mediated patterns (transitions) between the organisational discussion and the actual idea generation and meaning-making in knowledge building and vice versa.

Based on our observations, there were specific turn-takings; for example, after summarising the roles part, the control group made a move to the task as such before holding the brainstorming session on creating new ideas on the task.

Table 1. Team organisation and coordination results

	Supercategory	Experimental		Control			
	Social	EuroCAT Message		Moodle Chats		Moodle Forum	
		Codes	%	Codes	%	Codes	%
	Emotion	2	33	5	7	1	10
	Feeling	1	17	2	3	2	20
	Greeting	2	33	14	18	3	30
	Name	1	17	24	31	2	20
	Social Other	0	0	31	41	2	20
Total		6	100	76	100	10	100
	Supercategory	Experimental		Control			
	Person	EuroCAT Message		Moodle Chats		Moodle Forum	
		Codes	%	Codes	%	Codes	%
	Individual	15	83	2	40	3	
	Group	3	17	3	60	1	
Total		18	100	5	100	4	
	Supercategory	Experimental		Control			
	Time	EuroCAT Message		Moodle Chats		Moodle Forum	
		Codes	%	Codes	%	Codes	%
	Present	0	0	3	75	2	33
	Past	0	0	1	25	1	17
	Future	2	0	0	0	3	50
Total		2	100	4	100	6	100
	Supercategory	Experimental		Control			
	Team	EuroCAT Message		Moodle Chats		Moodle Forum	
		Codes	%	Codes	%	Codes	%
	Agreement-Disagreement	2	6	23	30	4	31
	Evaluation	2	7	9	12	0	0
	Organisation	12	40	25	32	5	38
	Roles	12	40	8	10	4	31
Total		30	100	77	100	13	100
	Supercategory	Experimental		Control			
	Task	EuroCAT Message		Moodle Chats		Moodle Forum	
		Codes	%	Codes	%	Codes	%
	Complete-Incomplete	2	5	4	6	0	0
	Decision making	2	5	12	19	10	56
	Instruction	19	50	5	8	2	11

	Supercategory	Experimental		Control			
	Task	EuroCAT Message		Moodle Chats		Moodle Forum	
		Codes	%	Codes	%	Codes	%
	Q&A	7	17	14	22	4	22
	Suggestion	8	21	28	45	2	11
Total		38	100	63	100	18	100
	Supercategory	Experimental		Control			
	Technical	EuroCAT Message		Moodle Chats		Moodle Forum	
		Codes	%	Codes	%	Codes	%
	Problem	0	0	0	0	0	0
	Problem Q&A	0	0	2	100	0	0
Total		0	0	2	100	0	0
	Supercategory	Experimental		Control			
	Other	EuroCAT Message		Moodle Chats		Moodle Forum	
		Codes	%	Codes	%	Codes	%
	EuroCAT related	3	100	0	0	0	0
	Ambiguous	0	0	0	0	0	0
	Incomprehensible	0	0	2	100	0	0
	Link Sharing	0	0	0	0	0	0
	Non-English	0	0	0	0	0	0
Total		3	100	2	100	0	0

There were five transitions for the experimental group in EuroCAT and six transitions for the control group in chat_01 (none in chat_02-03 and forum). For example:

Control group (Chat_01, Lines: 19-22)

16:22 St2: i prefer dreamlines out of those ones

16:22 St1: ok dreamlines it is

16:23 St2: cool

16:23 St1: what shall our mission statement include

Experimental group EuroCAT (EuroCAT Message, Lines: 15-19)

19:00 St3: i think we should call our airline boombastic airways, bringing the boom back to flying

19:00 St2: ok so once St1 comes on and looks if he's happy with that, we now have to do a vision statement, i think it means like a moto...

E. Micro Level - Category I: Knowledge Organisation

The first micro-level of analysis describes the knowledge organisation and collaborative learning building results anchored in our coding manual. The super-category presented here is the collaborative learning one.

It appears that the collaborative learning codes were significantly more for the chats. The chats had richer interaction compared to EuroCAT messages; however, the discussion forum was used only to arrange the chat meetings and post the vision statement.

Table 2. Groups Discussion Structure

	Group discussion structure		
	EuroCAT Message	Moodle Chats (1,2,3)	Moodle Forum
1	Open the topic	Open the topic	Open the topic
2	Task procedure	Suggest roles	Suggest the task
3	Provide instructions	Feedback roles	Suggest time limits
4	Negotiate team-roles	Propose solution	Summarise so far
5	Task procedure	Feedback request	*Suggest procedure* (end post)
6	Feedback request	Negotiate solution	Feedback team-roles
7	Propose solution	Propose new solution	Feedback on contribution
8	Negotiate solution	Feedback solution	Task complete
9	Suggest organisation	Negotiate new solution	*Suggest procedure* (end post)
10	Feedback organisation	Summarise so far	Feedback on team-roles
11	Task procedure	Feedback request	*Feedback on task* (end post)
12	Feedback team-roles	Negotiate solution	Propose solution
13	Present draft solution	Propose task organisation	*Feedback solution* (end post)
14	Feedback solution	Feedback task organisation	*Technical problem* (end post)
15	Task procedure	Present draft solution	Arrange meeting
16	Task finished	Feedback solution	*Feedback overall* (end post)
17	Close the topic	Present solution	
18		Close the topic	
19		Open the topic	
20		Feedback organisation	
21		Feedback request	
22		Task procedure	
23		Close the topic	
24		Open topic	
25		Finalise solution	
26		Negotiate solution	
27		Feedback request	
28		Finalise solution	
29		Task procedure	
30		Close the topic	

The EuroCAT messages were used for agreements or disagreements as well as evaluation and summaries. This was because one person suggested the vision statement and everyone else agreed. Working in the chats was a different experience; the students built the vision statement sentence by sentence.

Event: EuroCAT LSBU study (control group)
Session: 24/10/2010 16:22
Theme: "Vision statement for a new budget airline"
Move: Name of airline
Pair: "i prefer dreamlines out of those ones" "ok dreamlines it is"
Utterance: "cool, what shall our mission statement include"
Reference: joint problem space

Figure 5. Example of adjacency pair for the control group.

Event: EuroCAT LSBU study (experimental group)
Session: 24/10/2010 19:00
Theme: "Vision statement for a new budget airline"
Move: Roles
Pair: "i think we should call our airline boombastic airways, bringing the boom back to flying" "OK"
Utterance: "'so once St1 comes on and looks if he's happy with that, we now have to do a vision statement, i think it means like a moto"
Reference: joint problem space

Figure 6. Example of adjacency pair for the experimental group.

Overall, similar results were observed in the chats; the most frequent codes were on agreements, disagreements, evaluations and summaries with additional new ideas, explorations as well as questions and answers. Obviously, it is only a study and one small occasion; by no means have we generalised any of the results. The experiment was conducted to test the initial theoretical frameworks and tools and derive some feedback for future actions.

Overall Results

Table 4 and figure 7 present the super-categories overall results.

Although both groups finished the same task successfully, it appears that they used the available tools differently. Overall, there were more significant codes (>50%) for addressing to team-members by name (N=18) in EuroCAT, whereas the other code categories favour the synchronous chat (social 83%, team 64%, task 53% and collaborative learning 11%).

F. Micro Level - Category II: Group Knowledge Creation

The group knowledge creation level refers to the exact collaborative learning discussion part (a collaborative learning episode) that creates a new idea for the members as well as the team. There are two main new idea generation episodes, one for each group. Following the collaborative e-learning episode, the response structures for the two groups are presented as follows:

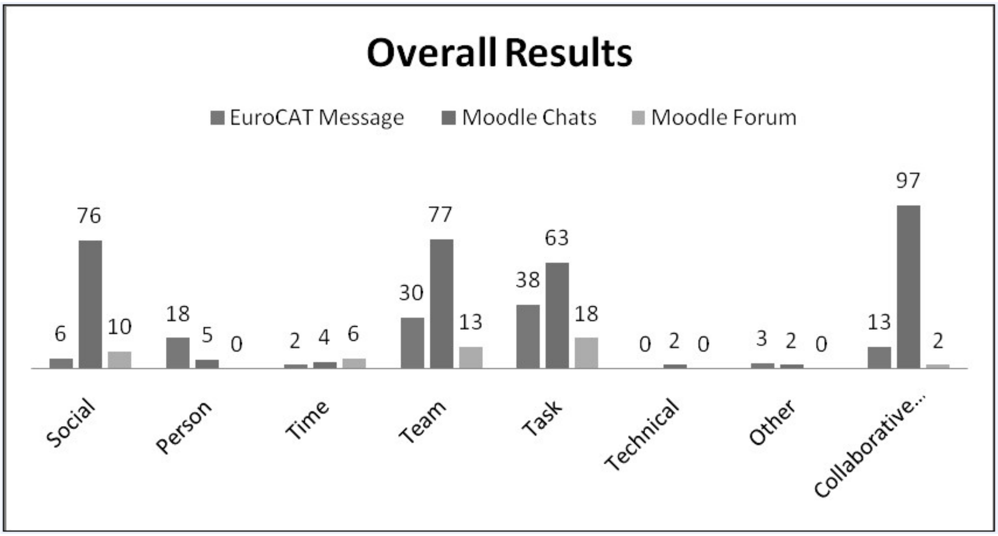


Figure 7. Overall results.

Control Group

Roles - Agreement-Disagreement on roles
Suggestion - Decision Making
Suggestions - New ideas (3)
Q&A
Exploration – Suggestion – New Ideas
Evaluation - Agreement (2)
Q&A
Suggestion – Instruction – Suggestion - Agreement
New Idea
Q&A
Suggestion – Exploration – New Idea
Q&A
Agreement-Disagreement
Q&A
Summarise – Agreement – Decision Making – Agreement
Evaluation – Exploration – Explanation
Exploration – Explanation (2)
Agreement - New Idea
Q&A
Evaluation - Decision Making
Q&A (2)
Suggestion – Summarise
Agreement
Summarise (4)
Exploration (3) – Explanation (2)
Q&A (2)

Agreement-Disagreement (4)
Summarise
New Idea – Suggestion
Evaluation – New Idea
Agreement – Exploration (3)
New idea
Agreement (3)
Suggestion – Evaluation – Agreement
New Idea – Suggestion - Evaluation (2) (FINAL draft)
Suggestion (2)
Agreement
Evaluation

Experimental Group

↓ Organisational summary
↓ Agreement
↓ Agreement
↓ Roles
↓ Draft
Agreement

In the experimental discussion, the vision statement contains both the motto-sentence and the team roles. The process was linear and very quick; first there was a general agreement on the roles; then St3 proposed an idea and the rest of the team-members agreed.

These results are similar to the previous coding results. The structure is linear in the EuroCAT tool and iterative in the chat. Compared to the experimental group, there was a different structure in the control group using mainly Moodle chat. Both groups had exactly the same examples of vision statements and there was no additional support by the researchers. However, the way the team-members perceived the vision statement was different. The experimental group included a motto-statement and the team roles, whereas the second group quickly decided on team roles and moved to the vision statement. This was built in small chunks with continuous summarisation cycles that included exploration, explanation, suggestions, new ideas and evaluation until a final draft was proposed. When the team-members read the draft, they immediately decided that this is the final version of their vision statement.

Using the chat, the control group team-members decided on the roles; after finalising this topic, they worked on the vision statement for the rest of the discussion. Starting with new ideas, they questioned and evaluated them building the ground for new suggestions, explorations and ideas. These were in turn objects for agreement or disagreement and were further evaluated, explored and explained. New ideas were continuously proposed to build up the vision statement while each time a summary was provided.

Table 3. Collaborative Learning coding for EuroCAT message

	Supercategory	Experimental		Control			
	Collaborative Learning	EuroCAT Message (words)		Moodle Chats (words)		Moodle Forum (words)	
		Codes	%	Codes	%	Codes	%
1	Agreement-Disagreement	4	31	24	25	0	0
2	Evaluation	3	23	10	10	0	0
3	Other	0	0	2	2	0	0
4	Q&A	0	0	11	11	0	0
5	Explanation	0	0	7	7	0	0
6	Exploration	1	8	13	13	0	0
7	Information	1	8	0	0	0	0
8	New Ideas	1	8	14	15	0	0
9	Summary	3	23	16	17	2	100
	Total	13	100	97	100	2	100

Each summary was continuously explored, explained and further evaluated until St2 posted a draft; all considered and agreed that this is the final draft and closed the discussion.

RESULTS ON SMALL-GROUP TEAMWORK PERCEPTIONS

The next section presents the results of the small-group teamwork questionnaire. It is divided into 2 parts; the first part refers to perceptions about individual behaviour and the second refers to perceptions about group behaviour regarding team unification. Because the sample was very small, it was not possible to generalise any responses. However, their perceptions are valuable to shed light between what we observed as researchers and their own perceptions. For this reason, we only concentrate on the highest results, that is, the “usually” and “almost always” responses. We will present the control group first and then the experimental one.

Teamwork Part I and II in the Control Group

The results for the teamwork aspect of the experimental and control groups are summarised in figures 8 and 9. All three students replied that they are always careful and polite in online discussion and respect others’ opinions; two students said they have taught the other team members. The researchers also observed that the students had different opinions. Their opinions differed on leadership; they were successfully working with individuals from other cultures; they were directing the discussion if necessary; they clearly understood and contributed to the group objectives.

Table 4. Super-categories overall results

	Supercategories	Experimental EuroCAT Message (18 posts)			Control Moodle Chats (129 posts)			Moodle Forum (9 posts)			Total Horizontal Comparison
		Codes	%	%	Codes	%	%	Codes	%	%	%
1	Social	6	5	6	76	23	83	10	20	11	100
2	Person	18	16	78	5	1	22	0	0	0	100
3	Time	2	2	17	4	1	33	6	12	50	100
4	Team	30	27	25	77	24	64	13	27	11	100
5	Task	38	35	32	63	19	53	18	15	15	100
6	Technical	0	0	0	2	1	100	0	0	0	100
7	Other	3	3	60	2	1	40	0	0	0	100
8	Collaborative Learning	13	12	13	97	30	97	2	4	2	100
Total		110	100		326	100		47	100		

It appears that the students had contradictory opinions about themselves working collaboratively whereas the researchers observed opposite facts.

As for the control group's teamwork: the members did not provide an overall high score to any of the questions and two members did not agree to any of the questions on the 2 Likert highest levels. They had different opinions on 3 questions: when working in a group the relationships between all team-mates are usually harmonic and fluid; when working in a group some students have clearer objectives than others; and, in a group, the ideas of how to organize the work are clear for some students and unclear for others. As before, it also appears that the control group students had *humble* if not negative opinions about their work in the group.

Figures 10 and 11 show the teamwork responses for the experimental group. All three students replied that they are careful and polite in their online exchange; two of them work very well with individuals from other cultures; and they appear to believe that they worked collaboratively with the other team-members as they understood and contributed towards the team objectives. It appears that the students thought they did their best on an individual level to succeed in the task. However, from the results we assume that one student sent the solution and the others agreed on this.

As for the teamwork, all agreed only on question No13: The main contribution in a group comes from the combined, integrated and coherent work of several people (it is more than copy paste). Two preferred individual work to teamwork; their work in a group is only integrated with other team-members; there are times they prefer to work in a group and other times they would rather work on their own; sometimes there are differences in perceptions regarding teamwork goals between the different team-members; and the ideas that one has on how to organize the work are very different from the other team-mates, thus creating disagreement. In opposition, we present the results that all students had different opinions, that is, did not agree at least twice: the success of a group depends on one or few students who propose solutions separately; when working in a group the relationships with the others are usually very complicated; and in a group, some people do not participate and/or are easily distracted.

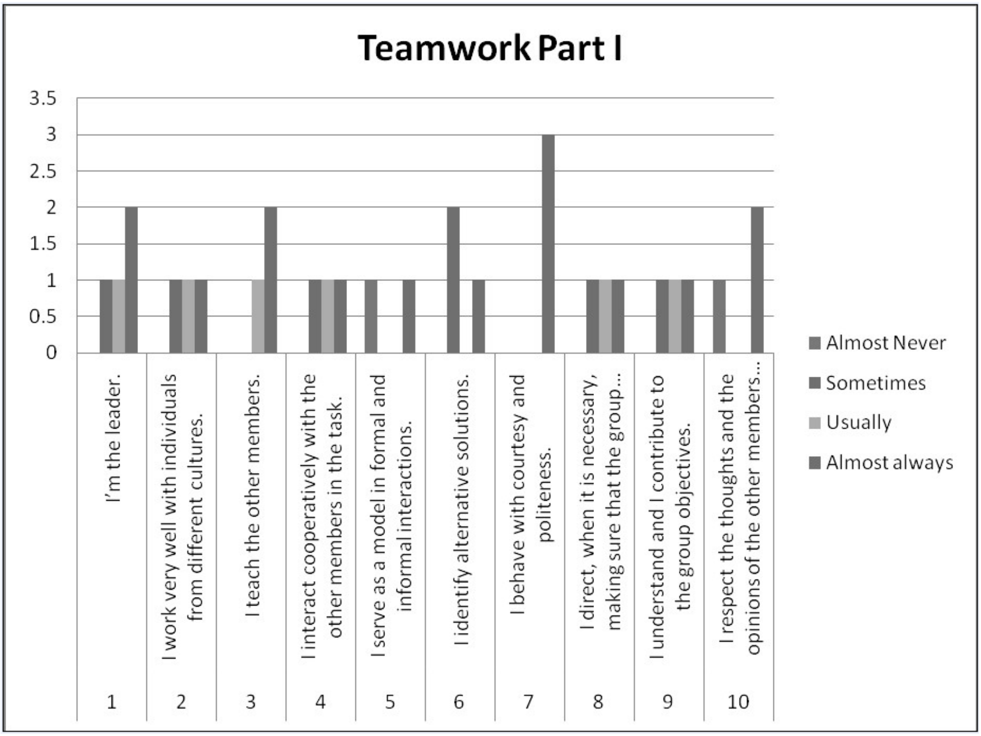


Figure 8. Control group teamwork Part I: Perceptions about own work.

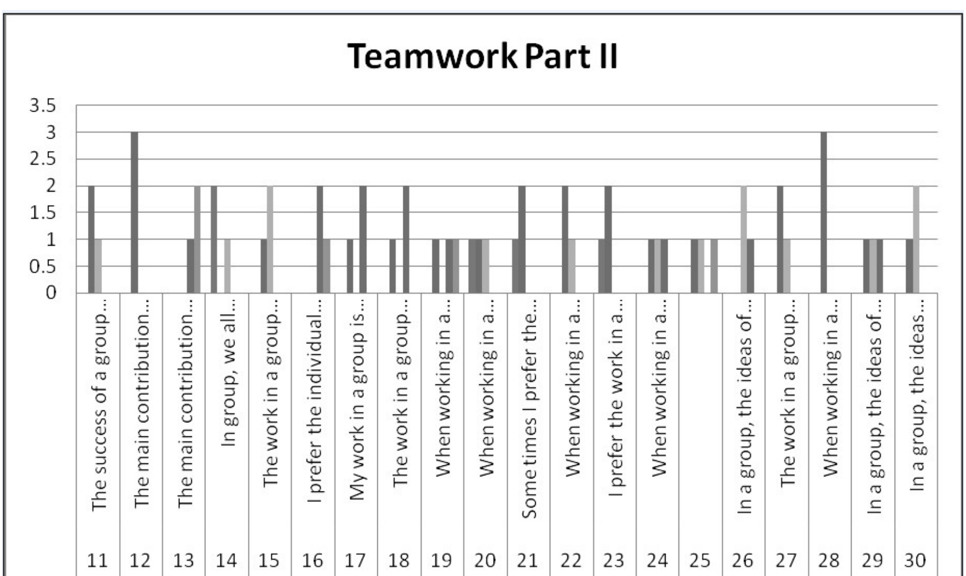


Figure 9. Control group teamwork Part II: Perceptions about group work.

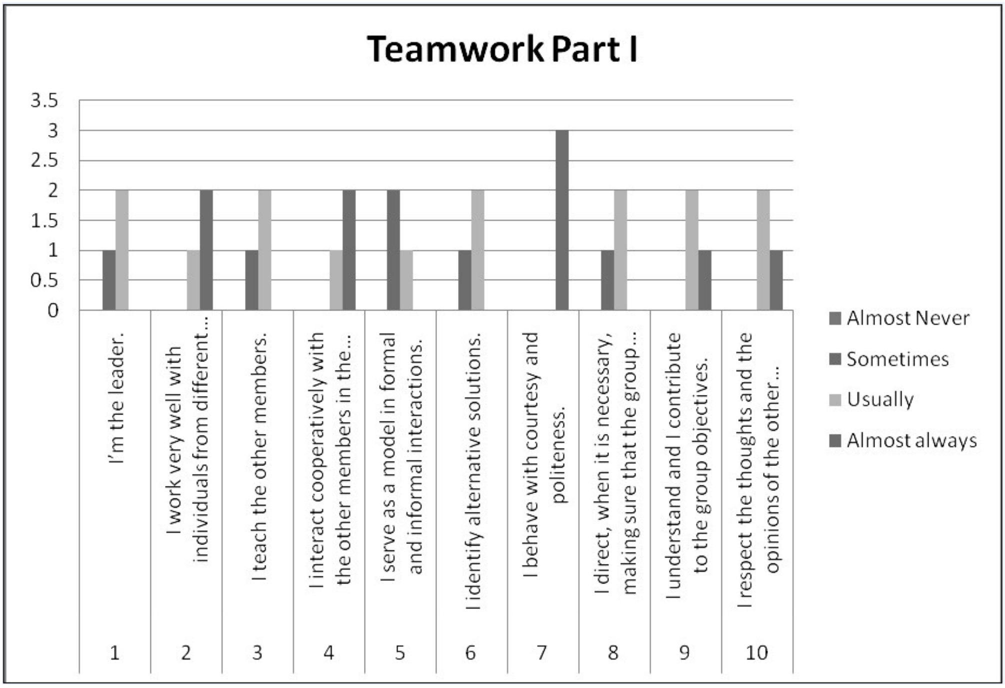


Figure 10. Experimental group teamwork Part I: Perceptions about own work.

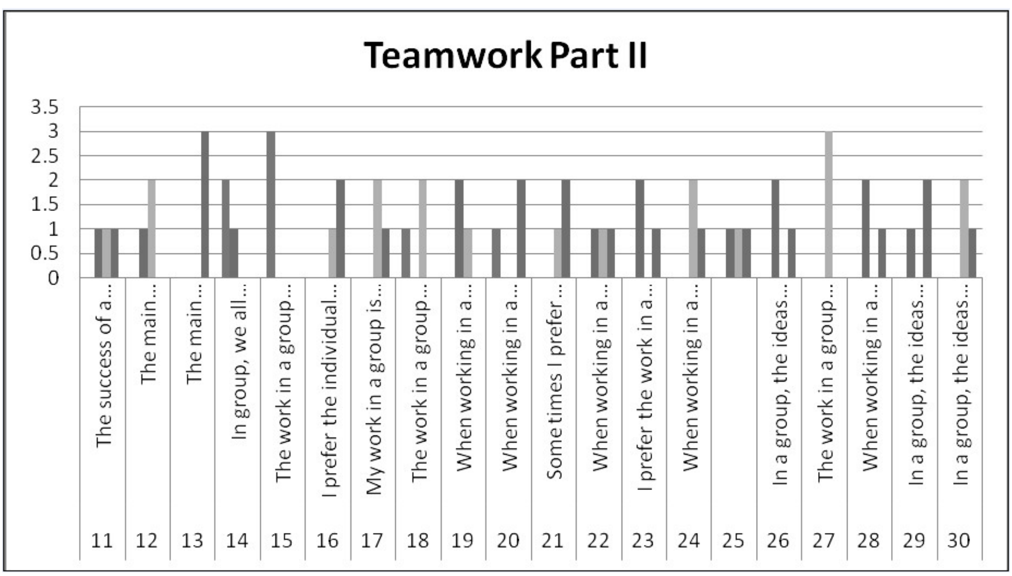


Figure 11. Experimental group teamwork Part II: Perceptions about group work.

As before, and contradictory to our observations, the students were not confident about the value of their participation in the group and their success on the task.

It appears that the experimental group students were more confident about their work in small-groups compared to the control group. They also seem to understand the difficulties of working on a group as well as ways to solve these. However, they did suggest that they sometimes prefer individual work and sometimes working in groups. The students also provided contradictory ratings about the success of a group depending on one or few students; these responses are consistent with our actual research findings.

In contradiction to the experimental group, it appears that the control group students did not really believe that they can work successfully when they collaborate in small-group activities. Although this is a strong claim for such a short time using specific software, the researchers only compared existing data based on students' claims equally analysed. Lack of confidence is also evident in a range of responses; for example even though the experimental group rates were in favour, such as leading a group, discrepancies in group objectives and team-organisation issues were in fact observed. Also, the team leader of the experimental group was very direct with her role responsibilities and provided clear indications for the task. Furthermore, the transition codes between the organisational and knowledge convergence were more prominent in the experimental group depending on the number of messages exchange.

Overall, it appears that initial response on the instructions by the team members and especially from the team leader influences the organisation of the teamwork and consequently, knowledge convergence. If a tool such as EuroCAT with awareness cues such as the micro-messages as well as the drop-down menu of planning activities can facilitate this transition, then it is possible for students to accelerate processes towards knowledge convergence.

DISCUSSION

The results from this study are consistent with other findings in the field. The *first research question* was to identify *the extent to which organisational and knowledge convergence is supported by awareness cues in group collaboration tools.* The authors suggest that awareness cues do improve knowledge convergence and the specific implementation of awareness cues in EuroCAT. Awareness cues work in EuroCAT so to notify the students about the relevant issues they would like to share; the main feature for these cues is "micro-messaging", as short 'twitter-like' sentences to share their intentions online.

From the overall findings it appears that there is an exchange between the organisational and knowledge cues on the tools used. The students were discussing both about the vision statements and the way to coordinate their activities on the same topic and even on the same sentence. Because this specific transition appears to be more with the use of EuroCAT rather than forums and chats, this perhaps suggests that EuroCAT fits its purpose of use; this is to facilitate the organisation of small-group activities. However, the students do need additional real-time tools to accelerate their interactions for group knowledge building. On the other hand, the findings also suggest that forums and chats lack such group awareness cues related to small-group organisational convergence.

Sustained group activity combines cue-based scripted collaboration (Weinberger et al., 2002) with awareness cues. In other words, we may improve our current scripting by providing suitable inferences towards activities' convergence within the EuroCAT platform. In this way, the students may be able to achieve better quality results of strategic quality discourse. Also, the experimental group students possibly confused the roles in collaborative writing with roles in project management. Perhaps this is the reason their vision statement included 'real' project management roles; so this means that scripts need to specify roles and stimulate rotation to enhance quality in group and individual learning (Spada, 2010).

As such, awareness cues appeared to be helpful for other researchers and practitioners as they could use EuroCAT for sharing online work and projects. Similarly, the communication media also took into account users' privacy (Bourimi et al., 2013).

The first sub-question was to investigate the *differences between determined structures of small-groups processes between the use of chats and discussion forums, and the EuroCAT message functionality.* In this specific very small scale experiment, the structures appeared to be very different. EuroCAT results present a linear straightforward structure of discourse with one person suggesting the solution and everyone else agreeing. In contradiction, the forum was used to arrange chat meetings whereas the chat meetings offered a rich textual interaction with apparent small-group collaborative learning occurring in a very short time. This result may have occurred as just one occasion based on different approaches used between the two groups. There is no indication that the tools facilitated such decision from the team leaders as differences could be probably attributable to diverse leadership styles. Other results on chats and discussion forums suggest that both tools support collaborative learning to occur either in formal (e.g. Cakir et al., 2005) or informal learning settings (e.g. Mi Heo and Breuleux, 2009).

Although the case study has limitations, the conclusions drawn can provide some insights for future research and design as any online case study suffers from inability to 'control' the control group. The quantified differences between the two groups displayed variations that might be a result of the experimental conditions as such. In online research there are other uncontrolled variables such as inherent differences from one group member to the next, cross-cultural affects, time zone issues, previous experiences working together, the team leader's leadership style, friends coming along for help etc.

The second research question was related to the *mixed analytical frameworks to facilitate deep understanding of small-group discussion analysis.* We were mainly based on Stahl's suggestions on small-group science analytical frameworks and we built on a more coherent framework addressing organisation and knowledge convergence as well as transitions. This framework consisted of a macro-, mid- and micro level of analysis (3M) with two categories each and a coding manual to assist the process.

Although direct comparison is not feasible due to the originality of the framework, mixed methodologies reveal hidden aspects in collaborative learning and provide feedback on students' recommendations on their organisational and learning habits. For example, Martinez et al., (2003) combined qualitative evaluation and social network analysis to promote active collaborative learning. They also uncovered hidden aspects of learning interactions by cross-comparing results in order to develop learners' better collaboration habits and attitudes. Jeong (2005) also found mixed evaluation methods helpful and tools to study group interaction and argumentation in online forums. Jeong (2005) used mixed evaluation methods and tools to study group interaction and argumentation in online forums. He concluded that the visibility of social and knowledge structures helped learners' reflection even though there was no difference in knowledge acquisition. Engelmann et al., (2009) suggested the integration of cues for social awareness with knowledge awareness within a shared space in order to improve learning quality. Also, Vassileva (2009) and Abel et al. (2010) advocated that the current discussion tools have poor support for e-learning purposes.

In a meta-analysis study on CSCL research methodologies (2010), Jeong and Hmelo-Silver observed that descriptive studies are dominant in CSCL. However, there is a variety of research designs and techniques, leading to cross-over or hybrid methodologies utilising diverse data sources, collected and analyzed both quantitatively and qualitatively. New techniques for analyzing collaborative processes are also emerging. Jeong and Hmelo-Silver also suggest that CSCL needs to be more principled in its applications of design-based research; furthermore, more diverse and systematic ways to analyze qualitative data can provide a full advantage for the rich data afforded in CSCL research.

Macro analysis refers to team organisation and coordination. The *first pillar* deals with the *textual information about the organisation and convergence of teamwork activities as well as the group discussion structures* (scripted or revealed). The results showed that the experimental group had more discussions about the team-roles and less on knowledge building. As the study was completely conducted in online environments, other elements or variables may have may have come into play since group collaboration is a very complicated interactive process. Similar studies suggest that some learners working in groups often realise such a suboptimal distribution of complementary roles; this leads one learner contributing to the task while others participate less (Strijbos and De Laat, 2007). Such behaviour has been recorded to reduce the potential of collaborative learning for equal participation in argumentative elaboration activities (Cohen and Lotan, 1995). Therefore task performance may not always predict individual knowledge acquisition well (Fischer, and Mandl, 2003). As face-to-face collaboration and thus body-language and facial expressions were absent in a tutor-free environment such behaviour could not be easily monitored with online learners.

Weinberger et al. (2002) conducted a similar study based on small-groups with 3 psychology students in each group. As the task was compulsory without conditions to prevent the students from participating as in this study, 105 students participated in their experiment. They suggest that the students can discuss without getting too critical; however, in order to improve the quality of discourse, a meta-communication component might be relevant for learning. This means that, facilitating the strategic quality of discourse by content-specific hints could have helped the experimental group students. In other words, these students needed more scripting than the control group and only shows that we cannot generalise scripting for all groups. As pointed out elsewhere (Lambropoulos and Romero, 2011), the ‘ideal’ level of scripting and regulation differs not only from group to group but also from individual to individual. Also, Järvelä, and Hadwin (2013), and Laru (2012) suggest the importance of regulating in order to support small-group learning with use of multiple Web 2.0 tools.

The second pillar of mid analysis refers to the *response structure of the online text* as the messages appear in a specific linear chronological order. The results showed some similarities between the two groups which may suggest a possible generic discussion response structure in CSCL. Such response structures (such as open the topic, negotiate the solution, present the formal solution and close the topic) were similar to results provided by Stahl (2011) when working in mathematics. According to Zemel and Çakir (2007) when investigating chat logs, it is essential to work on this response structure (threading) and then on meaning making. This is because the participants may or may not design their postings to be read in ways that make the response pair or threading structure apparent. If the participants were aware of such structures then an introduction of reflection on meta-responses is feasible. Following Blommaert (2005), an utterance, in this case a micro-message, can include relations to previous and future messages in a meta-language level. As in a chess match, such awareness can facilitate the learners to consider more thoroughly the possible consequences of their postings (reflexive use of language).

The second category of the second pillar refers to the textual information in conversational turn taking as *adjacency pairs* and related interaction patterns. The results showed that, the richer the text, the more the adjacency pairs. Also, following Stahl (2007), when comparing the time of postings we notice that people in chat rush to post to prevent postings from becoming too separated from their logical predecessors. Therefore they divide their messages into several short postings and introducing many shortcuts, abbreviations, typos, mistakes and imprecision. In EuroCAT such problems are also evident as the messages go directly on the timeline and sometimes seem unrelated.

More results in chats also reported chats adjacency pairs as couples of logically succeeding utterances as interaction patterns, for example question-answer, collaborative learning sequence or greeting to greeting. Trausan-Matu et al. (2007) in polyphonic collaborative learning propose that such couplings promote knowledge as well as unity making. Cakir et al. (2005) presented a simple mathematical model for chat sequential patterns. They implemented it through the development of a tool in order to represent the patterns graphically as well as manipulate them. They suggested five interaction patterns: local, frequent conversational, handle, problem solving, and maximal. Their results reveal that some interaction patterns were similar to the ones suggested in this study, seeing as we used open coding methodology i.e. initially based on existing data before adjusting them to existing ones from current literature.

The third pillar of micro analysis refers to the *actual knowledge organisation and convergence*. The results showed differences in knowledge construction structure, resulting from the ways in which team-members organised their team-roles, and consequently, their collaborative learning activity.

In so much as the control group's text was richer in codes related to knowledge organisation and construction, there were more ideas generated. The students worked on their vision sentence by sentence, and agreed on the outcome before they moved to the next. Such convergence implies the approximation of learners' cognitive responses by negotiation (Fischer and Mandl, 2001).

Richness of text is supposed to be a measure of the interactive learning process (Stahl, 2002). Although both groups finished their task, such richness was higher in the control group, also evident in the response structure without "chat confusion" (Fuks, Pimentel and Pereira de Lucena, 2006) detected. Lambropoulos (2008) reports poor knowledge building structures in adult collaborative learning resulting from absence of knowledge of these attributes in discussion structures. This is similar to Jeong's results, and perhaps suggests that the rich interactions of the control group were a pleasant surprise. On the contrary to synchronous chat results that were mostly used for decision making (Lambropoulos et al. 2008), the control group in this study used the chat for knowledge building.

Consequently, we might suggest that group cognition was evident. Group cognition refers to cognitive processes that can arise through the interactions within a small group of participants. It is not just externalization of individual mental representations, but emergent result of situated interaction. Such cognitive accomplishments are *enacted* in *in-situ* interaction.

The second sub-question was about the effectiveness of the proposed frameworks in order to provide an in-depth understanding of *discussion transitions between organisational discussion and knowledge building discussion*. The results showed that EuroCAT facilitated such transitions. This may have possibly occurred due to the two sets of awareness cues provided on the EuroCAT interface compared to the chats and forums; these are the direct functionality for text messaging at the top of the timeline screen and the drop-down menu with the planning activities. Although awareness methodologies and mechanism designs are rather old concepts in teamwork (e.g. Tran et al., 2005), there is still room for research on the importance of such cues as well as the consequences of their relationships with knowledge building activities.

The last research question was related to *students' perceptions on teamwork* compared to what actually happened in the experiment. The results showed that both groups completed the task successfully. However, because of possible lack of specific instructions for collaborative writing to both groups, the experimental group worked in a linear discussion manner (e.g. question and answer) instead of a progressive meaning/negotiation way (e.g. explanations, conflicts and agreement). According to Galegher and Kraut (1994), collaborative writing requires a nonlinear, dynamic process, which can change based on group and task characteristics. They support that collaborative writing has a social nature and involves negotiation about meaning in order to reach consensus as to an appropriate solution, division of labour, coordination of individual contributions, and resolution of questions about authority within the group. As these instructions were lacking, we had to accept the two solutions as equally successful.

In addition to the previous limitations as well as the inability to control all variables in online research, and also due to project time limitations, the researchers had no choice but to focus more on working on the theoretical approaches and their validation based on the small sample available, rather than aiming at the generalisation of the results. Also, the Hawthorn Effect (the fact that the students knew they were taking part in a study) could not be completely eliminated. More research with more students and in diverse contexts is needed in order to ensure the validity, generalizability and reliability of the propositions.

CONCLUSIONS AND FUTURE TRENDS

This study presented an experiment for small-groups' awareness to support distant collaborative learning. We used two learning settings and three tools, EuroCAT, and Moodle forums and chats. The proposed system was EuroCAT, a Collaboration Awareness Tool targeted at facilitating small-group students' organisation by the increase of the group awareness information available in the shared interface including sending micro-messages. Six psychology undergraduates participated in a scripted collaborative writing task. We worked on a collaborative, problem-oriented e-learning environment for small-groups on applicable knowledge, with three students in the experimental group using EuroCAT and three in the control group using the Moodle tools. The experimental group used the EuroCAT micro-messaging functionality. In order to direct our analysis in small-group micro-messaging postings, we anchored on existing Computer Supported Collaborative Learning (CSCL) analytical frameworks in order to create a new one to match the organisational and knowledge-building processes in CSCL. Therefore it consisted of micro, macro and mid levels of textual interaction analysis.

The results of the experiment showed similarities and differences between the groups, depending on the level and the exact situational activity. The teamwork perceptions questionnaire revealed major differences between the way the groups worked and what actual happened. Although the experimental group negotiated the task less, more work was executed regarding the organisation of the group; therefore the students had more positive group perceptions than the control group. In contradiction, although the control group negotiated the task much more, the students in the experimental group had more positive perceptions about their group than the control group. We may assume that this positive result for organisation convergence for the experimental group may be due to the use of EuroCAT micro-messaging functionality, a tool designed specifically to facilitate organisational convergence in small-groups in CSCL. Also, we need to consider the judgment of the result as negative, if observed on its own as a negative process convergence result. If observed as an outcome convergence, then the result is positive since the students completed their task successfully even though without providing textual background for others' collaborative activity. However, because the sample of the group was limited, it is not possible to generalise. As for the analytical framework, the structure appeared to reveal content and relational dimensions of the actual discussions.

Implications of this study are similar to Trausan-Matu et al. (2007) recommendations on collaborative discussions. The consequences for the design of CSCL environments must facilitate inter-animation not only on the longitudinal dimension, through threading but also the transversal, differential, and critical dimensions. This is a direct observation on the experimental group compared to the control group. In this way, the collaborative process facilitates the alignment and convergence of groups' activities in problem solving situations that need applicable knowledge. As Stahl (2008) proposed, the collaborative meaning-making process that produces the situated shared group meaning and thus group cognition, needs to produce in parallel individual interpretations of this meaning. Depending on the group members, the script may be adjusted by the tutor to follow both groups and individual interpretations and tendencies to facilitate or stop them. Therefore problems during the process, and thus in the chosen strategy, can be prevented.

Overall, following Warschauer (1997) on many-to-many interaction, digital internet tools and chats in particular, do create the opportunity for a group of people to construct knowledge together based on their specific social dynamics of chats providing time-and-place-independent communication. Therefore, the tools facilitate small-group goals accomplishment as faster messages can aid in making the exchange easier, less expensive, and more natural and frequent. This is a particular advantage in the digital age to support and facilitate online collaborative writing activities in this manner. Also in our future research we may relate our findings to temporal structures as in time-based research in order to provide more coherent perspectives of such experiments.

As the new tools, such as smart phones and tablet PCs, are becoming an integral part of our lives, e-collaboration tools that support micro-blogging and micro-messaging will eventually be part of our everyday activity. Consequently, tools such as EuroCAT and related evaluation techniques are needed to analyse such hybrid merge of formal and informal learning.

ACKNOWLEDGMENT

This research work is funded by Euro-CAT-CSCL, an FP7 Marie Curie IAPP research project aiming to develop a Collaboration Awareness Tool (CAT) for enhancing the collaboration process in Computer Supported Collaborative Learning (CSCL). Euro-CAT-CSCL consortium is composed by Ouak.net (France), London South Bank University (UK), Universitat Autònoma de Barcelona (Spain), Universitat Ramon Llull (Spain) and Université de Toulouse (France).

APPENDIX A: VISION STATEMENTS

Experimental Group Vision statement: Bombastic airways bringing the boom back into flying. St2 as the CEO of the bombastic airlines was in charge of general project management and planning. St3 as the general manager was responsible for logistical planning. St1 as the designer designed the website and was responsible for marketing strategy.

Control group Vision statement: Dreamlines is an affordable and reliable way to travel. With comfort and safety our top priority we bring you a minimum of 32 seat pitch on all flights, cheaper costs than competitive airlines. Flights to over 100 destinations and the highest security stringent checks and procedures in place. Dreamlines is truly an experience not to be missed.

APPENDIX B: TEAMWORK QUESTIONNAIRE

Name and surnames: ____

Year: ____

Institution: ____

Course: ____

Date: ____

Team Work Skills Questionnaire

This set of questions will help us to understand the way you understand teamwork and your experiences when working with others. We know that in different times in your life, like in the classes or leisures activities, you must work with others, in different ways, and that you can work differently in each of these activities. However, we would like you to read and answer each phrase below considering the way you generally think and feel about the teamwork. There are no wrong or right answers and some answers. You should not think much for each phrase. Remember: give the answer that seems to you that it describes as generally as possible the way you feel or you think about the teamwork.

The information you will provide is strictly confidential; by filling in the questionnaire we assume that you give your consent to use your personal data anonymously for research purposes only.

Profile: Demographics		PLEASE ADD FILL IN THE GAPS OR 'X' AS REQUIRED ADD FILL IN THE GAPS or 'X' AS REQUIRED						
1	Country							
2	City							
3	First Language							
4	Number of children							
5	Internet connection	Wifi	Cable	Public places		Work	Home	Mobile
6	Level of English	Basic		Intermediate		Advance		
7	Level of ICT (every day computing skills)	Basic		Intermediate		Advance		
8	Web pages and social media	Your own Web page		Skype	Twitter	Messenger		Facebook
9	Your motivation in online education (if any)	Work/study from different places		Work/study flexible times		I don't have time	University reputation	Interested in certification
10	If you work how many hours a day do you work?							
11	How many hours does it take to commute? (if any)							
11	Are you flexible with your time for working and studying?	Not at all		Semi-flexible		Flexible		Very Flexible
12	Type of company	Education		Government		Small company		Big company
13	Please describe what you do							

Team-Member Concepts

When I work as part of a group in a task, I.	Almost never	Some times	Usually	Almost always
1. ... I'm the leader.				
2. ... I work very well with individuals from different cultures.				
3. ... I teach the other members.				
4. ... I interact cooperatively with the other members in the task.				
5. ... I serve as a model in formal and informal interactions.				
6. ... I identify alternative solutions.				
7. ... I behave with courtesy and politeness.				
8. ... I direct, when it is necessary, making sure that the group works better.				
9. ... I understand and I contribute to the group objectives.				
10. ... I respect the thoughts and the opinions of the other members in the task.				

Teamwork Concepts

1. Never / 2. Some Times / 3. Regularly / 4. Almost Always / 5. Always

ACTIVITIES OR THOUGHTS - PLEASE ADD 'X' AS REQUIRED	1	2	3	4	5
The success of a group is usually based on one or few students who propose solutions separately.					
The main contribution in a group comes from the team leader.					
The main contribution in a group comes from the combined, integrated and coherent work of several people (it is more than copy paste)					
In group, we all participate and almost nobody is distracted.					
The work in a group does not add value to me, rather I waste my time and efforts.					
I prefer the individual work to the group work.					
My work in a group is usually integrated and reflected jointly with those of other team-mates.					
The work in a group does not help me a lot because only some students contribute to activities.					
When working in a group, each of the students usually has different objectives that they do not get to conciliate and compromise.					

ACTIVITIES OR THOUGHTS - PLEASE ADD 'X' AS REQUIRED	1	2	3	4	5
When working in a group the relationships between all team-mates are usually harmonic and fluid.					
Some times I prefer the work in a group and some some times I prefer the individual work.					
When working in a group the relationships with the others are usually very complicated.					
I prefer the work in a good group than working on my own.					
When working in a group some students have clearer objectives than others.					
In a group, some people do not participate and are distracted easily.					
In a group, the ideas of how to organize the work are usually shared and clear for most team-mates.					
The work in a group helps me in my own learning and I take advantage of everyone's contribution.					
When working in a group the objective of the task is usually clear for all.					
In a group, the ideas of how to organize the work they are clear for some students and unclear for some others.					
In a group, the ideas that one has on how to organize the work are very different from the other team-mates and is difficult to agree.					

References

Abel F., Bittencourt I., Costa E., Henze N., Krause D. and Vassileva J. (2010). Recommendations in Online Discussion Forums for E-Learning Systems. *IEEE Transactions on Learning Technologies. 3*, 146-165.

Bourimi, M., Kesdogan, D., Heupel, M., Dhiah el Diehn I. Abou-Tair and Lambropoulos, N. (2013). PETs at CSCL Service: Underutilized Potentials for Privacy-Enhancing Distance Education. *Journal of Universal Computer Science*. *19*, 912-931.

Blommaert, J. (2005). Discourse: Key Topics in Sociolinguistics. Cambridge: Cambridge University Press.

Bodemer, D. and Dehler, J. (2010). Group awareness in CSCL environments. *Computers in Human Behavior*. *27*, 1043–1045.

Cakir, M., Xhafa, F., Zhou, N. and Stahl, G. (2005). Thread-based analysis of patterns of collaborative interaction in chat. In: Proceedings of the Conference on Artificial Intelligence in Education: Supporting Learning through Intelligent and Socially Informed Technology.

Cohen, E. G. and Lotan, R. A. (1995). Producing equal-status interaction in the heterogeneous classroom, *American Educational Research Journal*. *32*, 99-120.

Dillenbourg, P. and Jermann, P. (2007). Designing integrative scripts. In: F. Fischer, I. Kollar, H. Mandl and J. M. Haake (Eds.) Scripting Computer-Supported Collaborative Learning

- Cognitive, Computational, and Educational Perspectives, Computer-Supported Collaborative Learning SeriesSpringer, New York. 275-301.

Dourish, P.; Bellotti, V. (1992). Awareness and coordination in shared workspaces. Proceedings of the 1992 ACM conference on Computer-supported cooperative work. ACM Press New York, NY, USA. 107–114

Engelmann, T., Dehler, J., Bodemer, D. and Buder, J. (2009). Knowledge awareness in CSCL: A psychological perspective. *Computers in Human Behaviour*, *25*, 949–960.

EuroCAT Coding Manual. Available at: http://globaloperationsdivision.net/wp-content/uploads/2013/09/EUROCAT-CODING-MANUAL.pdf

Fischer, F. and Mandl, H. (2001). Facilitating the construction of shared knowledge with graphical representation tools in face-to-face and computer-mediated scenarios. In: P. Dillenbourg, A. Eurelings and K. Hakkarainen (Eds.), European Perspectives on Computer-Supported Collaborative Learning. Proceedings of the First European Conference on Computer-Supported Collaborative Learning, Unigraphic , Maastricht, NL. 230-236.

Fischer, F. and Mandl, H. (2003). Being there or being where? Videoconferencing and cooperative learning. In: H. van Oostendorp (Ed.), Cognition in a digital world, Erlbaum, Mahwah, NJ, USA. 205-223.

Fransen, J., Kirschner, P. and Erkens, G. (2010). Mediating team effectiveness in the context of collaborative learning: The importance of team and task awareness. *Computers in Human Behavior*. *27*, 1103–1113.

Fuks H., Pimentel M. and Pereira de Lucena C. J. (2006). R-U-Typing-2-Me? Evolving a chat tool to increase understanding in learning activities. *Computer-Supported Collaborative Learning*. *1*, 117–142.

Galegher, J. and Kraut, R. E. (1994). Computer-mediated communication for intellectual teamwork: An experiment in group writing. *Information Systems Research*. *5*, 110-138.

Greenberg S., Gutwin C. and Cockburn A. (1996). Awareness through fisheye views in relaxed WYSIWIS groupware . In Proceedings of the Graphics Interface Conference. Toronto, Canada. Morgan-Kaufmann. 28-38,

Grossecka, G. and Holotescub, C. (2010). Microblogging multimedia-based teaching methods best practices with Cirip.eu. *Procedia - Social and Behavioral Sciences*. *2*, 2151-2155.

Herring, S. C. (2010). Web content analysis: Expanding the paradigm. In: J. Hunsinger, M. Allen and L. Klastrup (Eds.), The International Handbook of Internet Research, Springer Verlag, Berlin. 233-249.

Järvelä, S. and Hadwin, A. (2013). New Frontiers: Regulating learning in CSCL. *Educational Psychologist*. *48*, 25-39.

Jeong, A. C. (2005). Methods and Tools for the Computational Analysis of Group Interaction and Argumentation in Asynchronous Online Discussions. In the Proceedings of the Technology and Learning Symposium, 5-6 April 2006, New York, NY.

Jeong, H. and Hmelo-Silver, C. (2010). An Overview of CSCL Methodologies. In the ICLS '10 Proceedings of the 9th International Conference of the Learning Sciences.

Jongsawat, N. and Premchaiswadi, W. (2009). Group Awareness Information in Web-Based Group Decision Support System. In: Proceedings of the IEEE International Conference on Systems, Man and Cybernetics, San Antonio, TX, USA, 370-375.

Kollar, I., Fischer, F. and Hesse, F. W. (2006). Collaboration scripts - a conceptual analysis. *Educational Psychology Review*. *18*, 159-185.

Lambropoulos, N. (2008). Tools and Evaluation Techniques for Collaborative E-Learning Communities. Ph.D. Thesis, Centre for Interactive Systems Engineering Lonodn South Bank University, UK.

Lambropoulos, N., Gourdin, A., Danis, S. and Bakharia, A. (2012). eLearning Project Management for Innovation management: Team Project-Based Learning and Assessment at the IT Institute. In: G.Kurubacak, and V. Yuzer, (Eds.), Handbook of Research on Project Management Approaches for Online Learning Design, IGI Global Publications, Hershey, PA, USA. 12-31.

Lambropoulos, N., Kampylis, P., Papadimitriou, S., Gkikas, A., Vivitsou, M., Minaoglou, N., et al. (2008). Hybrid Synergy for virtual knowledge working. In: J. Salmons and L. Wilson (Eds.), Handbook of Research on Electronic Collaboration and Organizational Synergy, Vol. 1, IGI Global Publications, Hershey, PA, USA. 83-102.

Lambropoulos and Romero (2011). Internal and External Regulation to Support Knowledge Construction and Convergence in Computer Supported Collaborative Learning (CSCL). *Electronic Journal of Research in Educational Psychology*. *9*, 309-330.

Lambropoulos, N., Romero, M. and Demeure, V. (2010). EuroCAT Coding Manual http://www.cat-cscl.eu/moodle/file.php/1/EUROCAT-CODING-MANUAL_V03.pdf

Laru, J., Näykki, P. and Järvelä, S. (2012). Supporting small-group learning with use of multiple Web 2.0 tools in blended learning setting: A case study with learning sciences students. *The Internet and Higher Education. 15*, 29-38.

Lonchamp, J. (2007). About the Complexity of CSCL Systems. In: The Proceedings of CSCL'2007, Rutgers. Lawrence Erlbaum Associates, New Jersey, USA. 470-472.

Lonchamp, J. (2009). A three-level analysis of collaborative learning in dual-interaction spaces. *Computer-Supported Collaborative Learning*. *4*, 289-317.

Martínez, A., Dimitriadis, Y., Rubia, B., Gómez, E. and de la Fuentea, P. (2003). Combining qualitative evaluation and social network analysis for the study of classroom social interactions. *Computers and Education*. *41*, 353–368.

Martínez-Fernández, J. R., Duran, D., Corcelles, M., Fuentes Agustí, M. and Cerrato, M. (2009). Conceptions about the teamwork questionnaire (CTQ): A survey to know the high school students' beliefs. Paper presented at the 13th International Conference on EARLI, Amsterdam, Agost 25-29.

Mi Heo, G. and Breuleux, A. (2009). Roles of initiators and interaction patterns: exploring an informal online community at the interpersonal plane. In The CSCL'09 Proceedings of the 9th international conference on Computer supported collaborative learning - Volume 1.

Oulasvirta, A., Lehtonen, E., Kurvinen, E. and Raento, M. (2010). Making the ordinary visible in microblogs. *Personal and Ubiquitous Computing*. *14*, 237-249.

Oulasvirta A., Petit R., Raento M., Tiitta S. (2007). Interpreting and acting on mobile awareness cues. *Human Computer Interaction*. *22*, 97–135.

Persico D., Pozzi F. (2010). The three T's of the structure of online collaborative activities. *Procedia Social and Behavioural Sciences*. *2*, 2610-2615.

Riemer, K. (2009). E-Collaboration Systems - Identification of System Classes using Cluster Analysis. *International Journal of e-Collaboration*. *5*, 1-24.

Roschelle, J. (1996). Learning by collaborating: Convergent conceptual change. In: T. Koschmann (Ed.), CSCL: Theory and practice of an emerging paradigm, Lawrence Erlbaum Associates, Hillsdale, NJ, USA. 209-248.

Roschelle, J. and Teasley, S. (1995). The construction of shared knowledge in collaborative problem solving. In: C. O'Malley (Ed.), Computer-supported collaborative learning, Springer Verlag, Berlin, Germany. 69-197.

Spada, Hans (2010). Of scripts, roles, positions and models, *Computers in Human Behavior*. *26*, 547-550.

Stahl G. (2002). Contributions to a theoretical framework for CSCL. In: G. Stahl (Ed.), Computer support for collaborative learning: foundations for a CSCL community, (CSCL 2002 Proceedings), Lawrence Erlbaum Associates Mahwah, NJ, USA.

Stahl, G. (2005). Group cognition in computer-assisted collaborative learning. *Journal of Computer Assisted Learning. 21*, 79–90.

Stahl, G. (2006). Group cognition: Computer support for building collaborative knowledge. MIT Press Cambridge, MA, USA.

Stahl, G. (2007). Meaning making in CSCL: Conditions and preconditions for cognitive processes by groups. Paper submitted to the international conference on Computer-Supported Collaborative Learning (CSCL '07), New Brunswick, NJ.

Stahl, G. (2009a). For a science of group interaction. In: The Proceedings of GROUP '09 ACM 2009 international conference on Supporting group work. Sanibel Island, Florida, USA.

Stahl, G. (2009b). Studying virtual math teams. Springer, New York, NY, USA.

Stahl, G. (2010a). Computer Mediation of Collaborative Mathematical Exploration. A contribution to the ICLS 2010 symposium: “Social construction of mathematical meaning through collaboration and argumentation” by Shirley Atzmon, Rina Hershkowitz (organizer), Chris Rasmussen, Baruch Schwarz (organizer and chair), Gerry Stahl, Megan Wawro, Michelle Zandieh, Mitchell Nathan (discussant). http://gerrystahl.net/pub/icls2010stahl.pdf

Stahl, G. (2010b). Guiding group cognition in CSCL. *International Journal of Computer-Supported Collaborative Learning. 5*, 255-258.

Stahl, G., Koschmann, T. and Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In: R. K. Sawyer (Ed.), Cambridge handbook of the learning sciences, Cambridge University Press, Cambridge, UK. 409-426.

Slof, B., Erkens, G., Kirschner, P. and Helms-Lorenz, M. (2013). The effects of inspecting and constructing part-task-specific visualizations on team and individual learning. *Computers and Education. 60*, 221-233.

Soller, A., Martínez-Monés, A., Jermann, P. and Muehlenbrock, M. (2005). From mirroring to guiding: a review of state of the art technology for supporting collaborative learning. *Journal of Artificial Intelligence in Education*. *15*, 261–290.

Strijbos, J. W. and De Laat, M. F. (2007). Prototypical roles in computer-supported collaborative learning: A conceptual framework for the design of a tool for teachers. In Facilitating and analysing roles in computer-supported collaborative learning. Paper presented in a symposium at the 12th biennial EARLI conference, Budapest, Hungary A. Weinberger and J. W. Strijbos (Chairs).

Tran, M. H., Raikundalia, G. K. and Yang, Y. (2003). Methodologies and Mechanism Design in Group Awareness Support for Internet-Based Real-Time Distributed Collaboration. In: X. Zhou, Y. Zhang and M.E. Orlowa (Eds.), Web Technologies and Applications, Lecture Notes in Computer Science, Springer-Verlag, Berlin, Germany. 594-595.

Trausan-Matu, S., Stahl, G. and Sarmiento, J. (2007). Supporting Polyphonic Collaborative Learning. *E-service Journal*. *6*, 58-74.

Vassileva, J. (2009). Towards Social Learning Environments. *IEEE Transactions on Learning Technologies. 1*, 199-214.

Warschauer, M. (1997). Computer-mediated collaborative learning: Theory and practice. *Modern Language Journal*. *81*, 470-81.

Weinberger, A., Fischer, F. and Mandl, H. (2002). Fostering computer supported collaborative learning with cooperation scripts and scaffolds. In: G. Stahl (Ed.), Computer support for collaborative learning: foundations for a CSCL community. Proceedings of the Conference on Computer Support for Collaborative Learning (CSCL) 2002, Boulder, USA, Erlbaum, Hillsdale, NJ, USA. 573-574.

Weinberger, A., Stegmannb, K. and Fischer, F. (2010). Learning to argue online: Scripted groups surpass individuals (unscripted groups do not). *Computers in Human Behavior*. *26*, 506–515.

Zemel, A. and Çakir, M. P. (2007). Reading's work: The mechanisms of online chat as social interaction. Paper presented at the National Communication Association Convention, Chicago, IL. http://GerryStahl.net/vmtwiki/alan2.pdf

In: Collaborative Learning
Editor: Stephen Rutherford
ISBN: 978-1-63321-756-0

Chapter 12

A COLLABORATIVE ENVIRONMENT EQUIPPED WITH A TRACING SYSTEM TO DEVELOP PROFESSIONAL SKILLS AND ENCOURAGE PARTICIPATION OF LEARNERS

***Bénédicte Talon*[1], *Henda Belaid*[2] *and Insaf Kerkeni*[1]**
[1]University of Lille - North of France, LISIC – ULCO, France
[2]University of Tunis, LIPAH, Tunisie

ABSTRACT

This chapter describes a pedagogical environment equipped to track learners' activities. The instructional system is the result of an iterative design. Different cycles of design have produced a collaborative learning methodology and tools to support it.

The collaborative environments target vocational training of students who will work on projects in teams (including IT projects where collaboration is essential). The aim is to develop key skills, such as project management, planning, estimation, communication, negotiation, etc. while working the development of expertise in a specific area (database, system, network, software engineering, etc.).

The instructional design (ID) methodology that has been applied to design and implement the instructional system is a prototypal approach. Other different ID methods could have been used but the prototypal approach has the advantage to allow an iterative evolution of the system. Successive cycles have allowed the production of an educational method and environment that accompanies it.

A generic method emerged, which offers the acquisition of job skills through the in-group management of a project. The method is hybrid marrying face-to-face sessions with distant work. This method subscribes to the principles of the socio-constructivist theory and offers the characteristics and benefits demonstrated by this theory.

The teacher describes awaited activities in a logbook before each face-to-face session. Each group does restitution, under a standardized form, in the team logbook of what has been achieved and scheduled.

Tools encourage the restitution and collaboration activities. They are chosen in respect of specific requirements: the tools must be easy to understand, intuitive, provide logging capabilities, provide features for documents sharing, facilitate communication

and facilitate feedback from the teacher. The specifications led to use Web 2.0 tools rather than LMS platform.

However, the experience showed that traceability of actions ensures better management and assessment. The device has to be improved by adding indicators about the participation of students, the rate of work on activities, the distribution of communications within a group, etc.

A tracking tool based on agents has been developed that provides a dashboard for the teacher. Thanks to the dashboard, teachers can observe individual and group activities and detect and awake sleeping learners. Teachers visualize the activity and its distribution among stakeholders. Teachers are thus able to refine their evaluation of work. They can also reactivate the motivation of less active learners.

In the same way, a dashboard enables students to understand the nature of their activities and to evaluate their respective participation in the project. This dashboard has a regulatory effect on the activity of the group.

This chapter presents the instructional system and the traceability system in place to support and evaluate the learning activities.

INTRODUCTION

This chapter describes a collaborative pedagogical environment equipped to track participants' activities. The instructional system is the result of an iterative design. Different cycles of design have produced a collaborative learning methodology and tools to support it. This chapter will present the instructional system, as well as the traceability system that has been put in place to support and evaluate the learning activities.

This project focuses on the design and implementation of collaborative environments (including notably Information Technologies projects where collaboration is essential) that are dedicated to the vocational training of students who will work in project teams. The aim is to foster the development of key skills such as project management, planning, estimation, communication, negotiation, etc., while developing expertise in a specific area (database, system, network, software engineering, etc.).

The instructional design (ID) methodology that has been applied is a prototypal approach (Tripp and Bichelmeyer, 1990). Other different ID methods could have been used (Andrews and Goodson, 1980) but the prototypal approach described here has the advantage of allowing an iterative evolution of the environment.

According to this prototypal approach, field experiences, realized in a series of successive cycles, have refined the instructional method and the environment that accompanies it. After two cycles, a generic project-based methodology has emerged that has been validated experimentally in the field (Talon and Leclet, 2008). This methodology is dedicated to the acquisition of targeted soft and hard job skills. The methodology combines face-to-face sessions with distant work and subscribes to the principles of the socio-constructivist theory in order to obtain benefits demonstrated by this theory. According to the constructivist theory of learning, individuals master new approaches through interactions with others and by coordinating their own approaches to others' reality (Dillenbourg, 1995).

However, unlike most project-based learning methods where job organization is free, here operating rules regulate the organization and are reinforced by the orchestrator of the project. The student must maintain a workload imposed by the orchestrator. This choice has been realized in order to develop the rigor necessary to manage a project. The teacher describes awaited activities in a logbook before each face-to-face session. Each group undertakes restitutions, under a standardized form in the team logbook, of what has been achieved and what has been scheduled for the next session.

Information and Communication Technologies (ICT) encourage the restitution and collaboration activities, so, the decision was adopted to use them (Talon and Leclet, 2007). However, technologies must be chosen in respect of specific requirements: the tools must be easy to understand for a non-ICT specialist, intuitive, provide logging capabilities, provide features for documents sharing, facilitate communication and facilitate feedback from the teacher. The specifications often lead to favoring Web 2.0 tools (Talon and Leclet, 2011), but teachers can choose and combine various tools.

Indeed, our field experiences indicate that teachers practicing MAETIC (see below) encounter difficulties to assess the learners' participation in the project. Experiences showed that traceability of actions ensures a better management and assessment of group and individual activities (Pozzi et al., 2007). Assessment allows the measurement of groups' knowledge of the collaborative processes, the quality of groups' products and individuals' collaborative learning skills. Traceability of actions allows learners to visualize their real input into the project and be motivated. Traceability of actions also ensures the measurement of the impact of the pedagogical process in order to offer re-engineering capabilities to the teacher/designer of the activity (Pozzi et al., 2007).

The environment capability had to be improved by adding indicators and management facilities. These indicators inform the teacher/designer and learners about the participation of students, the rate of work on activities, the distribution of communications within a group, etc.

A tracking tool has been developed which is based on agents (Talon et al., 2013). The tool offers a dashboard for the teacher and another one for the learners. Thanks to the dashboard, the teacher can observe individual and group activities and detect and awake sleeping learners. The teachers visualize the activity and its distribution among stakeholders. Teachers are therefore able refine their evaluation of individual work. They can also reactivate the motivation of less-active learners. The inspection of real activities allows the teachers (as designers of the environment) to regulate the distribution of workload and to re-design the environment. In the same way, a dashboard enables students to understand the nature of their activities and to evaluate their respective participation in the project. This dashboard has a regulatory effect on the activity of the group.

In this chapter, the specific context of vocational training will be explored. Then, the instructional design method exploited for the production of the pedagogical environment will be presented. The following section will summarize the evolution of the instructional system. Then an overview of the pedagogical method will be offered, followed by the characteristics for the implementation of this method to deploy in computing environments. The following section will describe the needs that have emerged in terms of tool support for the teacher to monitor and evaluate the educational environment. After describing the concept of traces and indicators, the remaining sections present the analysis and design of the tracking system and the chosen technology. After this follows a presentation of the tracking tool. The perspectives opened up by the work are also explained.

The Instructional Problem

It is usual to establish a “requirements definition” during the specification phase of a project. The content of this document structures the activities by defining clear orientations for the work to be done. A requirements definition includes the definition of various items presenting the needs and constraints of the project. In order be clear with the finalities of the project, the first section presents the specific context of the work.

Objectives

The aim of this project is to promote the learning of professional practices through the design and development of specific IT supported training systems. The audience of these learning environments is students of higher education who follow a vocational training.

An additional aim of the work is to offer to teachers, in this context of professional competences development, a pattern of instructional system adapted to their needs. Using this pattern, teachers could deploy their own system by integrating tools of their choice.

The Public

The instructional system is intended for students enrolled in engineering programs of higher education. In this large context, the project specifically focuses on Information Technology (IT) training. Developing and integrating IT is a difficult job, and this relatively young discipline is confronted with specific constraints that other disciplines do not encounter: software "invisibility", deceptive flexibility and needs that are difficult to identify and to model, to name but a few.

Intended Outcomes. What Kinds of Competences Are Expected?

According to Denning and Dunham (2001), *“To create value for customers, the network-age professional needs two kinds of knowledge. One is deep technical skill, which is at the core of any promise to a customer. The other we call value skill, which enables the professional to connect with the customer and successfully deliver the promise. Without both, the professional will be ineffective”*.

Woods et al., (2000) agree with this assertion and detailed it in concert with ABET Engineering criteria: “*our goal as engineering educator should include equipping our students with problem-solving, communication, teamwork, self-assessment, change management and lifelong learning skills*”.

In 1991, the SCANS report already identified different soft skills as necessary for work and career success which includes notably prioritizing of task, work in team and effective communication. The Competency Model of the US Department Of Labour (DOL), which is based on a pyramid of skills required for employees to achieve success in the workforce, places soft skills at its base: interpersonal skills, integrity, professionalism, initiative, dependability, reliability, and willingness to learn (USDOL, 2011).

Intended Outcomes. What's the Problem?

Literature shows that the current instructional systems only partially address specific professional needs. The literature suggests that students coming from higher education often present a lack of the soft competences underscored in the previous paragraph, such as project management, team work and oral or written communication (Wanous et al., 2006).

In the IT domain, customers complain about the lack of product quality and the companies decry the lack of qualified personnel (Callahan and Pedigo, 2002; Conn, 2002); the project's success rates are still relatively low. French universities do not yet train students who have skills, knowledge and attitudes to satisfy the needs of the job market. Training programs do not adequately prepare students to the job skills that are judged crucial by employers. In fact, though theoretical knowledge provided by such organizations is often excellent, they are frequently reproached for training engineers who lack practical knowledge and experience.

The results of a survey carried out by Lethbridge (2000) show that the knowledge developed at the university, and the kind of knowledge required of computer science specialists on the job, do not match. The participants in this study revealed that, when leaving the educational system, students lack the skills that are considered essential, such as project management, writing, user interface design and database management. A recent survey of Chief Information Officers in the USA found that IT workers lack these interpersonal and social skills (Mielach, 201; BHEF, 2013). Managers are seeking candidates who not only possess technical abilities but also can meet deadlines and work well with customers and colleagues.

Instructional System. What to Focus on?

Higher education institutions must better adapt curriculum and co-curricular experiences to help students to build the awaited competencies. It is essential to adopt instructional practices that will provoke the understanding needed to motivate the student and emphasizing the rigor of the processes taught. As Denning and Dunham (2001) say, "*One does not learn value skills by studying them in a book or a lecture hall; one learns them by practice, often under the watchful eye of a competent coach.*". This means not only reflecting on appropriate program content but also changing and adapting teaching practices to include a more active pedagogy. In the second part of a series of papers, Felder et al., (2000) propose some effective instructional tips.

Instructional System: Learning Theory Support

Learning theories help designers to define instructional systems. The learning theories study the variables that influence the learning process and explain how this influence occurs.

They propose answers to important questions, such as “How does learning occur?”, "What is the role of motivation?”, “How does transfer of learning occur?” etc. By giving answers, they provide a framework for designing instructional systems (Schunk, 2012).

Three major theoretical supports are usually identified: behaviorist, cognitivist and constructivist models. Each of these models makes different assumptions about what is crucial for understanding and influences the modalities of implementation of an instructional model. These three theories have been synthesized in Talon et al., (2012). Among these theories, constructive alignment (Biggs, 1999) claims that a good pedagogical design ensures that there are absolutely no inconsistencies between the curriculum, the teaching methods, the learning environment and the assessment procedures (see figure 1). Constructive alignment provides foundations that match conditions of success formulated by Felder et al., (2000).

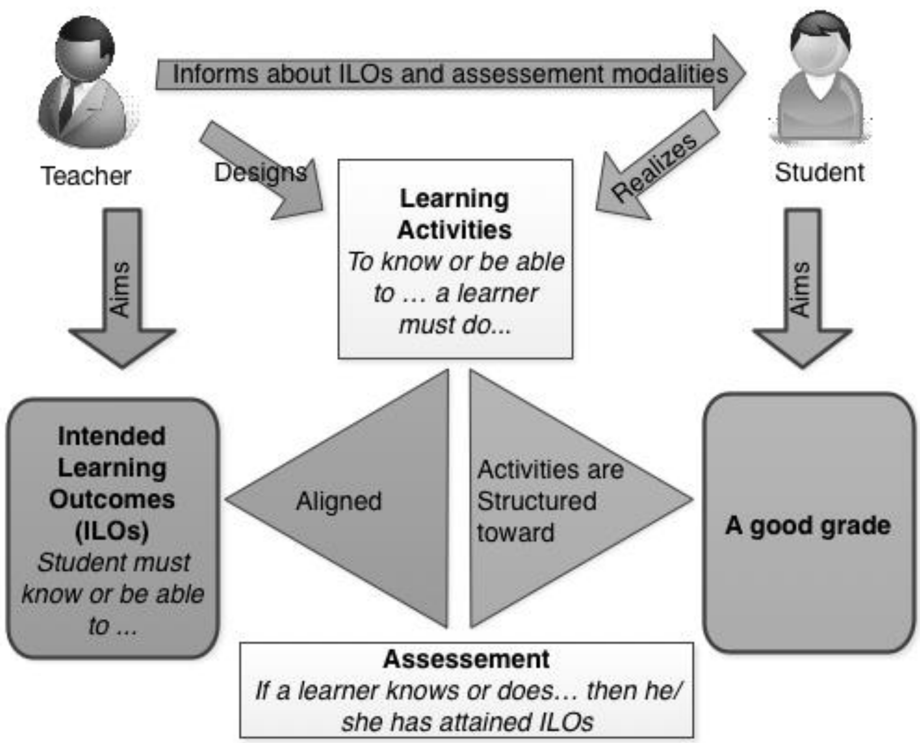


Figure 1. Constructive alignment. Good Instruction aligns Intended Learning Outcomes, activities and assessment techniques according to the fact that students essentially aim a good grade.

This section has introduced the context of our research. Our aim is to promote the learning of professional practices through the design and development of ICT supported training systems. The training systems are dedicated to students enrolled in engineering programs of higher education. The main objective is to favor training of students who possess technical abilities but can also manage projects, meet deadlines and work well with customers and colleagues.

INSTRUCTIONAL DESIGN AND RELATED CONCEPTS

Instructional Design (ID) is a method or process. Many authors summarize ID as a *systematic planning of instruction* (Zierer and Seel, 2012). Course designers use ID to organize an Instructional System (Tracey and Richey, 2007): learning and teaching activities, resources and actors involvement.

The Instructional System (IS) is a complex system allowing the instruction to take place. Its aim is to induce learning through instruction. The IS is designed to manage an instructional problem. It combines organizational conditions, arrangement of resources for the learner and the trainer and procedures to promote learning and instruments for evaluation.

The instructional problem is a set of variables that will affect the learning process such as the learner's profile, the instruction domain, the teacher's expertise, his/her preferences and the constraints (number of learners, size of the room, pedagogical material, and so on). Articulation of these concepts can be visualized in figure 2.

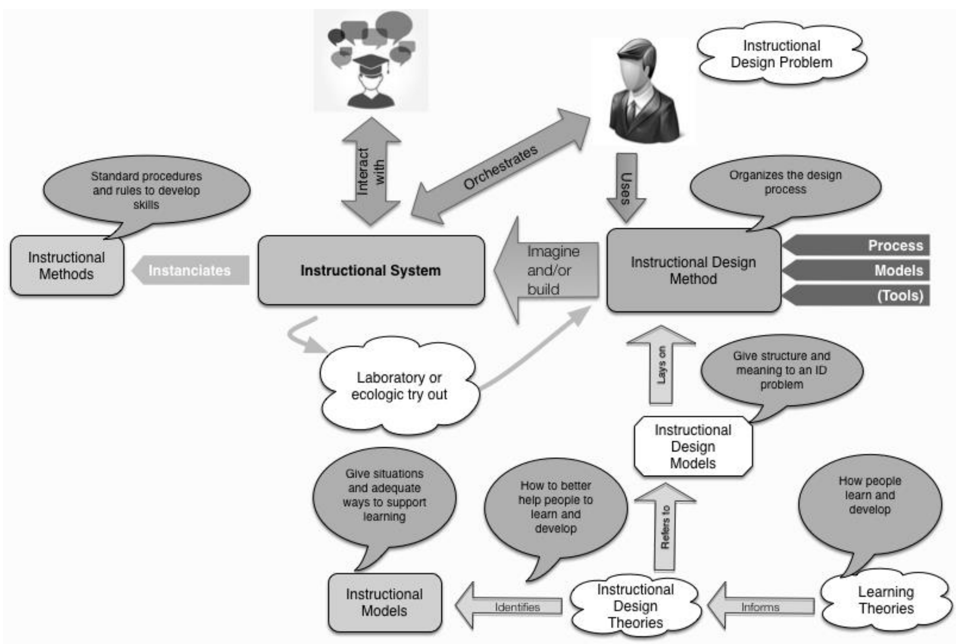


Figure 2. Articulation of concepts related to instructional design. Instructional systems are built using instructional design methods. These methods offer processes, models and tools used by teachers to imagine a suitable instructional system. During the design process, different theories and models are involved.

INSTRUCTIONAL DESIGN MODELS

An ID Model provides a framework for the systematic production of instruction that can be used in different contexts (Braxton et al., 1995). The model prescribes how combinations of instructional strategy components should be integrated to produce a course of instruction.

An ID model refers to an ID theory. The theory explains phenomena and the ways to attain learning goals (Reigeluth, 2013). Numerous ID Models have been proposed. In 1980, Andrews and Goodson already announced more than 40 ID models. A model of ID focuses on different components and strategies of ID (Zierer and Seel, 2012). Needs analysis and strategic planning are still some of the most important areas of ID and Instructional Systems development today. The model of ID most commonly cited is ADDIE for Analyze, Design, Develop, Implement and Evaluate (Molenda, 2003).

A constructive approach of ID views it as the preparation of resources and learning processes in order to facilitate students learning in a constructivist manner. Rather than emphasizing predetermined design steps, the constructive approach focuses on the iterative development and implementation of learning environments, offering opportunities for inquiry and discovery learning (Zierer and Seel, 2012). This approach favors rapid prototyping (Tripp and Bichelmeyer, 1990), after a succinct needs analysis.

It is not easy to structure the ID world because literature, in this domain, is full of complicated terms (sometimes used as synonyms due to misuse of language). Examples include instructional design method, instructional design model, instructional theory, learning theory, and instructional method. In this section, we have given definition of these concepts related to the production of instructional systems and we have proposed a diagram (figure 2) showing the relationship between these concepts.

THE MAETIC-BASED INSTRUCTIONAL SYSTEM

Since 2005, a constructive approach of instructional design in two French universities has been used to produce a model of an instructional system (Leclet and Talon, 2007), giving an answer to the requirements described in the first section. This model of an instructional system implements the principles described in the instructional methodology, and is named MAETIC (Méthode Pédagogique Assistée par les TIC (Pedagogical method assisted by ICT); Talon and Leclet, 2008). Whatever the system is, either entirely manual or ICT supported, all principles must be applied in order to favor, during a project, the development through in-group activities of technical and value skills. The technical skills are obtained with the application of a product development methodology (product design and implementation method) and value skills are acquired, due to successive steps of MAETIC (project management method) bringing out good practices.

The Methodology

MAETIC is a pedagogical method dedicated to a project-based pedagogy materialized in a guide. MAETIC proposes to organize a pedagogical project into the form of a standard project management lifecycle. The learners build their competences by means of a project, during which they identify and formulate their own problems.

The participants in this method are the groups of learners (4 to 6 students per group is advised), the customer and the orchestrator (the teacher). In many cases, the teacher who establishes project requirements according to the course objectives plays the role of the customer. The teacher monitors the project and fixes the product to be delivered according to the targeted technical competences.

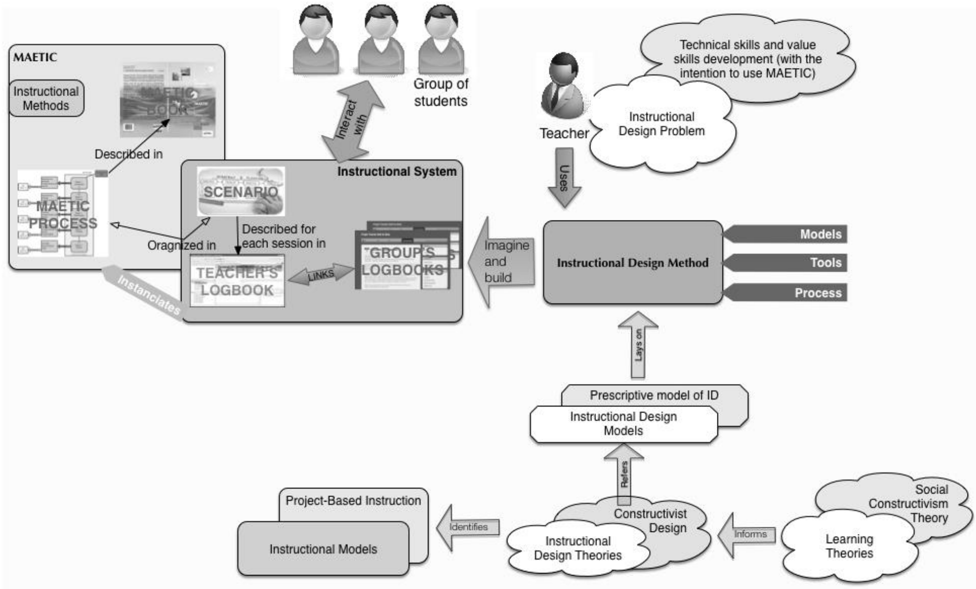


Figure 3. MAETIC method allows the implementation of collaborative project-based learning systems. Each instructional system is designed according to a prototypal instructional design method in order to implement a social constructivist approach.

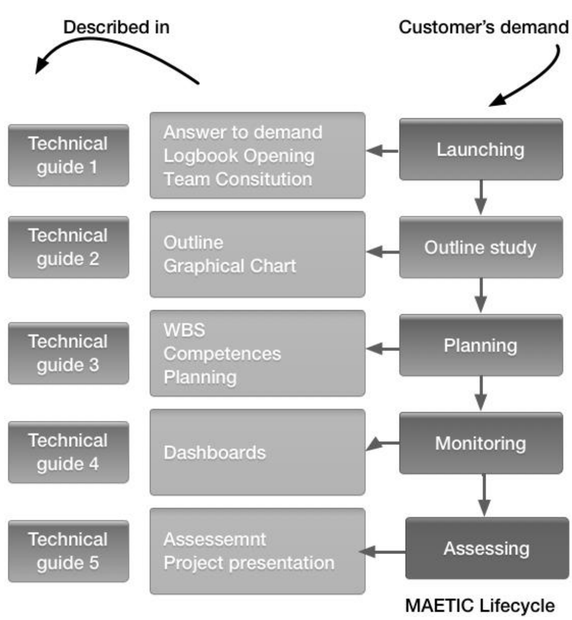


Figure 4. MAETIC Lifecycle. Each project is organized in five steps. Each step requires the production of deliverables (middle). Students can read technical guides (left) to organize the step and the production of deliverables.

The teacher realizes the pedagogical scenario (number of sessions, activities during each session, session duration, etc.) according to the MAETIC recommendations, the allocated time and the focus of the course. Before each face-to-face session, the teacher writes an article in the teacher's logbook. This article describes what has to be done during the next session. This paces the work of learners and teaches them to manage their time. Figure 3 presents the MAETIC instructional system.

A MAETIC lifecycle is sequential and includes five steps corresponding to the standard steps of a project management life cycle (figure 4). Each step requires the implementation of techniques and organization (distribution of roles, realization of a Work Breakdown Structure, etc.) and the production of deliverables typical of a project management method (answer to request, outline, planning, etc.). These requirements prepare students for a realistic project management production. Technical notes help students to organize and produce deliverables. MAETIC requires from students that they produce pedagogic deliverables that strengthen the methodological knowledge they have developed during the exercise. After each session, students explain in a logbook, what they had to do, what has been done and what they intend to do before the next session.

The MAETIC methodology joined the different conditions needed to produce an educational system oriented towards the success of the training of engineers (Felder et al., 2000).

1. *Formulate and publish clear instructional objectives*. The teacher establishes a scenario indicating the instructional objectives in a specific section. Objectives encompass both knowledge of content and mastery of the skills the students will develop. The scenario is presented and discussed during the first session.
2. *Establish relevance of course material and teach inductively*. The teaching course begins by describing the types of problems to be solved. The first session discusses realistic situations in which engineers are required to use the project management process.
3. *Balance concrete and abstract information in every course*. The MAETIC book gives students high-level information to help them appreciate the problems of project management. The book is organized in such a manner that it gives, through technical guides, a concrete description of the way to solve and process. The product development is oriented toward the direct application of the description. The teacher does a systematic discussion with students during each work session in the classroom to verify that students understand the current activity and how it relates to concrete cases.
4. *Promote active learning in the classroom*. The methodology has been proposed to organize a project-based pedagogy where students are active. Each activity of MAETIC targets specific skills. An ontology model of these skills has been built, which is described by Hassan (2010).
5. *Use cooperative learning*. MAETIC is dedicated to group activities. Each student member of a group has a role in this cooperative activity.
6. *Give challenging but fair tests*. The assessment is regular, its aim is to evaluate the production of deliverables and the process used to produce them. Students realize dashboards in which they indicate their activities and who undertook them. This

allows the teacher to individualize the evaluation. Detailed information about the different actions perfects this evaluation.

7. *Convey a sense of concern about students' learning*. The teacher evaluates the situation with each group during each in-presence session. Between sessions, the teacher consults the work done, compares it with the tasks assigned and leaves a comment to indicate the eventual problem or delay and to encourage the team.

The System – An Implementation Example

It is possible to carry out the MAETIC method without any ICT support. Teachers and learners can consult a book (the MAETIC book can be obtained from the library). Teachers can write the required activities on a board, before each session. Learners can write, during each session, articles in a paper logbook. Learners can also produce documents during the project steps and put them together into a folder. But ICT offers many advantages for a pedagogical context (Tinio, 2003). In the context of a MAETIC project, advantages are the ability to act between sessions thanks to a distant work, the centralization of the production of the group, the distribution by the teacher of on-line documentation, an easiest communication between participants, and the ability for the teacher to follow learners' activities between sessions and to comment on their work. The advantage of the MAETIC system is that a teacher can implement it according to his/her preferences. For example, teachers have deployed the MAETIC environment on Weblogs (Talon and Leclet, 2008). Another experiment has tested it on an Eclipse platform (Talon et al., 2009). Other approaches have tested it with collaborative tools (e.g. a Google Drive environment) coupled with social media (e.g. a Facebook page).

The underlying idea is to respect the recommendations of the guide and to organize the system in order to implement the logbooks' (the teacher's logbook and the students groups' logbooks) management organization easily and correctly. The teacher's resource provides the deliverables, storage management and the communication management (intra-group communication and teacher/learners communication). The guide does not force anyone to choose one implementation rather than another.

An example presented here is a declination of MAETIC dedicated to a project management course on the ILIAS platform (ILIAS, 2014) coupled with external Weblogs. The aim of this course was to develop competences in project management (knowing steps, activities and deliverables of a project management process) but also to improve collaboration (to negotiate, to solve conflicts, etc.) and communication (writing a professional document, presenting an idea, etc.) competences.

In the example, the teacher implemented a course on the ILIAS platform. ILIAS is an open-source collaborative platform, which includes various services such as resources storage, chat, mail, forum, wiki and so on. The teacher enrolled groups of students (between 3 and 6 students in a group) on the platform. The teacher prepared the organization of seven in-presence sessions (only two are visible in figure 6) because it was the number of sessions imposed by the management team. No distance-learning sessions were planned for this course. The time between sessions was allocated in order to finish the work in time.

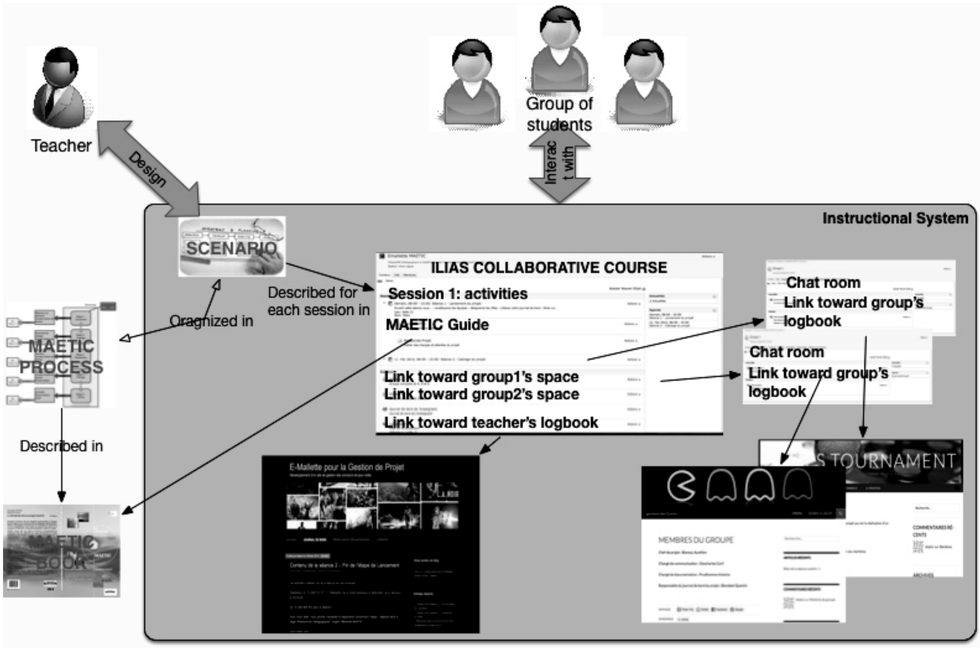


Figure 5. An example of MAETIC instructional system.

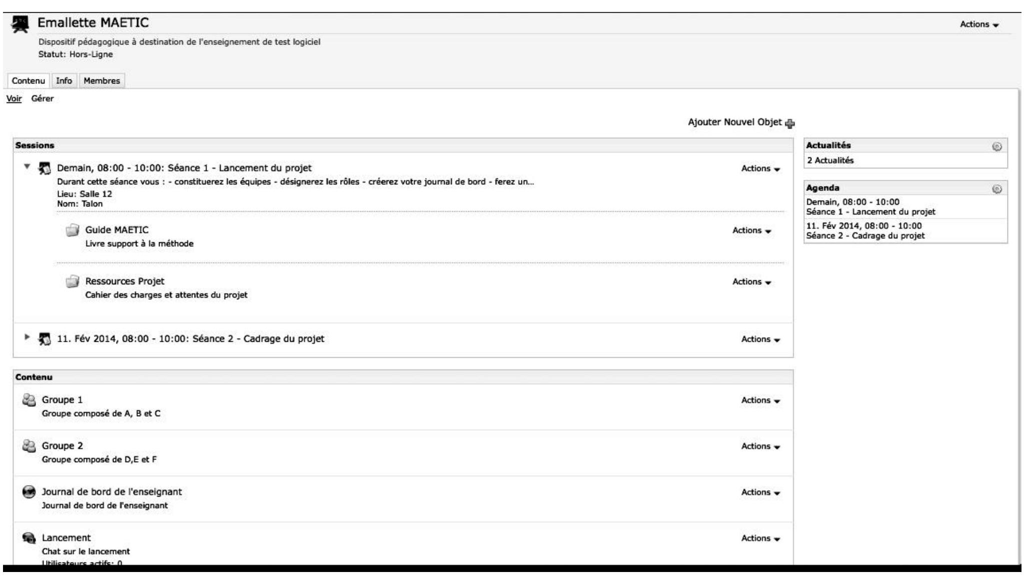


Figure 6. The project management course space on ILIAS.

Each session identified and explained the work to be done. The teacher delivered the necessary resources through well-identified folders. The teacher put a link toward an external logbook where students could consult generalities about the MAETIC Method (slides, process, tips, comments, etc.); see figure 6 for the project management course space on ILIAS. A chat room was opened in each group space and a general chat has been opened for the whole classroom. This medium offered the opportunity for students to communicate outside of the in-presence sessions. But students were not obliged to use the chat rooms to discuss. They could use email or other media according to the communication plan they produced during the second session. Each group had, in its space, a link toward an external logbook webpage. At the end of each session, students described the activities they had undertaken in the logbook.

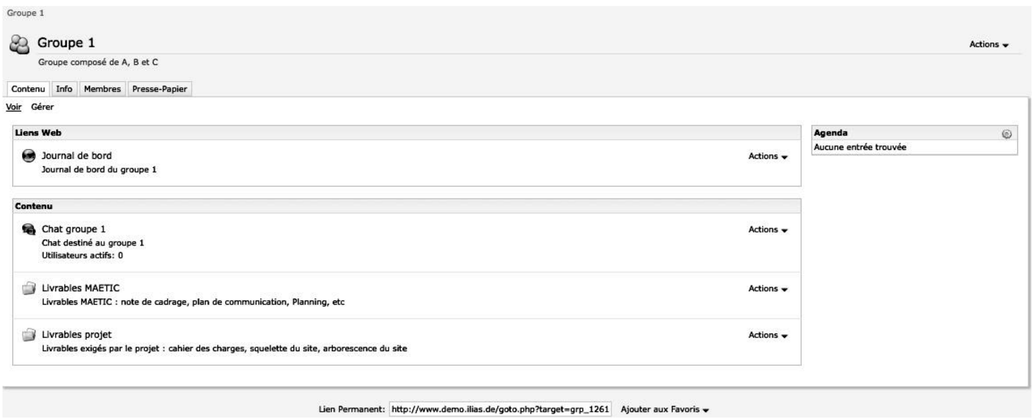


Figure 7. Group's space.

Deliverables that students produced were stored into their own folders (one for the project deliverables and one for the MAETIC documents). See figure 7 for the group's space. Between each session, the teacher consulted the students' logbooks and left comment on them, and then downloaded the deliverables to assess the work. During the work assessment, the teacher maintained an Excel worksheet. The teacher noted every delay and assessed each group according to the deliverables and posts.

In this section, the MAETIC methodology has been described. The lifecycle and the deliverables needed after each phase have been presented and a model of implementation on the Ilias platform has been described. The MAETIC method is well accepted by teachers (Leclet and Talon, 2007) and has been deployed in various universities (Picardie, Littoral, Fès, Djibouti, etc.) on various instructional domains (database, project management, thesis management, etc.) and under different forms, but experiments show that the system can be perfected to add assistance to the assessment activity. The next sections will explore the development of the tracking system.

SYSTEM ANALYSIS. IDENTIFIED NEED TO TRACK ACTIVITIES

In such a system as MAETIC, where work is distributed among students and where activities are made on-line, the teacher has difficulty identifying the real participation of each individual or the adequacy of the average time spent on an activity with the profitability of that activity. This information could help the teacher to evaluate students, but also to assess the instructional scenario in order to revise it. Even if teachers verify the work done after each session, and so evaluate regularity and quality of productions, they still suffer from a lack of quantitative elements that would allow them to refine their evaluation. Teachers expect information as diverse as the participation rate of each individual on an activity, the identification of non-engaged students, the identification of systematic delays, the total amount of time spent on a specific activity, the time spent on a project, the time distribution between activities, etc. These expectations require that the system keeps various traces about what has been done, when, at what time, for how long and by whom.

However, it is difficult to work with raw traces. The system needs to provide teachers with an aggregate analysis of elements. It gives a highest level of answers to the questions that interest teachers. Researchers called these answers ‘indicators’.

The next sections will deal with these questions of traceability, indicators and will present and describe a traceability system that has been implemented. A preliminary study of this work was presented in Tliche (2013) and in Talon et al. (2013).

TRACES AND INDICATORS

Definition of *Traces*

Generally, a trace refers to a fingerprint or a mark left by an action. Dyke (2009) informally defined the traces of an activity as “*the marks that activity leaves on the environment*”. In the context of a collaborative instructional environment, a trace is an automatic storage of elements related to the actions of the participants in the platform. When using a collaborative instructional system, a student uses different tools either synchronous or asynchronous such as a chat, forum, mailing service, etc. As shown in figure 8, each interaction is tracked and stored in a log file. Traces are only collected on the server, therefore, students’ activities made outside the platform are not traced.

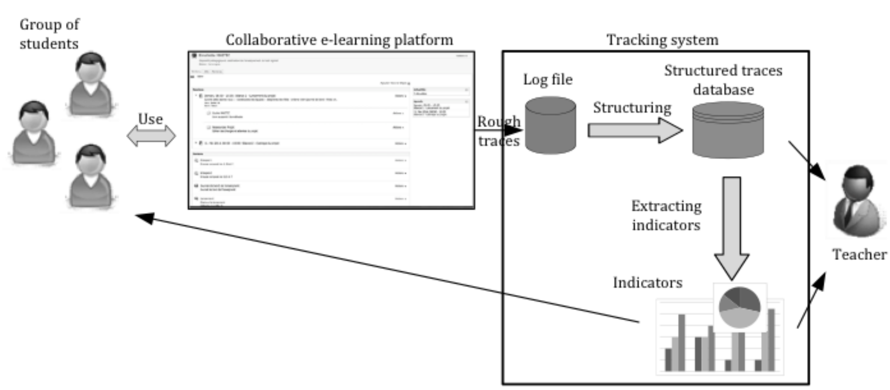


Figure 8. The traces processing cycle. All students’ actions are stored in log files waiting to be structured and stored in a database from where indicators are extracted.

Besides the identity of the user, the date, the time and the type of interaction, various other data are recorded as a trace in the log file. For example, when a student uses a forum, he/she can register or read a posted message, write a message initiating a new discussion or reply to a posted message. In this example, the action done, the time spent in reading a message and the topic of the discussion are also noted. And so on for each tool.

Definition of *Indicators*

The traces are useful as knowledge sources on learning and on collaboration activities. However, they are difficult to use in their raw form such as they are stored in the log file. Thus, these raw traces have to be structured to generate understandable traces. They are stored in an XML format, so that their use can be facilitated through a text editor or a web browser. Afterward, these traces are processed to extract indicators (see figure 8).

According to Dimitrakopoulou et al., (2006), "*interaction analysis indicators constitute variables that indicate something related to the mode or the quality of individual activity (e.g. variables that he/she change, order of significant actions, etc.), the mode or the quality of the collaboration (e.g. division of labor, participation rates, categories of specific contributions), the process or the quality of the collaborative product*". Thus, an indicator is "*a mathematical variable which has a list of characteristics. It is a variable that takes digital, alphanumerical or graphical values*" (Djouad et al., 2010). An indicator is calculated using the traces coming from the instructional system. Indicators are metrics that inform the teacher and/or the students of what's happening during the learning activities (Djouad, 2011).

What Are the Objectives of Indicators?

The main objective of the indicators is to evaluate the student. In collaborative learning situations, the student evaluation has two dimensions: the individual and the collective (the group of students). Moreover, according to the indicator's type, interpretations are made based on acquired knowledge and on the characteristics of the interactions between students. This type of evaluation is not only useful for the teacher, but also useful for the students to situate their achievements.

The indicators also allow regulation of the instructional system designed by the teacher and can report shortcomings. The differences observed between the scenario as it was designed and how it should be used (predictive scenario) and its actual use (descriptive scenario) are observed. This observation enables the teacher to identify how to re-engineer the system to better achieve instructional goals. Furthermore, the semantic of the indicators allows the customization of the learning activity (Lund and Mille, 2009). For example, students' use of some tools more than others informs the importance of those tools in a given context. Finally, the design of a new version of the system from an existing one is also based on the analysis of indicators collected during the flow of the learning scenario.

Different learning systems have developed the interpretation and visualization of traces and the calculation of the indicators. Each tracking system has its own target. For example, APLUSIX (Bouhineau et al., 2005) is an algebra technology enhanced learning system that uses traces to assist students in solving algebra exercises. SPLACH (Sébastien, 2001) uses a module exploiting traces to provide advices and guidance in relation with the activity. SBT-IM (Djouad, 2011) is a trace-based system implemented on the Moodle platform. SBT-IM calculates indicators of interactions on this platform as the ratio of two types of actions: the participation rate and the number of actions made by all participants. However, all of these tracking systems are dedicated to specific platforms.

Which Indicators?

To define the adequate indicators for the MAETIC instructional system, we use the CAS (Cognitive, Activity, Social) taxonomy proposed in Diagne (2009). This taxonomy classifies the indicators we propose in the tracking system according to three groups:

1. **Cognitive indicators**. Cognitive indicators provide information about the acquisition of knowledge during the learning activities (Diagne, 2009). Cognitive indicators are calculated on the basis of solved exercises, test results and students productions. These indicators enable learners to compare themselves to other learners and enable teachers to assess, assist and guide the learners during the process of knowledge acquisition. Among these indicators are the following:
   - *Depth of forum subjects*: This indicator measures the average number of shares made after the action "Initiate discussion" (readings and answers). It allows the teacher to assess the learners' ability to solve problems encountered during the project.
   - *Groups' evolution*: This indicator allows the teacher to make an overall assessment of the groups and allows the groups of learners to situate themselves in relation to the other groups by comparing their level of work.
   - *Degree of impact of resources and discussions on deliverables*: This indicator measures the importance of a resource or a discussion and its influence on the number of deliverables submitted by the learners.
   - *Contribution of a learner*: This indicator gives an approximate idea of the contribution of a learner to the collaborative work of his group.

2. **Activity indicators**. Activity indicators highlight how learners use the educational resources and tools provided by the e-learning platform. These indicators provide information about each learner's behavior and attendance. Activity indicators inform on the motivation and adaptation level. Activity indicators include:
   - *Activity within all collaborative tools*: This indicator compares the overall activity using collaborative tools, in terms of total number of actions performed and in terms of time spent within each tool.
   - *Activity within each tool*: This indicator compares the activity within the tool, in terms of the total number of actions performed and in terms of time spent within this tool.
   - *Resources consultation rates*: This indicator calculates the average frequency of the consultation of a pedagogical resource. The indicator compares the interest associated within this resource, compared to that associated within the others, in terms of the number of consultations.
   - *Average consultation time of a resource*: This indicator calculates the average time of the consultation of a pedagogical resource. The indicator compares the

interest associated within this resource to that associated within others, in terms of time spent in the consultation.

- *Browsing type*: This indicator describes the navigation of each learner. The indicator is based on the duration of the sessions of the learner and on the time spent on each part of the pedagogical device. We identify three types of navigation:
  - *Overview*: when the learner tends to see a large proportion of pages constituting the pedagogical device without insisting on them, thus to acquire a global vision.
  - *Full consultation*: when the learner tends to view all the pages of the pedagogical device passing sufficient time on each one.
  - *Depth consultation*: when the learner tends to see the same pages several times taking enough time for reading.
- *Learner type*: This indicator classifies the learner. The indicator is based on the number and the type of the actions performed in the instructional system
  - An *active learner* is a learner who leaves a mark during his/her passage on the platform. For example, this type of learner most often initiates the discussion or answers to a topic in a forum post.
  - A *present learner* always consults what other learners have posted or what the teacher has published without taking part in the discussions or leaving comments.
  - An *absent learner* does not often use the e-learning platform.

3. **Social indicators**. Social indicators provide information on the interactions between learners. Among these indicators:
   - Learner's degree of centrality (Martınez, 2003): The indicator describes the type of each learner's relationship with the other members of the group.
   - Interactivity of a group: The indicator is based on the number of messages and emails exchanged among all the members of the group.

The process to extract indicators is iterative. It allows to always have updated values of indicators. The two main purposes of indicators are alert and appreciation.

1. **The alert indicators**. These inform the learner and his/her group on problems so that the group reacts. For example, when a learner does not (or almost not) use the instructional system and is not realizing the attended activities, then a sleeping learner alert is sent to the student and to all the members of the group. Communication between members allows to see what is happening and to find a solution. If no solution is found, then the group can inform the teacher about the problem.
2. **The appreciation indicators**. The teacher uses them to evaluate the learner's level, the group's level and the educational session. The teacher can use this information to correct the student's pedagogical scenario.

Table 1 presents some indicators.

Table 1. Examples of indicators generated by the tracking system. Each indicator has a purpose (alert or appreciation) and a target audience (student, group of students, teacher or a combination of them)

Indicator	Purpose	Target user
Percentage of activities carried out per student	Alert	Student/ Group of students/ Teacher
Sleeping student	Alert	Student/ Group of students
Total duration of the consultation of each resource per student	Appreciation	Teacher
Total duration of the realization of each activity per student	Appreciation	Teacher
Level of interest in a forum	Appreciation	Teacher
Degree of interaction by chat within the group	Appreciation	Teacher
Participation rates in the task by student	Appreciation	Teacher
Consultation rate of the resource	Appreciation	Teacher

In this section, the concepts of traces and indicators have been defined. The kinds of indicators that interest the tracking of activities in MAETIC systems have been identified and classified. The next section will describe the analysis and design phases needed to proceed to the tracking system development.

ANALYSIS AND DESIGN OF THE TRACKING SYSTEM

Communication between users (teachers and students) in a MAETIC device is mainly done via technologies that provide a very consistent material, easy to collect but more difficult to analyze. The time spent by the teacher to monitor and analyze the activities of the student is higher than the time spent in the traditional classroom (Al-Sakran, 2008).

A statistical analysis of interaction justifies adding an automatic assistance to the MAETIC environment. The assistance includes tools for the teachers in charge of managing groups. The statistics about interaction enable the teacher to evaluate the group's life-cycle and its evolution. The status indicators of progress and sustainability of the group especially interest us. The aim is to help students in the realization of the project and in their collaborative learning. Another aim is also to assist the teacher in the monitoring of both individual and collective activities by collecting traces of activities performed by the students. Therefore, we are developing a system which collects and analyzes data from the project activities. This system must trace the activity of the participants in order to make the most meaningful analysis. The system must analyze the use of the environment and the data generated in this environment (forum, mail, meetings, etc.).

We have opted for an incremental and iterative approach for the design of the observation and assistance system. Our MAETIC environments will be equipped with this system. It is based on a multi-agent systems technology.

In this section, we briefly described the state of the art of the technology used and its deployment in the e-learning system. Hereafter we present our multi-agent architecture for the observation and assistance-type system.

AGENTS AND MULTI-AGENT SYSTEMS

Arguably the Multi-Agent Systems (MAS) have emerged with the advent of distributed artificial intelligence (DAI). At its beginning, however, the DAI only facilitated the cooperation between problem solvers to help solve a common goal. To achieve this cooperation, a problem is generally divided into sub-problems. These sub-problems are allocated to different solvers. The solvers are required to work together in order to develop partial solutions, eventually synthesizing them into a comprehensive response to the initial problem. Thus, the DAI supports the problem solving while focusing on the resolution of problems of multiple intelligent entities. In today's MAS, agents are (among others) autonomous, possibly preexisting and generally heterogeneous. In this case, the focus is instead on how the agents will coordinate their knowledge, goals and plans to act and solve problems.

What is an Agent?

The concept of an agent has been studied for several decades in various disciplines. It has been used not only in knowledge-based systems, robotics, natural language and other areas of artificial intelligence, but also in disciplines such as philosophy and psychology. Today, with the advent of new technologies and the expansion of the Internet, this concept is still associated with several new applications such as a resource agent, broker agent, personal assistant, interface agent, ontological agent, etc. In the literature, there is a plurality of definitions of agents; they all look alike, but differ depending on the type of application for which the agent is designed. Fikes (1972) argues about the various definitions assigned to agents and the difference between an agent and a traditional program. For example, here is one of the first definitions given by Ferber (1999): *An agent is a real or abstract autonomous entity which is capable of acting on itself and its environment, which in a multi-agent world, can communicate with other agents, and whose behavior is the result of its observations, its knowledge and interactions with other agents*. This definition implies autonomy, action, perception and communication properties. Other properties can be attributed to agents such as reactivity, efficiency, commitment and intention.

Jennings et al., (1998) proposed the following definition for an agent: *An agent is a computer system located in an environment, which is as independently and flexible to meet the objectives for which it was designed*.

These concepts of agents are defined as follows:

- *Located*: the agent is able of acting on its environment from sensory inputs he receives from the same environment. For example: systems, process control systems board, etc.;
- *Autonomous*: the agent is able to act without the intervention of a third party (human or agent) and control its own actions and its internal state.
- *Flexible*: the agent in this case is:
    - *Able to respond in time*: the agent must be able to perceive its environment and develop a response within the required time;

- *Proactive*: the agent must exhibit a proactive and opportunistic behavior, while able to take the right time initiative;

- *Social*: the agent must be able to interact with other agents (software and human) when the situation requires to complete tasks or to help them.

Multi-Agent Systems

A multi-agent system is a distributed system consisting of a set of agents. Unlike Artificial Intelligence systems, which simulate, to some extent, the capacity of human reasoning, MASs are ideally designed and implemented as a set of interacting agents, most often in ways of cooperation, competition or coexistence (Chaib, 1996).

MAS is typically characterized by:

- Each agent has information or solving abilities limited problems and each agent has a partial view;
- There is no overall control of multi- agent system;
- The data are decentralized;
- The calculation is asynchronous.

MASs are ideal systems to represent problems with multiple solving methods, multiple perspectives and/or multiple resolvers. These systems have the traditional advantages of distributed and concurrent problem solving, such as modularity, speed (with parallelism), and reliability (due to redundancy). MASs also inherit the possible benefits of Artificial Intelligence, such as the symbolic treatment (in knowledge), ease of maintenance, reuse and portability but more importantly, they have the advantage of involving sophisticated patterns of interaction. Common types of interaction include cooperation (working together to solving a common goal), coordination (organizing problem solving such so that harmful interactions are avoided or beneficial interactions are exploited), and negotiation (reaching an agreement acceptable to all parties concerned).

Analysis and Design

To analyze and design the multi-agent tracking system, we have used the MaSE (Multi-agent System Engineering) methodology (Wood, 2001). This methodology uses several graphical models and a logical approach to provide a comprehensive way to develop a multi-agent system from analysis to deployment. Figure 9 presents the goal hierarchy diagram of the tracking system, summarizing and organizing thee system functionalities in the form of a tree of goals and sub-goals.

The following use cases have been identified:

1. Visualize the traces of learners' activity.
2. Calculate the indicators of learners' activity.
3. Calculate the indicators of the pedagogical device use.
4. Assist learners.

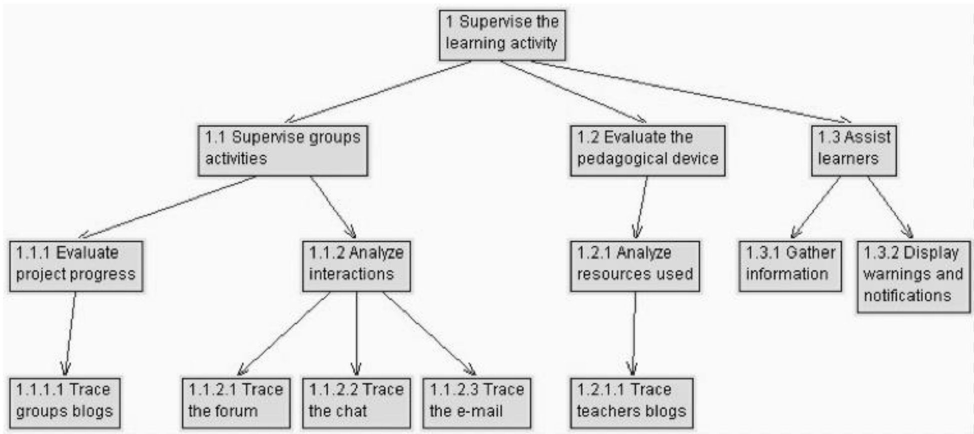


Figure 9. Goal hierarchy diagram.

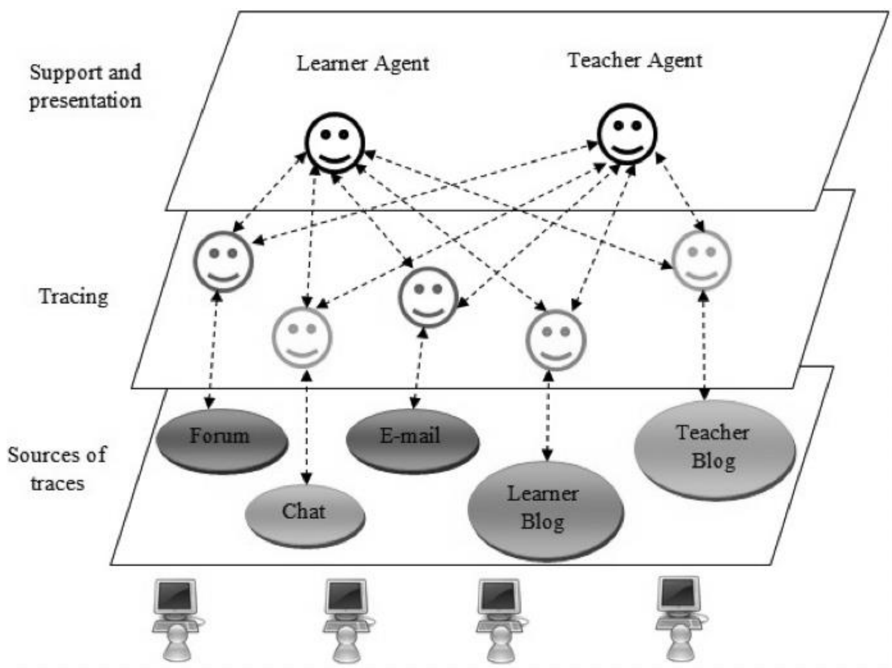


Figure 10. Identification of agents needed in the tracking system. Some agents are in charge of tracking activities while others are responsible for users' support and presentation.

During the design phase, following agents (figure 10) have been isolated:

- **Tracking agents**: These agents supervise activities undertaken with the e-learning collaborative tools. An agent has been defined for each tool (chat agent, e-mail agent, forum agent, group's blog agent and teacher's blog agent). After modeling traces, these agents calculate indicators dedicated to the evaluation of the learning activities.
- **Assistance agents**: These agents perform a role of guidance and control of the users' activity within the e-learning platform. There are two agents for assistance: teacher

agent and learner agent. These agents present the information traced and analyzed by tracking agents to enable teachers to carry out the assessment of the activity and to provide assistance to learners.

This section has synthetized the analysis and design phase of the tracking system. The application of MAS methodology has allowed the identification of various agents. The following section will explain how these agents have been implemented.

IMPLEMENTATION OF THE TRACKING SYSTEM

The system has been implemented with the Madkit (Madkit) platform and the Java programming language. Figure 11 situates the tracking system developed for the MAETIC instructional system. The developed tracking system has been tested on the ILIAS platform (ILIAS, 2014) according to the specific variation presented in a previous section (The system – an implementation example).

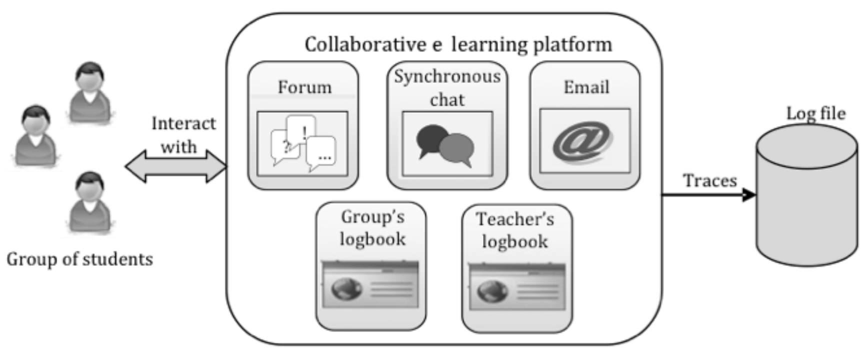


Figure 11. Raw traces of students' interactions with the different tools of the e-learning platform are stored in a log file.

The first step is the tracing step. The observation of activity is done through a specific code integrated into the source code. This code is charged to record each user's action in log files. The system allows the modeling of traces extracted from log files according to a defined format. The modeled traces are stored in a MySQL database (figure 12).

Then, already-treated log files are deleted. During this step, the teacher can request the database to view structured traces in tabular form. The visualization of learners' traces allows the teacher to view all traces - traces of a learner or traces of a tool. The teacher can refine the selection of traces by giving a start date and/or end date. Figure 13 presents the interface that allows the teacher to visualize the totality of collected traces. These traces are used to calculate indicators. Each participant can visualize the adequate indicator in his/her space (tutor's space or learner's space). The visualization functionalities do not depend of the instructional environment. Once the log files are constituted, thanks to integration of code portions in the system, the visualization interface will be effective whatever the kind of implementation the teacher has chosen.

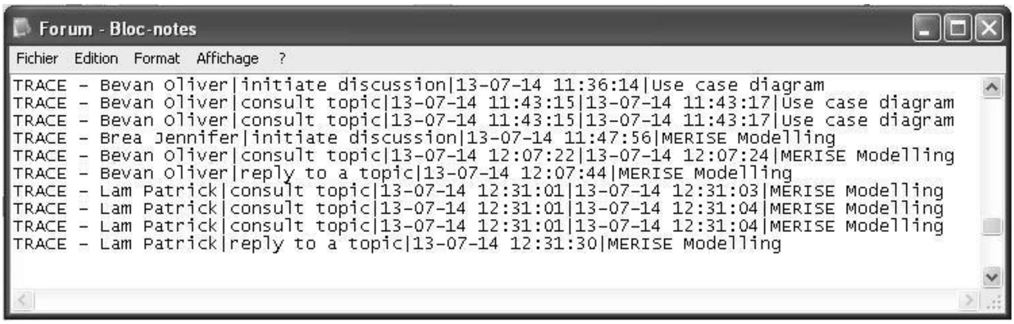


Figure 12. Traces collected in a forum tool. Traces are recorded in a log file.

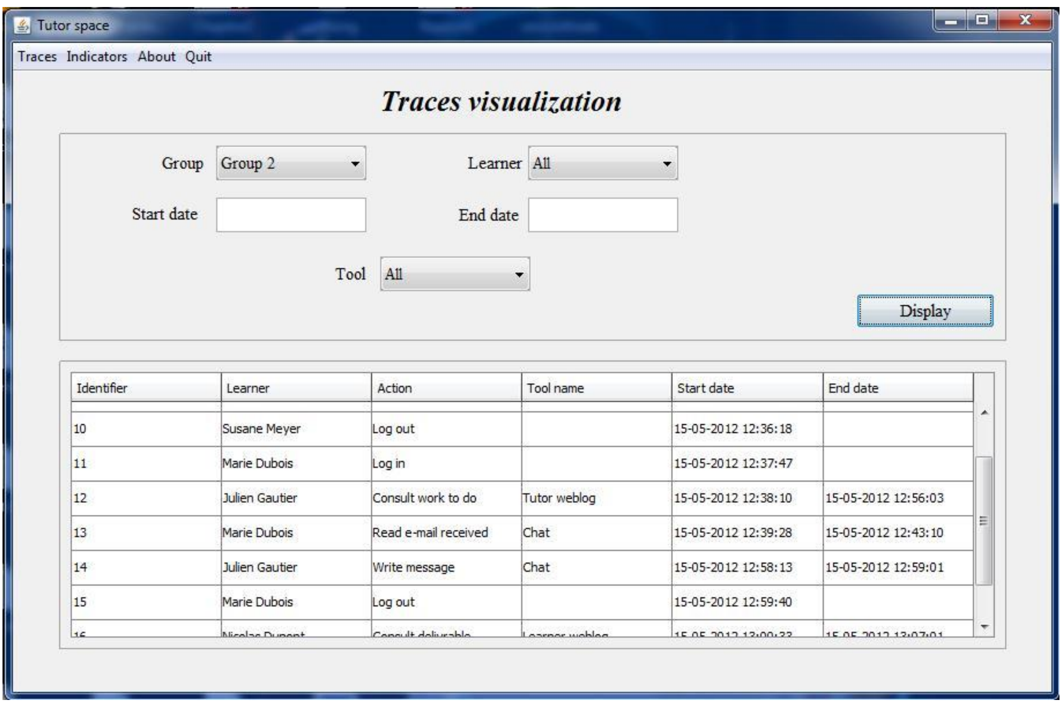


Figure 13. Raw traces can be selected and visualized under a tabular form.

Among indicators offered by the tracking system, the level of the resources impact on deliverables is illustrated in figure 14. This indicator measures the usefulness that learners grant to the resource proposed by the teacher. This indicator enables the teacher to assess the instructional system. On the other hand, by showing the level of discussions impact on deliverables, the teacher may have an idea about the learners' ability to solve problems and the degree of their collaborations. Figure 15 groups together different screenshots extracted from the teacher's space of the visualization tool. Figure 16 shows the self-assessment interface. A learner can compare his/her contribution to the required work compared to the contributions of the other members of his group. Some screenshots of the learner's space are very similar as those present in the teacher's space.

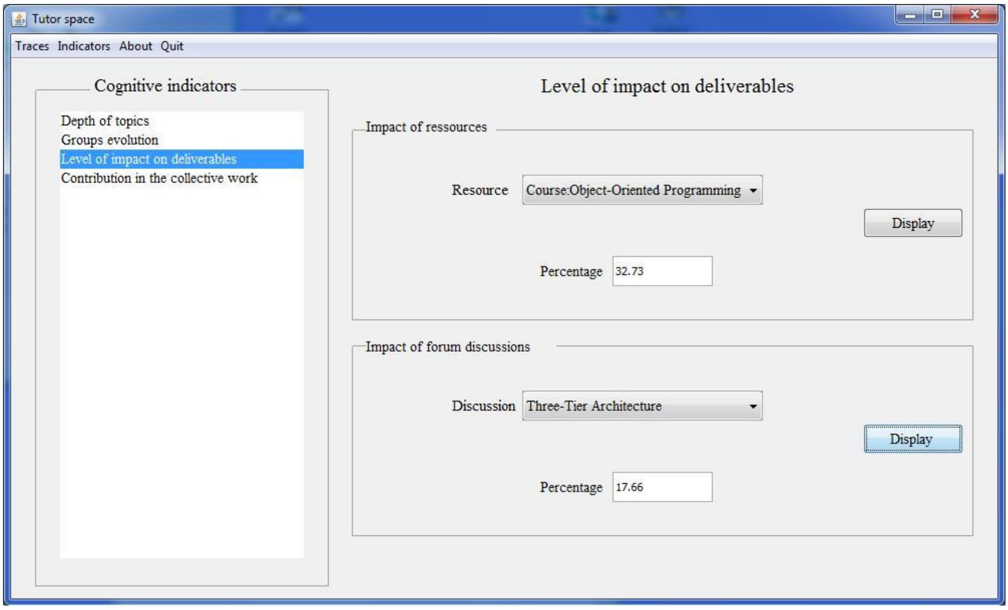


Figure 14. Example of indicator. In this screenshot, the user has selected the level of impact of deliverables. This indicator shows the usefulness that learners grant to a resource.

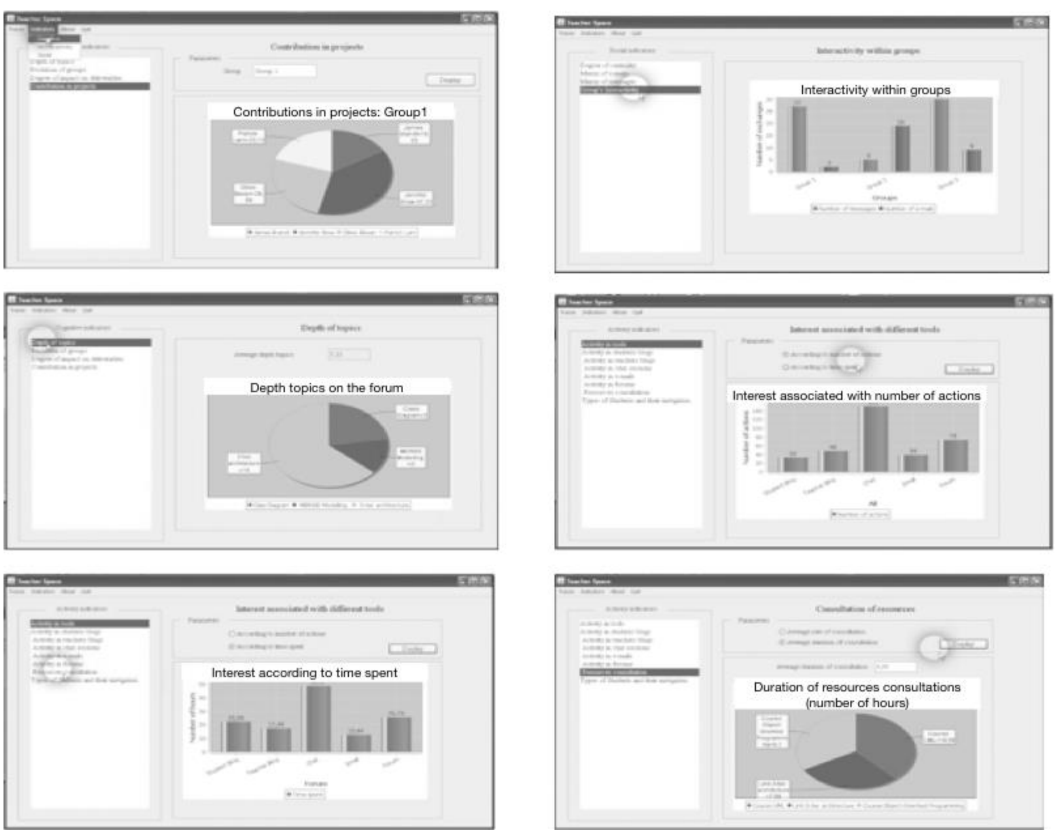


Figure 15. Different screenshots in the teacher's space. Each screenshot offer the visualization of a specific indicator.

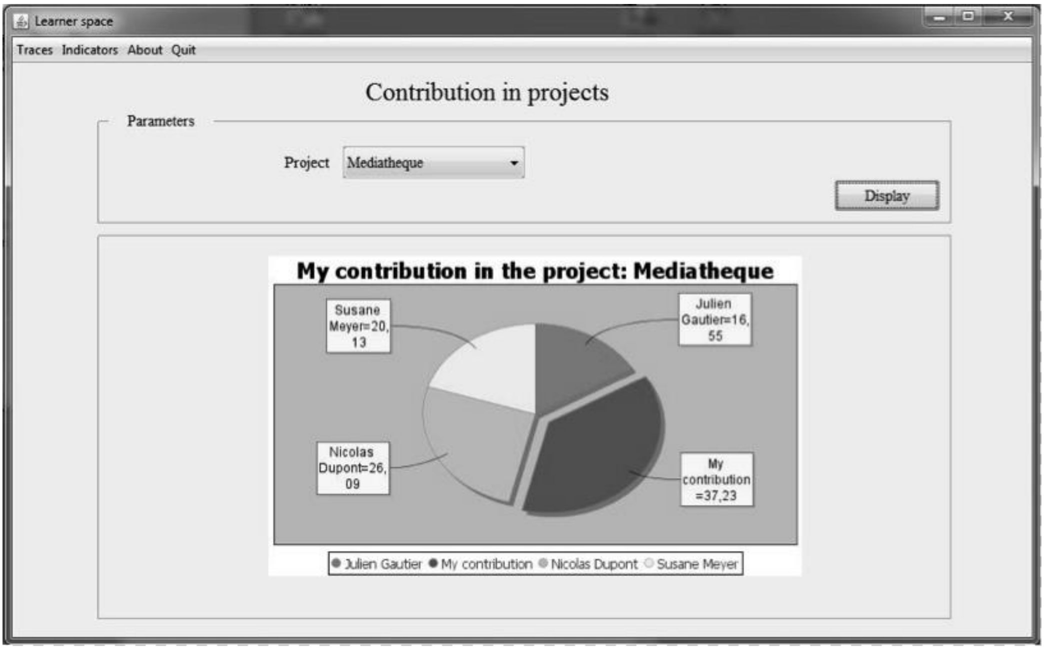


Figure 16. Contribution of a learner in different projects. Graphical visualization helps understanding and analysis.

CONCLUSION

In this chapter, we have described a collaborative instructional system and in the extraction of traces from the platform. These traces are modeled, stored in a database and processed to generate indicators. Teachers and learners visualize them in graphical interfaces.

The generated indicators are of different types and concern learner activities or group activities. They are used to support the evaluation of the learners and groups, of learning situations and of instructional system. Thus, thanks to this system, the teacher can assess the learners, the teaching scenario and the system. Teachers are informed in failures cases when they are consequence to negligence of the learners, to poor design of instructional content, or to a cognitive overload, etc. The learner can do self-assessments and compare his/her own participation with the participation of the other members of the group.

The tracking system is a multi-agent system. The prototype has been tested on an instructional system combining the ILIAS open source platform and Wordpress Weblogs.

The next step in the development of this approach is to finalize the prototype, to evaluate its usability with other teachers and to compare the performances of this system with other tracking systems. An extension of the representation of raw traces toward a graphical form is also planned. One important work is to upgrade the system by adding an intelligence level to the agents. They must be able to make decisions or to make suggestions to the teacher. Finally we plan to offer a personalized system of indicators. The teacher would be able to define his/her own space of indicators according to the instructional system and the awaited assessment. He/she would build his/her own indicators by selecting specific traces and formulating calculation modalities. The design phase of this new tool is initiated.

References

Al-Sakran, H. and Serguievskaia, I. (2006). A Framework for Developing Experience Based e-Negotiation System. *Journal of Computer Science*. *2*, 180-184.

Andrews, D. H. and Goodson, L. A. (1980). A comparative analysis of models of instructional design. *Journal of instructional development*. *3*, 2-16.

Belaid-Ajroud, H., Talon, B. and Tnazefti-Kerkeni, I. (2013). Monitoring Activities in an E-Learning 2.0 Environment: A Multi-Agents system. In *ICIW 2013, The Eighth International Conference on Internet and Web Applications and Services*, pp. 260-265.

BHEF (2013). Workplace competencies. From: *http://www.bhef.com/our-work/workplace-competencies*

Biggs, J. (1999). What the student does: teaching for enhanced learning. *Higher Education Research & Development*. *18*, 57-75.

Bouhineau, D., Nicaud, J.-F., Chaachoua, H., Bittar, M. and Bronner, A. (2005). Two Years Of Use Of The Aplusix System. In: *Proceedings of 8th IFIP World Conference on Computer in Education*, Cape Town, South Africa.

Braxton, S., Bronico, K. and Looms, T. (1995). Models of instructional design. *The George Washington University: Computer Science Department*. *Washington, DC, USA.*

Brock, W. E. (1991). What Work Requires of School: A SCANS Report for America 2000. *US Department of Labor. Washington, DC, USA.*

Brouns, F., Koper, R., Manderveld, J., Van Bruggen, J., Sloep, P., van Rosmalen, P., & Vogten, H. (2005). A first exploration of an inductive analysis approach for detecting learning design patterns. *Journal of Interactive Media in Education*. *Special Issue*, 1-10.

Chaib-draa, B. (1996). Interaction between agents in routine, familiar and unfamiliar situation. *International journal of cooperative information system*. *5*, 1-25.

Denning, P. J. and Dunham, R. (2001). The Profession of IT: The core of the third-wave professional. *Communications of the ACM*. *44*, 21-25.

Diagne, F. (2009). Instrumentation de la supervision par la réutilisation d'indicateurs: Modèles et Architecture. Ph.D. thesis.

Dillenbourg, P., Baker, M. J., Blaye, A. and O'Malley, C. (1995). The evolution of research on collaborative learning. In E. Spada and P. Reiman (Eds), *Learning in Humans and Machine: Towards an interdisciplinary learning science*, Elsevier, Oxford. UK. 189-211.

Dimitrakopoulou, A., Petrou, A., Martinez, A., Marcos, J. A., Kollias, V., Jermann, P. and Bollen, L. (2006). State of the art of interaction analysis for Metacognitive Support & Diagnosis.(D31.1.1) *EU Sixth Framework programme priority 2, Information society technology, Network of Excellence Kaleidoscope, (contractNoE IST-507838), project "Interaction analysis* - *Supporting participants in technology based learning activities".*

Djouad, T. (2011). Ingénierie des indicateurs d'activités à partir de traces modélisées pour un Environnement Informatique d'Apprentissage Humain. Ph.D. thesis.

Djouad, T., Ben Mohammed, M. and Mille, A. (2010). Indicators computation from modeled traces in the context of computer Human Learning environment. In *Proceedings of International Symposium on Modelling and Implementation of Complex systems, Constantine, Algérie*. 1-7.

Dyke, G. (2009). A model for managing and capitalizing on the analyses of traces of activity in collaborative interaction. PhD dissertation, French.

Fikes, R. E. and Nilsson, N. J. (1972). STRIPS: A new approach to the application of theorem proving to problem solving. *Artificial Intelligence*. *2,* 189-208.

Ferber, J. (1999). *Multi-agent systems: an introduction to distributed artificial intelligence* (Vol. 1). Reading: Addison-Wesley.

Felder, R. M., Woods, D. R., Stice, J. E. and Rugarcia, A. (2000). The future of engineering education II. Teaching methods that work. *Chemical Engineering Education*. *34,* 26-39.

George, S. (2001). Apprentissage collectif à distance, SPLACH: un environnement informatique support d'une pédagogie de projet. Ph.D, Université du Maine, France.

Goel, V. (1995). *Sketches of thought*. The MIT Press.

Hanke, U., Ifenthaler, D. and Seel, N. M. (2011). Effects of creative dispositions on the design of lessons. *The Open Educational Journal. 4* (*Suppl 1: M10*),113-119.

Hassan, D.M. (2010). *Formalisation et instrumentation d'un modèle de compétences: l'outil d'assistance LIMA*, Doctoral dissertation, Université de Picardie Jules Verne, France.

ILIAS (2014). ILIAS Open source e-Learning . From: *http://www.ilias.de*

Jennings, N. R., Sycara, K. and Wooldridge, M. (1998). A roadmap of agent research and development. *Autonomous agents and multi-agent systems*. *1*, 7-38.

Leclet, D. and Talon, B. (2007). Expérimentation d'un dispositif pédagogique pour un apprentissage de savoir-faire selon une pédagogie de groupe par projets. In *Actes de la conférence EIAH 2007*.

Lethbridge, T. C. (2000). Priorities for the education and training of software engineers. *Journal of Systems and Software*. *53* , 53-71.

Lund, K. and Mille, A. (2009). Traces, traces d'interactions, traces d'apprentissages: définitions, modèles informatiques, structurations, traitements et usages. In J-C Marty and A. Mille (Eds.) *Analyse de traces et personnalisation des environnements informatiques pour l'apprentissage humain*. Hermès. 21-66.

Madkit. *http://www.madkit.org*

Martınez, A., Dimitriadis, Y., Rubia, B., Gómez, E. and De La Fuente, P. (2003). Combining qualitative evaluation and social network analysis for the study of classroom social interactions. In: Computers & Education. 41, 353-368.

Mazyad, H. and Kerkeni, I. (2010). A Multi-Agents Approach For Modeling a Collaborative Learning System. In *The Ninth IASTED International Conference on IASTED Web-based Education (WBE 2010),* Sharm el-Sheikh, Egypte.

Mielach, D. (2013). The Skill IT Professionals Are Lacking. *http://www.businessnewsdaily.com/4763-it-worker-personality.html* Accessed 11/7/13.

Merrill, M. D. and Wilson, B. (2007). The future of instructional design (point/counterpoint). In: R.V. Reiser and J.V. Dempsey (Eds.), *Trends and issues in instructional design and technology*, Pearson, Boston, MA, USA. 335-351.

Molenda, M. (2003). In search of the elusive ADDIE model. *Performance improvement. 42*, 34-37.

Pozzi, F., Manca, S., Persico, D. and Sarti, L. (2007). A general framework for tracking and analyzing learning processes in computer-supported collaborative learning environments. *Innovations in Education and Teaching International*. *44*, 169-179.

Reigeluth, C. M. (Ed.) (2013). *Instructional-design Theories and Models: A New Paradigm of Instructional Theory* (Vol. 2). Routledge. New York, USA.

Rowland, G. (1992). What do instructional designers actually do? An initial investigation of expert practice. *Performance Improvement Quarterly*. *5*, 65-86.

Schunk, D. H. (2012). *Learning theories: An educational perspective*. Pearson Education, Boston, MA, USA. 6th Edition.

Talon, B., Kerkeni, I., Tliche, S. and Belaid-Ajroud, H. (2013). Tracking a Collaborative Web2.0 E-Learning Environment. In D. Hernández-Leo, T. Ley, R. Klamma and A. Harrer (Eds.), *Scaling up Learning for Sustained Impact*, Springer, Berlin Heidelberg, Germany. 577-580.

Talon, B. and Leclet, D. (2008). Dispositif pédagogique pour un apprentissage de savoir-faire. *Revue internationale des technologies en pédagogie universitaire/International Journal of Technologies in Higher Education*. *5*, 58-74.

Talon, B., Leclet, D., Bourguin, G. and Lewandowski, A. (2009). A Fruitful Meeting of a Pedagogical Method and a Collaborative Platform. In U. Cress, V. Dimitrova and M. Specht, (Eds.), *Learning in the Synergy of Multiple Disciplines*, Springer, Berlin Heidelberg, Germany. 405-417.

Talon, B. and Leclet, D. (2011). Un Atelier de Génie Pédagogique pour la Conception Assistée de Dispositifs. *Atelier*, 18. *http://www.u-picardie.fr/~leclet/ATELIER-CONCEP/talonleclet.pdf*

Talon, B., Sagar, M. and Kolski, C. (2012). Developing competence in interactive systems: The GRASP tool for the design or redesign of pedagogical ICT devices. *ACM Transactions on Computing Education (TOCE)*. *12*, 9.

Tinio, V. L. (2003). *ICT in Education*. United Nations Development Program-Asia Pacific Development Information Program.

Tracey, M. W. and Richey, R. C. (2007). ID model construction and validation: a multiple intelligences case. *Educational Technology Research and Development*. *55*, 369-390.

Tliche, S. (2013). Un système à base de traces pour l'apprentissage collaboratif. Masters report. Tunisia.

Tripp, S. D. and Bichelmeyer, B. (1990). Rapid prototyping: An alternative instructional design strategy. *Educational Technology Research and Development*. *38*, 31-44.

United States Department of Labor (2011). Employment and Training Administration Competency Model. From: *www.careeronestop.org/competencymodel/pyramid.aspx*.

Van Merriënboer, J. J. and Martens, R. (2002). Computer-based tools for instructional design: An introduction to the special issue. *Educational Technology Research and Development*. *50*, 5-9.

Visscher-Voerman, J.I.A. (1999). Design approaches in training and education: a reconstructive study. Ph. D Thesis.

Wanous, M., Procter, B. and Blamey, M. (2006). Professional Studies for Engineering Students: an Innovative Approach. In *Proceedings of International Conference on Innovation Good Practice and Research in Engineering Education.* 206-211.

Wood, Mark F., DeLoach & Scott A. (2001). An overview of the multi agent systems engineering methodology. In: *First international workshop, AOSE 2000 on agent-oriented software engineering*, New York, USA. Springer-Verlag. 207–221.

Woods, D. R., Felder, R. M., Rugarcia, A. and Stice, J. E. (2000). The future of engineering education III. Developing critical skills. *Chem. Engr. Education. 34*, 108–117.

Zierer, K. and Seel, N. M. (2012). General Didactics and Instructional Design: eyes like twins A transatlantic dialogue about similarities and differences, about the past and the future of two sciences of learning and teaching. *SpringerPlus. 1*, doi:10.1186/2193-1801-1-15.

INDEX

C

D

E

F

G

H

M

N

O

P

Q

R

S

T

X

Y