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Facilitating student-driven constructing of learning environments using Web 2.0 personal learning environments

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ABSTRACT

Web 2.0 Personal Learning Environments (PLEs) are becoming a promising area of development in e-Learning. While enhancing students' control over the entire learning process including constructing learning environment appears to be an essential objective of introducing Web 2.0 PLEs to education, there is little consensus on how to attain this objective. In this paper a theory-informed model to facilitate students' engagement in constructing their learning environment using Web 2.0 PLEs is proposed and evaluated. The model consists of four components: student's control dimensions, student-centric instructional approaches, the learning potential of Web 2.0 tools and services, and technology enhanced learning activities. This model is used to conduct a design-based research in the context of a first grade class in a secondary school in the Netherlands consisting of 29 students (18 girls and 11 boys, aged 11–13 year). The results suggest that the model can facilitate students' engagement in constructing their learning environment through influencing communication between teacher and students, involving students in adding tools, resources, and people into their learning environment, and enhancing their feeling of ownership over their learning environment.

1. Introduction

Web 2.0 tools are receiving intense and growing interest across all sectors of the educational industry as means for building personal learning environments (PLEs) and extending the student's control over the entire learning process (Conole & Alevizou, 2010; Dabbagh & Kitsantas, 2012; McLoughlin & Lee, 2008). These tools and services provide students with “just-in-time” and “at-your-fingertips” learning opportunities and can support a wide range of teaching and learning activities including creative and collective contribution (Twitter, Facebook), knowledge (co-)producing (wikis, YouTube, Google Docs), communication (Skype), knowledge management and organizing (Delicious, Diigo), self-expressing (blogs), creating and managing personal pages (Netvibes), analysing and developing new concepts and ideas (MindMeister), and sharing and exchanging documents (Google Docs, Dropbox) (Rahimi, van den Berg, & Veen, 2014b).

A learner-driven personalization of learning process can achieve through addressing two objectives: (*i*) empowering students with appropriate competencies to achieve more control over the educational process, and (*ii*) supporting students to take part in designing and constructing their learning environment (Drexler, 2010; Johnson & Liber, 2008; Valtonen et al., 2012). As asserted by Rahimi, van den Berg, and Veen (2013a, 2014a, 2014b), the first objective can be achieved by facilitating and following a self-regulating learning process consisting of preparation, performing, reflecting, and feeding back phases. The second objective is achievable by providing students with appropriate technological, social, and content choices and scaffolding them to take advantage of these choices for constructing and (re) shaping their learning environment. This student-driven approach to personalizing learning and constructing learning environment has been suggested as a necessity to form the nature of the relationship between institutions and students in today's rapidly changing technological advancements and develop self-regulated learning competencies among students (Dabbagh & Kitsantas, 2012; Johnson & Liber, 2008).

PLEs is a fairly new and developing concept and there exists no clear picture describing their functions and purposes as well as their impacts on the students' engagement in constructing their learning environment (Kop & Fournier, 2013). Attwell (2007) attributed learning

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functions and purposes such as producing and publishing materials, communication, collaboration and scaffolding learning to PLEs. There are few empirical research that investigate the real impact of PLEs on the learning process of students. Based on the results of an empirical research, Türker and Zingel (2008) suggested that the organization of learning resources by students in a PLE into meaningful learning activities toward achieving learning goals corresponds to the forethought phase of Zimmerman's self-regulated learning model (Zimmerman, Bonner, & Kovach, 1996). In another empirical research conducted by Valtonen et al. (2012) in vocational schools in Eastern Finland, four different functions and purposes of PLEs have been identified including 'Mirroring the conventional learning environment', 'An environment for reflection', 'An environment to showcase skills' and 'An environment for collaboration and networking'. Also, they identified three categories describing the challenges of PLEs including 'The PLE as a compulsory task', 'Challenges with collaboration' and 'ICT skills and use of time'. In another empirical study Drexler (2010) has shown that the integration of PLEs with student-centric instructional approaches such as inquiry-based learning offers students a variety of learning functions such as 'becoming much more knowledgeable about a topic than reading from a textbook through creating out own learning tools', getting a sense of pride in being able to complete a project or conduct an inquiry, 'increased comfort with technology and improved learning through its use', and being equipped to study other topics in the similar format with less guidance from a teacher.

In spite of the increasing attention drawn to Web 2.0 PLEs, there is not a robust theory-informed model to integrate them into educational practices. So far, a common solution to integrate Web 2.0 tools into educational practices is by providing students with a set of Web 2.0 tools and allowing them to select and use these tools in a personal way they deem fit. This "gift-wrapping" approach to new technologies and media provides some technological personalization and add-ons to existing practices of students (Fischer & Scharff, 1998) rather than increase their engagement is shaping their learning environments (Väljataga & Laanpere, 2010). On the contrary, to support and enhance student's control over their learning process new technologies and learning theories must together serve as catalysts for fundamentally rethinking and redefining what the pedagogical and epistemic practices of teachers and students can and should be (Fischer & Scharff, 1998; Rahimi et al., 2013a; Rahimi, van den Berg, & Veen, 2013b).

The purpose of this paper is to introduce a theory-informed model to integrate Web 2.0 PLEs into educational practices and then examine their influences on the students' engagement in constructing their learning environments. The remainder of this paper is divided into three sections. The following section describes a theory-informed model introduced by Rahimi et al. (2014a) to integrate Web 2.0 PLEs into educational settings. The second section explains the implementation of the model and the empirical results. Lastly, in the final section we discuss the ways that the model influences the students' engagement in constructing their learning environment, present our conclusions and suggest future lines of research.

2. A pedagogy-driven model to integrate Web 2.0 PLEs into educational process

To integrate Web 2.0 PLEs into educational practices and assisting students to construct their learning environment, we adopted a pedagogy-driven model introduced by Rahimi et al. (2014a). This model comprised of four components namely: (*i*) *student's control dimensions*, (*ii*) *student-centric instructional approaches,* (*iii*) *learning potential of Web* 2.0, and (*iv*) *technology-enhanced learning activities.* The authors used the principles of constructivism (Jonassen, 1995), social constructivism (Vygotsky, 1978), Connectivism (Siemens, 2005), transactional control and choices (Dron, 2007) to underpin their model. The model starts with identifying the dimensions of student's control over educational process. As suggested by Garrison and Baynton (1987), the student's control over educational process can be achieved by supporting and establishing a dynamic balance between three elements, namely p*ower*, *support*, and *independence* through the process of communication between teacher and students. Built upon these elements, Rahimi et al. (2014a) defined three dimensions to enhance student's control over educational process: *capability* (refers to the cognitive abilities and competencies student requires to participate in particular learning experiences), *support* (refers to the resources such as learning materials, course structure, teacher's guides and scaffoldings, and community experts that the student needs in order to carry out their learning), and *autonomy* (refers to the student's freedom and ability to choose what, how, when, and where to learn). To emphasize and support the active role of students as developer of their learning environments, these dimensions then serve to inform defining roles for students in educational process and designing relevant learning scenarios and activities to develop competencies required by students to undertake and practice these roles.

Rahimi et al. (2014a) translated the capability, support and autonomy dimensions into three roles, namely *content producer*, *socializer*, and *decision maker* respectively. By defining the content producer role, the model aims to provide students with opportunities to practice and strengthen cognitive capabilities such as searching, reading, remixing, evaluating, and creating content using Web 2.0 tools and technologies. By introducing socializer role, the model aims at developing social and help-seeking, -giving skills among students by means of Web 2.0 tools and technologies. By defining the decision maker role, the model aims to prepare students to become autonomous learners by providing them with appropriate choices and then facing them with learning situations where they are urged to make wise decisions about their learning using these choices. As shown in Fig. 1, these roles work together to facilitate a student-driven construction of learning environment by adding relevant web tools, people, and content.

3. Implementing and evaluating the model

3.1. Research context and set up

To implement the model and examine its influence on the students' engagement in constructing their learning environment, we conducted an experiment in a first grade class of a secondary school in the Netherlands consisting of 29 students (18 girls, 11 boys) aged from 11 to 13 year old. As a part of their geography course a learning project titled "designing and building digital travel guide" for a country of their interest was defined. The experiment lasted 8 weeks. During this period the students were working on their projects in 2-h sessions twice per week. Prior to starting the project, a survey was administrated among the students to collect some information about the participating students including their demographic information, and their previous experience with the PLE concept and using Web 2.0 for learning purposes. The results of the survey revealed that although many of students were familiar with Web 2.0 tools such as Facebook, Twitter, and Hyves (a Dutch social networking service), they had no previous experiences about technology-based student-centric learning. All students

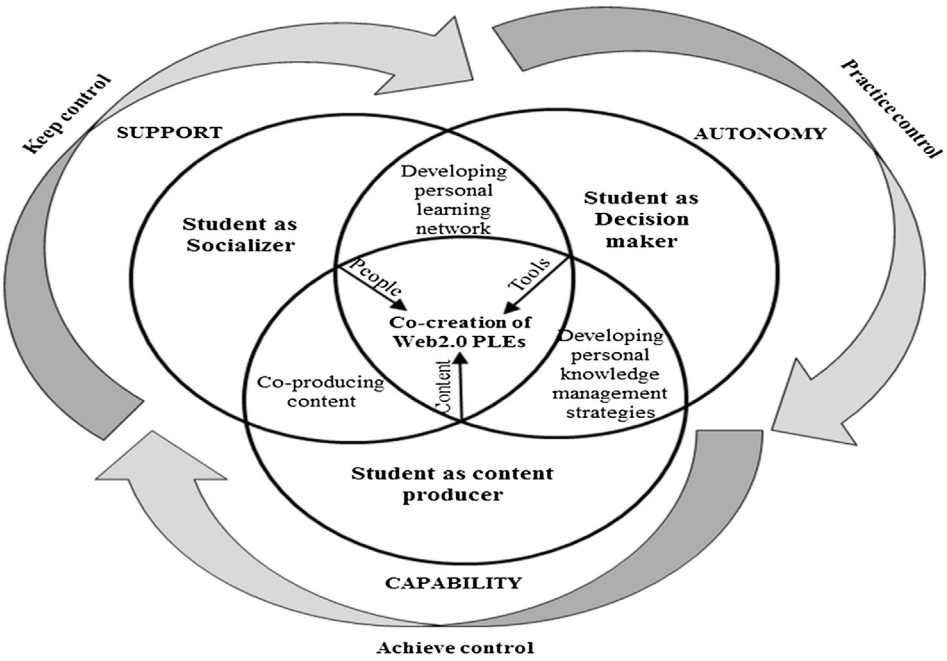


Fig. 1. Defined roles for students in PLE-based learning and their interplays. Adopted from Rahimi et al. (2014a)

owned their laptops and could use them to manage their learning requirements during the school time. The teacher was a young, high technology literate man, enthusiastic to adopt and implement new technologies and learning concepts in his courses.

At the beginning of the experiment, the students were grouped in five-person teams and all teams were asked to develop a separate digital travel guide. In order to address students' personal learning interests and encourage them to participate (partially) in choosing their learning objectives, each team's members were asked to choose their country of interest to develop their travel guides accordingly. However, all teams selected Egypt. The students' access to Internet was extended during the project time. A list of suggested technology-enhanced learning activities pertain to the defined role for students was designed to support and orchestrate students' activities (Table 1). It is important to notice that these learning activities were not meant to restrict the personal endeavours of the students. Rather, they aimed to provide general guidelines for students during different phases of their learning process. An initial set of Web 2.0 tools was made available and introduced to the students to perform these learning activities. The role of the teacher in the project was that of the facilitator for guiding students whenever and wherever they needed support.

3.2. Research questions, data collection and analysis process

The main objective of this research is to examine the influence of the proposed model on facilitating the students' engagement in constructing the learning environment by the students. The main question that guides this research is:

How can the proposed supportive model influence the students' engagement in constructing their learning environment?

To answer this question we decided to identify three sorts of evidence: (i) the main learning functions of the model as perceived by the participants, (ii) the learning activities accomplished by students, and (iii) the faced problems and challenges by the students during the project. Then we mapped these findings onto the students' control dimensions in order to draw a clear picture of their influence on these dimensions. Accordingly the below questions guided the data collection and analysis processes:

What are the learning functions of the PLE-based learning perceived by the students and teacher?

What are the learning activities accomplished by students during the project?

Table 1
Suggested learning activities to scaffold the students to develop and use their PLEs.

Student's role (s)	Learning activities	Provided choices
Content producer	Observing several web-based travel guides, conducting research about Egypt, aggregating/filtering content and web feeds, building the travel guide	Search engines, Wikipedia, Google reader YouTube, web hosting& building tools
Socializer	conducting group mind mapping to design the structure of travel guide, participating in digital storytelling	Email, Twitter, Hyves, Google Chat, MindMeister, Google Docs
Decision maker	Planning and timing the different steps of their project	Google calendar, MindMeister, iGoogle

What are the problems and challenges faced by students during the project?

This research follows a single iteration, design based research process (Ma & Harmon, 2009) for analysing a problem, developing a solution, testing the solution, and reflecting on the results. It addresses the problem of facilitating students' engagement in constructing their learning environment. For the purpose of this research, we collected data using several methods including documentation (i.e. teacher notes, emails and researcher field notes), physical artifacts (i.e. the PLEs constructed by the students using iGoogle, personal blogs, students' reflections on their experiences during the project, and final travel guides), and direct observation of the class over eight weeks, one 2-h block per week by the research team. Two semi-structured group interviews were conducted with eight students (5 girls, 3 boys) at the end of the project. These interviews lasted between 45 and 65 min. Further, three interviews, lasting between 45 and 75 min were conducted with the teacher and another teacher involved in the project as representative of the school's administrators, at the middle and end of the project. Also, after each session a meeting between the researcher and these teachers was held to evaluate whole session including evaluating the processes that students went through, the challenges and problems faced by the teacher and students, and learnt lessons. Further, we conducted an interview with the teacher six months after finishing the project in order to investigate the possible long term impacts of the PLE project on the structure of the learning environment and learning behaviour of the students.

To answer the first research question we went through the following analysis process: The first phase of the analysis procedure included transcribing audio data, entering collected data into Atlas.ti software and conducting the coding process. In order to allow for emergent functions out of the model, no pre-defined categorizations were used to code the data. The analysis process continued by reading the transcripts and assigning freely named codes to the descriptions. This phase resulted in 72 different codes. The second phase of the analysis process involved reading the transcripts organized by codes, writing memos, recoding and merging similar codes as necessary, grouping codes into categories, creating network diagrams by establishing relationships or links between codes, and writing up conclusions. This process was done several times resulted in yielding ten different functions out of the model. These functions are explained in the next section.

To answer the second and third research questions we followed the below process: First by reviewing the collected qualitative data the learning activities accomplished by the students and also the problems and challenges they faced with during the project were identified. The identified learning activities and problems were categorized, re-categorized and refined several times. These results then informed a questionnaire containing the detailed list of the identified learning activities and problems which was administrated among the students a week after finishing the project. In this questionnaire the students were asked to determine the learning activities they accomplished and the problem they faced with during the project. The answers of the students then were analysed and visualized using Microsoft Excel.

3.3. Results

3.3.1. The learning functions of the model

Below the main learning functions of implementing the model as perceived by the students and the teacher are described:

a) Broadening technological and content choices
b) Feeling ownership and taking more responsibility over learning process
c) Practicing digital responsibility
d) Improving the students' ways of learning
e) Improving students' technical and web skills
f) Supporting collaboration and networking
g) Practising web-based cognitive activities
h) Promoting communication about technology
i) Supporting the establishment of a student-centric learning environment
j) Increasing the students' awareness about the learning benefits of Web 2.0 tools

a) Broadening technological and content choices

From the students' perspective, the PLE project had broadened their technological and content choices through extending their access to Internet. In this regard, one student appreciated this opportunity as below:

> *Because of the PLE project, our access to the Internet was broadened. Now, there are no blocked sites and we have access to any required content. Previously, if a student tried to find some content about Greece or myths, only two or three sites were available and other were blocked. But now we are really satisfied by this broadened access to Internet. It is a real benefit of PLE.* (Student #5, interview)

b) Feeling ownership and taking more responsibility over the learning process

The student-centric and activity-based nature of the project had caused students to take more responsibility over their learning process. For example one student asserted:

> *When you are provided with more control whether in access to the Internet or in choosing and planning your learning activities and designing content, you feel yourself more independent and responsible and as a person who owns her work. At the beginning, I took pleasure of this extended freedom for fun, but after a while I started to use it for my learning.* (Student #1, interview)

Further, participating in the PLE project had provided the students with a great opportunity to develop their learning environment and assume ownership over it. One student remarked this point in his blog as below:

Using iGoogle is very useful; especially when you find a useful gadget then you can add it to your iGoogle page and work with it. Also you can share your gadgets with your friends and show your iGoogle page to your family and friends as a part of your learning environment. (Student #10, blog post)

c) Practicing digital responsibility

The PLE project had provided students with appropriate opportunities to practice digital responsibility to become responsible users in using technology. In this regard a student mentioned his reaction in his blog as follows:

Because of the PLE project all sites have been de-blocked for us and if we do well as a class then they [*school administrators*] *will do the same for the whole school! Therefore, we should respect this freedom and not abuse it.* (Student #14, blog post)

d) Improving the students' ways of learning

The cloud-based and collaborative functionalities of Google Docs and MindMeister have been perceived by students as very useful to support their daily learning tasks. For example one student said:

Previously, during our group working on a document, all group members had to seat around a computer, which was annoying and non-comfortable. Now, by using Google Docs we can work on a same document through our laptops in a more efficient and comfortable way. Also we can continue working on the document at home. (Student #2, interview) … *.You can do mind mapping in a piece of paper or on a white board but I think it is more useful when you do it in MindMeister. Because then you have it in a digital format and you can share it or put it in your blog to receive the teacher's or other students' feedback and comments on it*. (Student #3, interview)

e) Improving students' technical and web skills

As asserted by students, participation in the PLE project has improved their technical knowledge and web skills. For example:

During the PLE project, I found many new web tools and gadgets that can be useful for my school tasks, now I need to learn how to use them to support my learning. (Student #7, interview)

In the same vein, the teacher emphasized the impact of the PLE project on the students' technical knowledge and web skills as below:

Undoubtedly they've got technical knowledge in the process of developing and using their PLEs. It is the direct result of working with PLEs. Because they have to work with certain tools and, even though some of them perhaps have little knowledge about these tools and can work with them slightly, they have to learn how to work with these tools. Therefore, acquiring the technical knowledge is an evident outcome of PLE-based learning.

f) Supporting collaboration and networking

The social functionalities of Web 2.0 tools provided the students with great opportunities to collaborate and communicate with each other, their teacher, and also people outside of the classroom to develop their projects. Besides supporting within group and class communication, these tools have increased their control over time and place of learning by extending their communication and working outside of the class time and boundaries. Apart from using these tools for knowledge sharing and co-working purposes, one student explained her experience of how she was using social media tools as a mood changer:

My learning has not suffered from introducing social media into classroom. Indeed, before introducing and allowing us to use social media in our class, if I was not in learning and working mood, I could not do any learning tasks except speaking with my friends in neighbourhood. But now if I'm not in a learning and working mood, I can chat or tweet with my friends without disturbing the whole class and most probably I can return to a good learning mood faster. (Student #6, interview)

g) Practicing cognitive activities

From a cognitive perspective, the project was a great opportunity for students to practice several low-level and high-level cognitive skills including searching, reading, brain storming, storytelling, mind mapping, analysing, evaluating, and creating digital artefacts. With regard to cognitive activities, the project has highly been appreciated by the teacher as he asserted:

In this project the students performed great collaboration, deep brain storming, and complex mind mapping. For example, to help them to create a mind map about the structure of travel guide, I defined a default and simple mind map, and you can see that their mind maps are really great and very complex. It is a result of real group working. It seems that they already are learning how to do research and they are following a scientific process.

h) Promoting communication about technology

The teacher remarked the impact of the model on nurturing and encouraging the social interaction and communication between the students about technology:

The PLE project had a great impact on encouraging the students to communicate about technology by finding and introducing tools to each other and their teacher. During the project time the students really were listening to each other and trying to co-explore and-experience the relevant tools. I think that is a logical social interaction which comes out of this kind of technology-based educational form.

i) Supporting the establishment of a student-centric learning environment

The learner-driven and explorative nature of the PLE project had provided appropriate opportunities for the teacher to take advantage of the students' personal endeavours with technology to establish a student-centric learning environment. During the experiment, students were trying to exploit the learning potential of the provided technological choices and suggest their findings to their teacher and peers. Furthermore, as asserted by the teacher, the PLE project has great potential to reveal the ways that students use and learn with technology as well as their technological, cognitive, and social preferences and needs. These insights had promoted the teacher to adjust his teaching process in line with the students' needs and preferences:

It seems that a PLE is not only introducing some tools for students. By using a PLE, everything has to be changed such as assignments, assessment methods and the teaching process. For instance, by introducing Google Docs to the students and realizing its useful functionality and also students' tendency to this tool, I've changed my teaching process and tried to focus and emphasize social and group working activities which could be supported by Google Docs. Further, during observing students' working in class, I realized their tendency towards using animation and graphical content. This triggered me to think that for teaching specific subjects, it is better to use these formats. To do so I've changed my teaching practice and materials.

j) Increasing the students' awareness about the learning benefits of Web 2.0 tools

As mentioned earlier, in order to investigate the possible long term impact of the project on the students' behaviour the teacher was interviewed six months after finishing the project. The teacher illustrated the long term impact of PLE project as below:

It seems that the PLE project has increased their awareness about the learning benefits of web tools and improved their attitudes toward these tools. What I see is that, now, they do tend to use more digital tools and the PLE project has made them aware of this fact that there are many different tools useful for their learning and they are easily inclined to use these tools such as Google sites, Mindmeister, Blog, Prezi or Google Docs for their learning purposes.

3.3.2. *The accomplished learning activities by the students during the project*

Figs. 2–4 present the results of the questionnaire regarding different types of learning activities accomplished by the students during the project. The results also include the number of students who accomplished each type of activity. Fig. 2 presents the accomplished learning activities pertain to the content producer role of students. As shown in this figure, a majority of students participated in performing several cognitive activities including: searching web to find, read, and use relevant facts, concepts, and procedures about travel guides and Egypt; practicing in mind mapping, storytelling, brain storming and creating web site; synthesizing, mixing, and organizing content; utilizing several formats of information; and blogging.

Fig. 3 shows the social learning activities accomplished by the students. According to this figure, participating in the project triggered performing six types of social learning activities among the students including: communicating with teacher through blogs, email, and Twitter; job sharing, collaborating and discussing with other students about the structure and content of travel guides; helping each other to solve faced technical problems; and communicating around technology. Surprisingly, in addition to promoting social activities within the classroom setting, participating in the project motivated many of the students to follow informal learning activities by asking support from their family members and students and teachers in other classes.

Fig. 4 shows the accomplished learning activities by the students pertain to their role of decision maker. According to these results, the students had done five types of individual-driven learning activities include (i) *managing technology* through creating accounts, dealing with technical problems, bookmarking, identifying new web tools, (ii) *following instruction* i.e. accomplishing assignments and following guidelines, (iii) *practicing identity building and ownership* through customizing and personalizing their iGoogle pages and blogs, trying to make their own blog attractive, showing their personal page or blog to family or friends, (iv) *self-managing* their learning process through exploring the affordances of web tools and gadgets and using them to support the learning tasks of other courses, and (v) *practicing digital responsibility* through using technology for non-school tasks. In encountering with the distracting situations such as gaming and using technology for non-learning purposes, the teacher always tried to follow an open approach to remind them their responsibility about their work, group and school.

3.3.3. *The faced problems and challenges by students and teacher*

Conducting the project was not straightforward and trivial for the teacher and students as they faced with several problems and issues. Fig. 5 illustrates the type and frequency of the faced problems by the students. Technical problems caused by several sources including

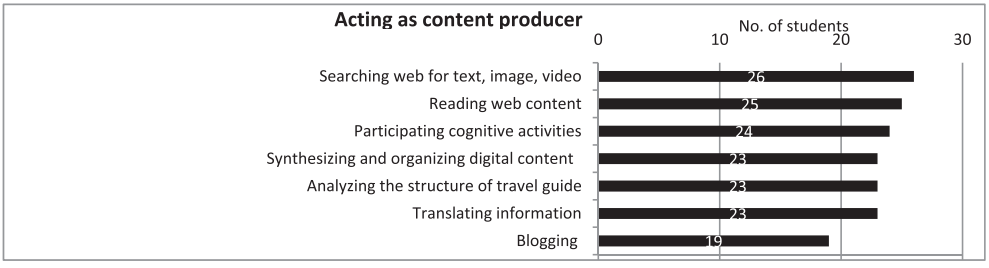


Fig. 2. Accomplished learning activities by students pertain to their role as content producer.

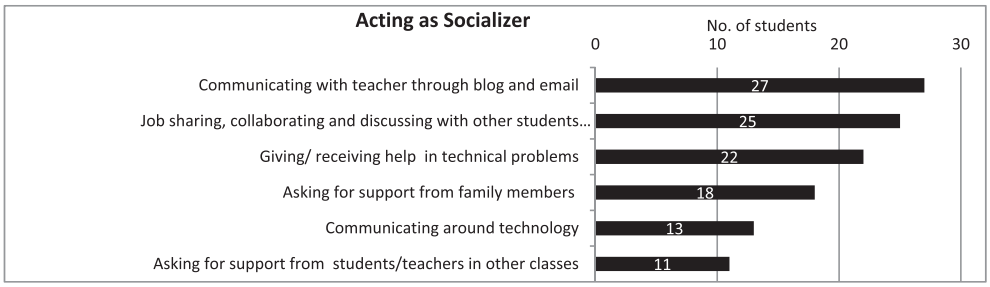


Fig. 3. Accomplished learning activities by students pertain to their role as socializer.

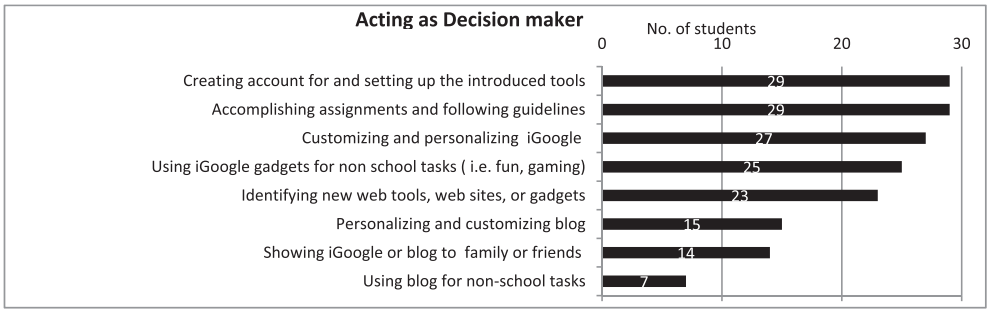


Fig. 4. Accomplished learning activities by students pertain to their role as decision maker.

having difficulty in creating and managing several accounts for different tools, forgotten passwords, and inconsistency between web tools and operating systems. As asserted by the interviewed students and teacher, the challenges caused by these technical problems were frustrating, stressful, and demotivating for students and teacher, especially at the beginning of the project. The second type of the faced problems by the students and teacher pertains to the social aspect of the project including struggling with job sharing, group coordination, peers' disagreement about the structure and content of travel guide, and social loafing issues. Indeed, this project was the first technology-based group working experience for most of them and they could easily be distracted by difficulties in technology or group working issues.

Content issues were identified as the third category of the faced problems in this project. As shown in Fig. 5, many of the students reported content issues including having difficulty in finding appropriate web content to construct their travel guides, inability to evaluate the quality of web content, and difficulty in translating content from other language to Dutch. As a result, although the Internet provided them with a repertory of content resources to use and build their travel guides, the quality and accuracy of the content they used to build their travel guides has been called into question by the teacher as below:

> *Instead of focusing on content and quality aspects of content, the students were mainly busy with look and feels and visual aspects of their websites. So they developed very nice and beautiful websites with less quality content within*!

Managing time and conducting project according to the defined time conditions was another problem faced by one third of the students. The time limitation of the project, i.e. 8 weeks, struggling with technical and team working problems, and other sorts of unplanned and unpredicted issues served to delay the students' learning process. Having difficulty in understanding the objectives of the project and following the student-driven approach of the project was perceived as a problem by about one third of the students. Indeed, the student-centric approach of the project was new to many of them. They just left the primary school with a strong top-down and teacher-driven instructional approach. As a result, at the start of the project they were heavily dependent on the teacher's guidelines and support.

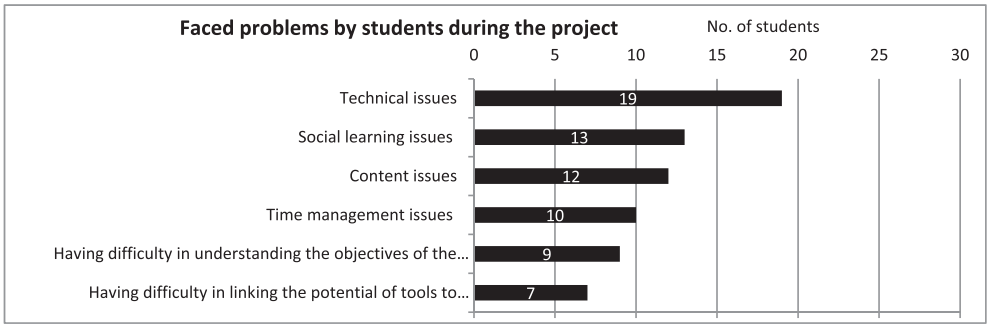


Fig. 5. The faced problems by students during the project.

Finally, about one fourth of the students faced with problems in linking the learning usefulness of the provided choices to their learning needs and process. A student mentioned this problem as follows:

> *We can quickly learn how to use and work with tools such as Google Docs or MindMeister, or iGoogle. But the purpose of using these tools is not clear for us. We need to learn how to link the functionalities of these tools to our learning needs.* (Student #7, interview)

In addition to the faced problems by the students, the teacher also experienced the following problems in this project:

The blurred border between students' personal and educational life: Supporting social aspects of the learning process using technology has been perceived by the teacher as the most difficult and challenging part of this project. According to the teacher, the lack of well-defined approaches and rules for implementing social activities using open social tools can hurt the relationship between the teacher and students, as he quoted:

> *I found it very difficult to implement social tools in the classroom setting. Indeed by using this tools you might stuck in the boundaries of school life and private life which may cause some problems. Perhaps students don't want to combine their personal and educational life. I think riding on the verge of educational and personal life in these tools is very difficult and I found it as the hardest part of the project. We, as teachers and school administrators, need to make well-defined legislations about these kinds of things.*

Possible abuse of technology by students: Another problem was caused by using the provided choices by the students for gaming and non-school related tasks. Due to the provision of extended access to Internet during this project, students were able to access more websites which were inaccessible through the school's network before the project. Unsurprisingly, while this aspect of the project was appreciated highly by students, it was the main source of concern for the school administrators. For instance, the administrator's representative in this project expressed his concern about providing students with extended access to the Internet as below:

> *Possible abuses of the Internet like gaming, seeking porno images, and hacking the system make some sort of concerns for school administrators. Indeed, using the Internet for gaming, porno, or other outside-of-learning border is like late coming to school. In late coming we will show a restrictive reaction, so here for abusing of Internet, the same approach is necessary. Otherwise this abusing behavior might be spread and become unmanageable. It poses an important question for school managers that how much freedom in accessing the Internet should be allowed and is sufficient for 12–15 years old students … .When we allow students to have full access to Internet, we should consider how it can affect the school reputation in the outside world. For instance, if students write unpleasant things in their blogs under the name of the school it can really affect the reputation of the school and causes parents do not choose and send their kids to our school.*

Lack of triggered reflection on the learning process: While the project seems to improve practical aspects of the learning process such as access to tools and facilitating group working, its influence on triggering students' reflection on their learning process has been called into question by the teacher as he said:

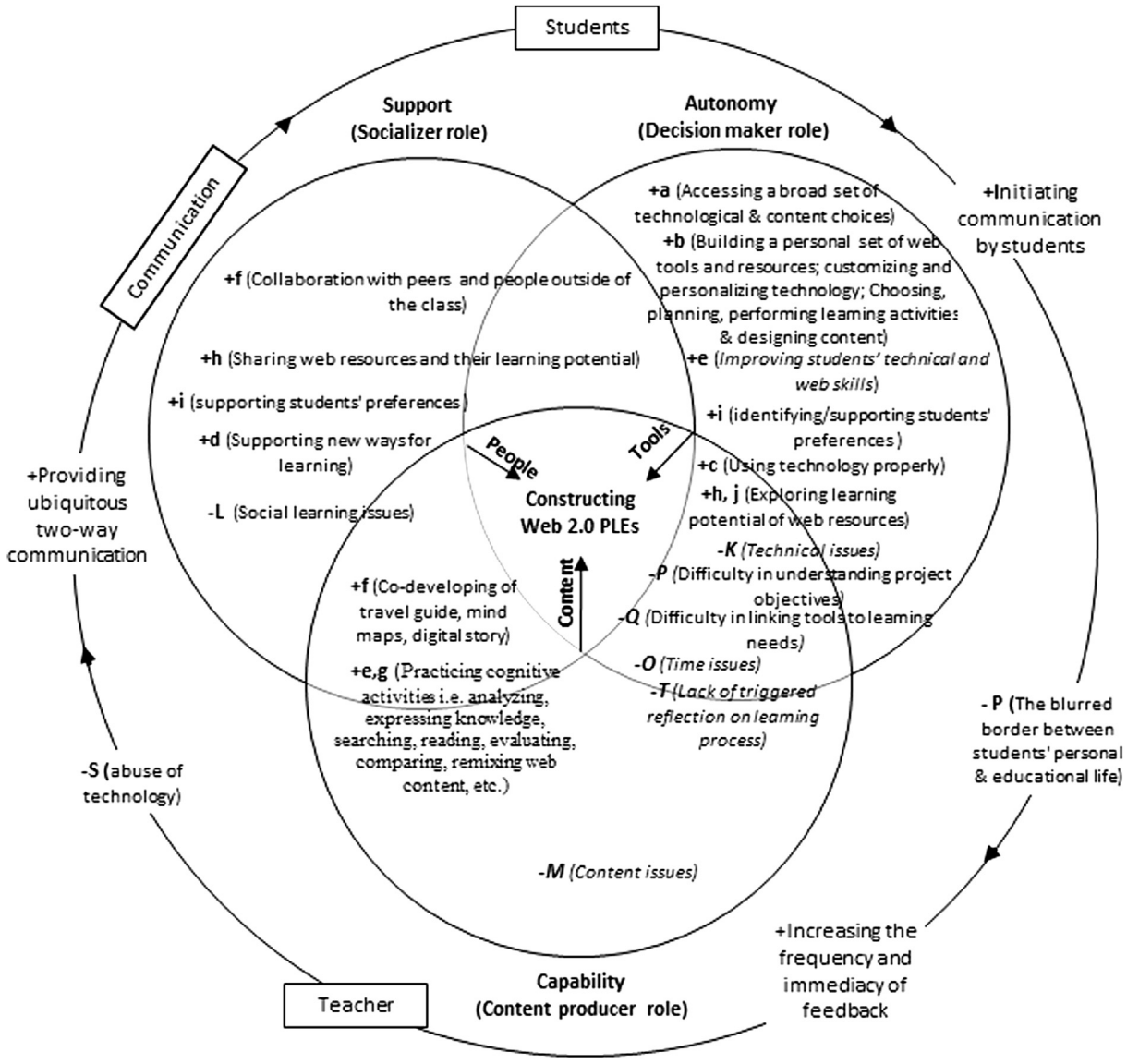
> *They can easily learn to work with the tools and they really like to use the tools. But, I think it is important to notice that the students in this age are very pragmatic. They are looking for short-term and immediate benefits of these tools to support their learning tasks. They are not concerned about the whole learning process. I think gaining a reflective ability to reflect on whole learning process is a function of age and experience not mere technology.*

4. Discussion

The identified learning functions correspond to some extent with the characteristics of PLEs described by Attwell (2007) and Van Harmelen (2006) as well as the learning functions and purposes of PLEs explained by Valtonen et al. (2012), Drexler (2010), and Johnson and Sherlock (2012). According to Attwell (2007), PLEs include tools to support producing and publishing content and digital artifacts, communication, collaboration and scaffolding learning. Van Harmelen (2006) recognized the integration of multiple web tools and resources as an important student-driven instructional tool that can develop autonomy, ownership, diversity, openness, and connectedness. As asserted by Johnson and Sherlock (2012), introducing the PLE concept into classroom settings can promote communication about technology among the students and increase their awareness about its learning benefits. Drexler (2010) emphasized that the construction of PLEs, informed and driven by student-centric instructional approaches such as inquiry-based learning, can facilitate comprehension or deep understanding through the compilation and synthesis of content. Along similar lines, McLoughlin and Lee (2008) asserted that following learner-generated content approach might trigger individual and social thinking of students and foster higher level of cognitive and metacognitive activities such as analysing, evaluating, synthesizing, and creating digital artefacts.

With regard to the accomplished learning activities as shown in Figs. 2–4, we argue that performing these digital learning activities provides opportunities to practice lower and higher order cognitive activities. In this regard, as proposed by Churches (2008), digital learning activities such as listing, retrieving, locating, finding, bookmarking, social networking/bookmarking, searching, blogging and sharing can be assigned to the lower order thinking skills of the revised Bloom's taxonomy (Anderson et al., 2001) namely remembering, understanding, and applying sub-processes. Furthermore, Churches (2008) attributed digital learning activities such as organizing content, mind mapping, monitoring, storytelling, mixing content, and creating web site and digital artifacts to higher order thinking skills consist of analysing, evaluating, and creating sub-processes of the revised Bloom's taxonomy.

Wilson (2008) refers to student-driven constructing of learning environment as the ways they “construct the environment for themselves:the tools they choose, the communities they start and join, the resources they assemble, and the things they write” (p.2). To scrutinize the influence of the model on the students' engagement in constructing their learning environment, we mapped the identified learning functions, activities and problems onto the main dimensions of student's control, as shown in Fig. 6. The mapping process was guided by the relatedness between the nature of the learning functions and problems and the specification and intention of each role. According to this



Functions: **a** (Broadening technological and content choices), **b** (Feeling ownership and taking more responsibility over learning process), **c** (Practicing digital responsibility), **d** (*Improving the students' ways of learning*), **e** (*Improving students' technical and web skills*), **f** (*Supporting collaboration and networking*), **g** (Practicing cognitive activities), **h**(*Promoting communication about technology*), **i**(Supporting the establishment of a student-centric learning environment), **j** (*Increasing the students' awareness about the learning benefits of Web2.0 tools*)

Problems: **K** (Technical issues), **L** (Social issues), **M** (Content issues), **O** (Time issues), **P** (Having difficulty in understanding project objectives), **Q** (Having difficulty in linking the potential of tools to their learning needs), **R** (The blurred border between students' personal and educational life), **S** (Possible abuse of technology by students), **T** (Lack of triggered reflection about the learning process)

Fig. 6. Mapping the PLE-based learning functions onto the main dimensions of the student's control.

mapping, the model can influence the students' engagement in constructing their learning environment in two ways: (*i*) influencing the students' engagement in extending the learning environment by adding tools, content, and people to the learning environment, and (*ii*) influencing the communication between teacher and students.

4.1. Influencing the student's engagement in extending the learning environment

As shown in Fig. 6, the identified learning functions and faced problems can influence the process of constructing the learning environment by students as below:

4.1.1. Adding web tools and services to the learning environment

Student-driven learning approaches such as PLEs center on the *self* and *personal agency* as the main driving forces for directing the learning process. Personal's agency refers to "the capability of individual human beings to make choices and to act on these choices in

ways that make a difference in their lives" (Martin, 2004, p. 135). As stated by Bandura (1997), the student's *thought* affects her *action* through the exercise of personal agency. We argue that the model by facilitating the students' access to a broad set of technological, pedagogical and content choices (*function a*) has provided students with enough freedom which alongside appropriate structure and scaffolding has enabled them to assume an active role in their learning by accessing and choosing preferred web resources, planning, and performing learning activities and designing content for their learning environments (*function b, and* Figs. 2–4). From the personal agency perspective, by mapping *thought* onto the students' planning and choosing of web tools and resources (*function a*) and *action* to the co-construction of travel guides using these tools and resources, it can be claimed that the model has provided students with appropriate opportunities to exercise personal agency (*functions b, e, g, f*) by getting engaged in different types of learning activities through organization and management of technology. As a result, we argue that providing students with choices and supporting student-driven personalization of learning resources (*functions b*) can involve students in communication about technology and exploring and finding relevant web tools and services to construct the learning environment as a student-created, and administrated matrices of resources (*functions h, j*).

Moreover, this project had provided students a great opportunity to be aware and practice digital responsibility (*function c*) through adhering the school rules and policies regarding using Internet and web technologies and citing used resources in their final travel guides. Digital responsibility is a subset of digital citizenship and refers to appropriate use of all types of media, behaving responsively when interacting with others online, and following school acceptable use policies. However, the extended access to Internet was tempting for some of students who took advantage of it to play game gadgets in iGoogle (*problem S*) which may affect the communication between school, teacher, and students.

Furthermore, we argue that this student-driven personalization of learning resources and the development of PLEs as student-created, and administrated matrices of resources (*functions b, c*) have the potential to enhance the student's feeling of ownership over the learning environment and increase her willingness to practice autonomy over her learning process. In this regard, performing activities such as customizing and personalizing iGoogle and blog pages and showing them to their family and friends and extending the learning process beyond the classroom settings by involving family members and friends, arguably, can be envisioned as evidence on students' feeling of ownership over their learning environment. Furthermore, the project-based and constructivist nature of the model and involving students in the whole/entire learning process including involving (partially) in choosing their learning objectives, choosing tools and content resources, planning and constructing project, asking for support from other people and feeding back can enhance the students' self-motivational beliefs and ownership by creating a sense of accomplishment and control.

Finally, as asserted by Johnson and Sherlock (2012) and Rahimi et al. (2014b), student-driven constructing of learning environment is a long-term and iterative process of tooling and retooling the learning environment. Accordingly, it can be argued that participation in the project can increase students' awareness and understanding of the learning usage of web technologies and can improve their long term tendency toward technology-based learning (*function k*) as a prerequisite to support self-directed learning in digital era. Moreover, providing students with appropriate choices and allowing them to pursue their learning pathways can reveal their technological, pedagogical, and content preferences (*functions i*). This insight into students' preferences provides a great opportunity for teachers to adjust their teaching process, tool and retool the learning environment and establish a dynamic student-centric learning environment based on the students' preferences.

Although, the model seems effective in providing appropriate *structure* in terms of learning choices and opportunities for students to actively participate in constructing the technological part of their learning environment and feeling *ownership* over it, the identified problems have called its capacity in improving the students' *ability* to self-regulate their learning process using technology into question. As asserted by Rahimi et al. (2014b), constructing personal learning environments using Web 2.0 tools and services goes through a self-regulated learning process consisting of preparation (i.e. having access to learning choices), performing (i.e. using the provided choices to accomplish learning activities), reflecting (i.e. reflecting on different aspects of the learning process), and feeding back (i.e. providing implicit and explicit feedback to reshape the learning environment) phases. While the model provided opportunities for students to actively participate in preparation (*function a*), performing (*functions b, e, g, f and* Figs. 2–4), and feeding back (*functions h, j*) phases, no clear evidence on triggering students' reflective approach to learning process was observed. Rather, the students have experienced several problems regarding the learning process including having difficulty in understanding the objectives of the project and linking the learning potential of web tools to their learning needs (*problems P and Q*), time management issues (*problem O*), and lack of triggered reflection on the learning process as asserted by the teacher (*problem T*).

4.1.2. Producing content

Creating content resources play a key role in forming learning environments. Following the learner-generated content approach (McLoughlin & Lee, 2008), the model provided students with opportunities to practice several learning activities using technology such as searching web, reading and evaluating web content, analysing the structure of travel guide, remixing and appropriating content, structuring the learning materials, and creating final travel guides (*functions e, g,* Figs. 2 and 3). These digital learning activities correspond to lower-order and higher-order cognitive activities defined by Bloom's digital taxonomy map proposed by Churches (2008). From this perspective, we argue that the model supports a novel form of learning that serves a dual process which helps students not only learn the course through the production of content, but also develop their technical knowledge and competencies linked to the course objectives.

However, although the model seems to be effective in providing opportunities for students to practice technology-based cognitive activities, the quality of the produced content by students has been called into question by the teacher (*problem M*). Furthermore, the students faced with several content issues including having difficulty in finding relevant and accurate content and inability in evaluating the quality of the web content. Solving these problems and addressing the teacher and students concern about the quality of the web content requires a collaborative, iterative process to review, amend, comment on, interconnect and tag content (McLoughlin & Lee, 2008).

4.1.3. Constructing social aspect of the learning environment

As shown in Figs. 3 and 6, the model has triggered a *student-driven social approach* to keeping control over the learning process through co-solving the faced technical problems, working collaboratively around their projects, providing emotional support, and connecting to and asking for support from family members, friends and teachers (*functions f, h*). However, the students faced with several problems pertain to the social aspect of their learning including experiencing job sharing and group working problems, distracting by peers, social loafing, and having difficulty in connecting to experts (*problem L*) which might decrease and affect their control over their learning process.

4.2. Increasing communication between teacher and students

The model has influenced the control of students over educational process through improving the communication between teacher and students. According to Moore (1973), the degree of control that a student has over the educational experience is determined by the communication between the teacher and student during the *negotiation phase*, i.e. planning time to develop the structure of a course, and *dialogue phase*, i.e. instructional time. There are three main factors which determine the degree of dialogue between teacher and students, include *the type of communication technology*, *the frequency and immediacy of feedback*, and *the initiator of communication* (Garrison & Baynton, 1987). We argue that the model has improved and increased the communication and dialogue between teacher and students by providing students with opportunities to influence these factors as follow:

Firstly, as remarked by Garrison and Baynton (1987), a technology in order to improve the dialogue between teacher and students should support two-way communication and be easily accessible by them. By incorporating two-way technologies, such as Twitter and Blogs, into educational process the model has provided students and teacher with appropriate two-way communication channels and facilitated *the frequency and immediacy of feedback* between teacher and students, as shown in Fig. 3. Secondly, the model promoted the students to take part in constructing their learning environment by finding, using, and sharing learning resources. As asserted by Rahimi et al. (2014b), following this approach along with the permanent and intensive contact of students with technology and unceasing development of Web 2.0 tools can shift the gravity center of educational practices from content as the teacher's sphere of influence to communication around the content and communication about technology. This shift arguably can provide opportunities for students to be the *initiator of communication* by finding and introducing relevant resources.

In spite of these functionalities, using the model also introduced some problems which might influence and hurt the communication and relationship between teacher and students including possible abuse of technology by students (*problem S*), and the blurred border between students' personal and educational life (*problem P*). Avoiding these problems asks for training students how to use technology properly, emphasizing digital responsibility, and enacting and following appropriate technology usage policy within the school setting.

In summary, it can be argued that a student-driven process of constructing learning environment is a function of the *communication between teacher and students*, the *structure* of the learning environment, students' *ownership*, and their *ability* to take part in this process. In other words, while the structure of the learning environment should provide appropriate level of *choice*, *freedom, activity space, and adaptation*, the students need enough feeling of *ownership* and *abilities* to utilize these choices to construct their learning environment. The results of this study suggest that although providing students with appropriate choices and allowing them to perform personal learning activities using these choices is a perquisite to facilitate students' engagement in constructing their learning environment and enhance their ownership over it, still there are other conditions needed to be considered to increase their *ability* to self-regulate this process. Without careful consideration of developing these abilities, according to Scardamalia and Bereiter (2006), any activity-based learning experiences can easily decline to a form of shallow constructivism or doing for the sake of doing with no significant impact on the students' personal development. Accordingly, to avoid this drawback, appropriate self-regulating and reflecting learning activities such as peer-based learning, self-evaluating, creating personal meaning from learning experiences, evaluating the quality of online content, and using web tools in different context are required. This type of learning activities can foster internal learning abilities such as self-reflecting and evaluating and develop critical thinking regarding the learning choices and range of possibilities to select and construct the learning environment.

Taken together, this study has provided us with the following insight into developing Web 2.0-based PLEs in formal educational settings:

- Skills and abilities students need to construct their learning environment using Web 2.0 tools cannot be taken for granted. Rather, developing these skills and abilities goes through a long term process of interaction between teacher and students and requires adopting student-centric instructional approaches and teacher's scaffolding.
- Building a student-driven learning environment requires: (*i*) adopting a student-centric instructional approach by teachers to seed the learning environment with relevant resources (initial seeding), (*ii*) increasing students' willingness and abilities to participate in designing and building the learning environment (bottom-up evolving), and (*iii*) reseeding the learning environment according to the students' feedback and preferences (flexible structure). Addressing these requirements, in addition to following appropriate pedagogical approaches, calls for appropriate technological platform.
- There have been several difficulties and challenges pertaining to implementing the model including managing students' social activities using Web 2.0 tools and social software, the lack of adequate digital and self-regulated learning skills in the part of students, blurring the borders between students' personal and educational activities, technical problems and inconsistencies, and lack of appropriate technology to monitor and analyse the personal experience of students with different technologies. Addressing these challenges, among other factors, requires training students how to use technology to develop their social, help-seeking, and self-regulating skills, defining and enacting appropriate Internet usage policy and legislation to make an appropriate balance between students' freedom and school's expected level of control, and choosing reliable and consistent web tools.
- Students need teachers' support and scaffolding to discover the learning affordances of Web 2.0 PLEs and linking them to their learning requirements. Using these tools by different teachers in different subjects and context can assist students to observe their applications in different learning scenarios and use them to meet their current and future learning needs.

Facilitating students' engagement in constructing their learning environment using Web 2.0 PLEs is a new phenomenon and thus requires more research. Within this research, further research is required to find out the impact of PLE-based learning on the students' self-regulated learning process: What processes do students go through when constructing and using their PLEs? How can PLE-based learning contribute to developing self-regulated learning skills among the students? What do the assessment and evaluation mechanisms conducive to developing self-regulated and self-directed competencies using Web 2.0 PLEs in students, look like? The next research theme will concentrate on deploying the model for other educational approaches such as problem-based learning and inquiry-based learning: What adjustments in the model are required to apply it to support problem-based and inquiry-based learning approaches?

5. Research limitations

The main limitations of this study include: (i) running the research process for one iteration, (ii) conducting the research in a classroom setting where the main emphasis of instruction was on improving the students' learning process rather than transferring content, and (iii) defining a unique learning project for all students. Accordingly, further iterations and longtitude implementation of the model is required to find out the emergent dynamics of shifting the control of learning process from teachers to students. Also, implementing the model in the educational settings with more emphasis on transferring formal content might determine the required adjustments in the pedagogical and technological components of the model.

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