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Alan Amory [a]

[a] Science and Technology Education, University of Johannesburg, Auckland Park, Johannesburg 2006, South Africa

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Tool-mediated authentic learning in an educational technology course: a designed-based innovation

Alan Amory*

Science and Technology Education, University of Johannesburg, Auckland Park, Johannesburg 2006, South Africa

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This design-based research project is concerned with the design, development and deployment of interactive technological learning environments to support contemporary education. The use of technologies in education often replicates instructivist positions and practices. However, the use of Cultural Historical Activity Theory (C), authentic learning (A), and educational technologies as tools (T) to mediate learning provides an integrated CAT framework to design and use learning experiences that transform not only individuals but also their world view. The work reports on the design, redesign, and evaluation of an honors course on the use of information communication technologies in teaching and learning. Analyses identified a number of design principles useful in conceiving learning tasks to support the theoretical framework. The CAT framework fosters the use of learning mediation through the use of educational tools that support collective knowledge construction of individuals and their communities, rather than replicate the use of technology for instruction.

Keywords: design-based research; design and evaluation of learning environments; information communication technologies; activity system; authentic learning; CAT framework

Introduction

This research, which uses a design-based research inquiry (Bannan-Ritland, 2003; Barab & Squire, 2004; Brown, 1992; Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Reeves, Herrington, & Oliver, 2004; The Design-Based Collective, 2003), is concerned with the design, development, and deployment of an interactive technological learning environment, which supports contemporary educational practices. The introduction identifies the problem under investigation, which is followed by the development of a theoretical framework, an iterative use of the framework to design the course, evaluation of the designed course, and the development of design principles to support future course designs.

Educational technologies that do not support innovative interactive collaborative environments may, in part, be due to the design and use of Learning Management Systems (LMSs) (Reeves et al., 2004). While educators can make creative use of

*Email: aamory@uj.ac.za

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LMSs (Benson, Lawler, & Whitworth, 2008), the design of these systems often foreground content (Finger & Jamieson-Proctor, 2009), the importance of information rather than learning processes (Paulsen, 2003), focus on technical issues (Dutton, Cheong, & Park, 2004) and use commodified learning content (Amory, 2010). In addition, teachers who use LMSs habitually replicate traditional instructional practices (Blin & Munro, 2008; Browne, Jenkins, & Walker, 2006; Dutton et al., 2004; Yueh & Hsu, 2008). To challenge traditional content-based instructional practices, Amiel and Reeves (2008) argued that the technology should not be the unit of the analysis, but be the part of a learning process. The problem under investigation asks how education technology and interactive learning environments that support learning and individual transformation can be designed to support collaborative social problem-solving activities (Amory, 2010; Downes, 2006; Gifford & Enyedy, 1999; Laurillard, Stratford, Luckin, Plowman, & Taylor, 2002). Moreover, interactive learning environments need to be aligned with constructivist learning theories, as articulated variously by Vygotsky (1933/1978) and Piaget (1977), among others.

This article will first develop a theoretical framework for the design of a technological educational environment that is aligned with social constructivism and where technology is not deployed as the unit of analysis. It will then describe the design and evaluation of a course based on the developed framework. To support the social constructivist agenda, this article makes use of Cultural Historical Activity Theory (CHAT), a contemporary theory, which draws on Vygotsky's work.

Developing the theoretical framework

The theoretical framework combines CHAT, authentic learning (Reeves et al., 2004) and the roles of educational technology in teaching and learning, as discussed in the following sections.

Cultural historical activity theory

Vygotsky (1933/1978) argued that learning is never direct, but is always mediated by cultural and psychological tools. Through tool-mediation, we learn about our world and thereby learn to master ourselves and the world around us. This Vygotskian subject–object–tool triad was expanded by Engeström (1987) to include rules, the community, and division of labor to better understand human activity and work (Figure 1) as explained below.

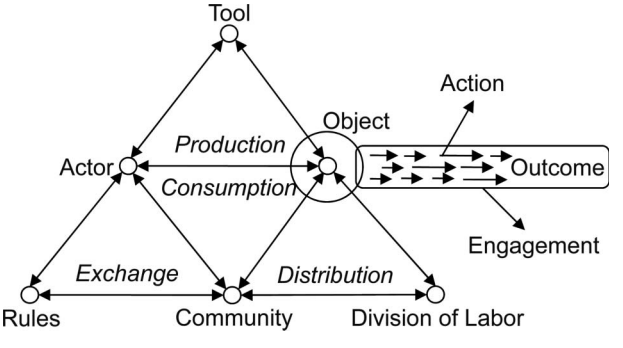

Figure 1. Activity system diagram (redrawn from Engeström, 2008).

Central to CHAT is the concept that all activities, both inter- and intra-psychological, are social and cultural in nature where actors transform an *Object* (Leont'ev, 1978). *Objects* are thus cultural entities that embody social transformational practices which developed further during human activity (Stetsenko, 2005). The prime unit of analysis in an activity system is the *Object* (Engeström, 2001) and, with motive, gives the system coherence (Engeström, 2000). Furthermore, Kaptelinin (2005, p. 4, 5) argued that the object of activity is "undoubtedly one of the most basic concepts of activity theory" and "[e]employing the object of activity as a conceptual lens means anchoring and contextualizing subjective phenomena in the objective world and changes one's perspective on both the mind and the world".

The *Outcomes* of any activity result from *Actors* interrogating *Objects* by means of *Tools* that mediate the interactions (Production). In addition, the *Rules* mediate relationships between *Actors* and the *Community* (Exchange), the *Division of Labor* mediates between the *Community* and the *Object* (Distribution), and the *Community* between the *Actors* and *Object* (Consumption) (Barab, Evans, & Baek, 2004; Engeström, 1987, 2000, 2001; Roth & Lee, 2007). The social action subsystem of consumption, production, distribution, and exchange supports the exploration of complex social interactions (the engagement) that are made up of multiple strings of actions that are neither linear nor aligned (Engeström, 2008).

CHAT has been used as a tool to design learning (Issroff & Scanlon, 2002; Puustinen, Baker, & Lund, 2006) and as a heuristic to evaluate learning and teaching (Barr, Noble, & Biddle, 2007; Blin & Munro, 2008; Hardman, 2005). Therefore, the first theoretical construct useful to this study is concerned with collaborative transformation of the views of individuals and their worlds. CHAT forms the basis for the design of the learning experience but, in addition, this study uses CHAT as a heuristic to describe, design, and develop a course. However, meaningful learning, from an activity theory perspective, requires that the *object of the activity* be clearly described, for example, through the use of authentic tasks, as explored in the following section.

Authentic learning

Amiel and Reeves (2008) suggested two positions related to the use of information communication technologies (ICTs) in the classroom: the power of technology to change pedagogical practices, and the use of computers as tutors with no human intervention.

In order for the technology to influence learning outcomes positively, Amiel and Reeves (2008) insisted that technology should support complex human, social, and cultural interactions rather than act as a dumb servant. Smeets (2005) argued that powerful learning environments include rich contexts, authentic tasks, active, autonomous learning and co-operative learning, and an adaptive curriculum. Cognitive apprenticeship (Brown, Collins, & Duguid, 1989) is the genesis for the use of authentic tasks in teaching and learning. Brown et al. (1989) defined authentic activities as "the ordinary practices of the culture" (p. 34) and included collective problem solving, displaying multiple roles, confrontation of ineffective strategies and misconceptions, and developing collaborative work skills. Such an approach supports knowledge construction as students who used authentic classroom tasks, which required constructing knowledge rather than information reproduction, outperformed students who were taught in traditional instructional manner

(Newmann, Bryk, & Nagaoka, 2001). It is therefore necessary to understand the notion of authenticity in teaching and learning in order to design and evaluate classroom practices.

Reeves et al. (2004) suggested that learning environments should include authentic tasks that:

- have real-world relevance;
- are ill-defined and include a number of sub-tasks;
- are complex and require students to undertake complex investigations;
- provide opportunities for students to investigate the tasks from different perspectives;
- provide collaborative and reflective opportunities;
- integrate across different subject areas;
- include integrated assessment;
- yield possible products that include more than one iteration; and
- allow competing answers or solutions.

Recently, Iverson, Lewis, and Talbot (2008) carried out an extensive review of authenticity in teaching, learning, and assessment and, on the basis of this, developed an authenticity framework for individual teacher education and for the evaluation of classroom practices. This framework includes five criteria:

- the learning task is performed by professional teachers;
- the outcome of the task is an artifact that can be used outside the classroom;
- the use of the learning task promotes knowledge of the practice of teaching;
- reflection is part of the purpose of the task in teaching and learning; and
- formative assessment is integrated into the learning task.

Therefore, the second theoretical construct useful to this study is the concept of authentic learning as the *object of the activity*. What then is the role of educational technology in an activity system where the authentic task is the *object of the activity*?

Role of educational technology

The work of Benson et al. (2008) on course management systems (CMS) reinforces the concept of learning with technology (*tool-mediation*) rather than learning from technology (as the *object of activity*) (Jonassen and Reeves, 1996). Initially, Benson et al. (2008) considered the CMS as the *object of the activity* but this was not the way in which the *actors* saw the system. Therefore, they re-conceptualized the CMS as a constitutive part of the infrastructure that affected three mediators of the activity: the *tool* that functions at the psychological level, the administrative *rules* that can be disruptive and stakeholder groups that play different roles (the *division of labor*). While such a position emphasizes technology as a mediating *tool*, the production and use of teaching and learning technologies most often perpetuates behaviorist values, as argued above. Analyzing Learning Objects, CMSs, blended learning and computer video games, Amory (2010) argued that the design of these technologies mostly rejects constructivist approaches and legitimatizes instructivist positions. This occurs when technology acts as the *object of the activity* that facilitates the transfer of information into students' minds. Students are therefore involved in the

consumption of the ideas of others and not in the production of their own ideas. While educational technologies have the potential to support individual transformation, and thereby their world, the technological tools are mostly designed and used to support instructivist practices.

The contradiction between the social constructivist's concept of tool-mediation and the common, wide-spread use of educational technology could be solved by describing the ways in which ICTs could be used in teaching and learning, including:

- *As information stream*: The delivery of learning resources and other necessary information pertinent to learning, research, and administration (for example, medical imagery needed for a case study).
- *As enabler of communication*: The use of both synchronous (real time) and asynchronous (any time) communication modes.
- *As enabler of collaboration*: The use of collaborative authoring and other online services to support co-authorship and co-construction (for example, Google documents allow many authors to write and edit documents synchronously).
- *As information transformation tool*: Information transformed from one, or many, information streams to alternative streams (for example, the development of a storyboard from a written novel).
- *As professionalization tool*: The use of technological tools associated directly with a profession (for example, the use of Computer Aided Design software by architecture students).

Educational technology can thus act as the mediating artifact to support knowledge construction in a designed activity system; a *learning with* technology (Jonassen & Reeves, 1996). Teaching and learning systems therefore need to consider technology as a provider of information, enabler of communication and collaboration, transformer of information from one into many representations, and a tool to support professional practices. The uses of ICT tools to mediate knowledge construction therefore could overcome instructivist educational technologies practices.

The use of CHAT (C), authentic learning (A), and educational technologies as tools (T) to mediate learning provides an integrated framework to design learning experiences that support knowledge construction. In the next section, this CAT framework is used to design a course on the use of ICT in teaching and learning.

Design of course and the learning environment

Background

In this study, ICTs are used in a process of collaborative exploration, as suggested by Amiel and Reeves (2008), and not as an artifact or tutor. First, the unit of analysis is not the technological artifact itself, but rather the process of engaging with the technological tool. Second, research needs to inquire "into techniques and tools in an effort to improve and refine the process of teaching and learning and, consequently, the design of learning environments" (Amiel & Reeves, 2008, p. 32). To meet these two requirements, this investigation makes use of a number of teaching and design cycles (Figure 2) that are part of a design-based research inquiry. The 11 research and design actions (Figure 2a–k) involved in this design experiment are: (a) identification of problem (see Introduction); (b) development of an appropriate framework (the CAT framework described above); (c) initial design of the course (this section, Figure 3);

(d) initial evaluation (the evaluation section below); (e and f) two additional course redesign cycles (this section, Figure 4); (g–j) evaluation with three instruments and analysis on performance (evaluation section, Figures 5 and 6, Table 3); and (k) development of design principles (see Discussion). The research methodology in this inquiry makes use of what Reeves and Hedberg (2003) referred to as an eclectic-mixed methods-pragmatic approach and therefore uses quantitative and qualitative methods.

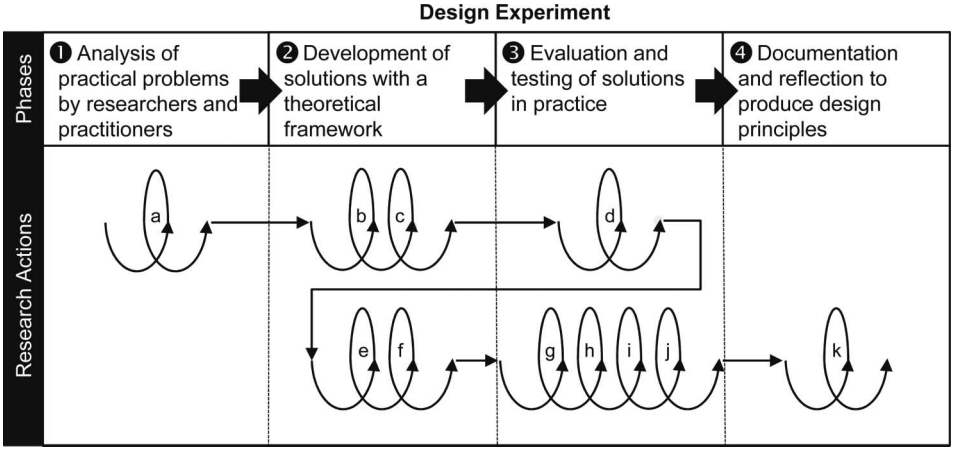

Figure 2. Research activities associated with the different phases of the design experiment. (a) problem identification; (b) theoretical framework; (c, e, f) course design; (d, g) student opinion instrument; (h) authentic learning instrument; (i) participation–facilitation–contribution instrument; (j) course examination assessment; (k) design principles.

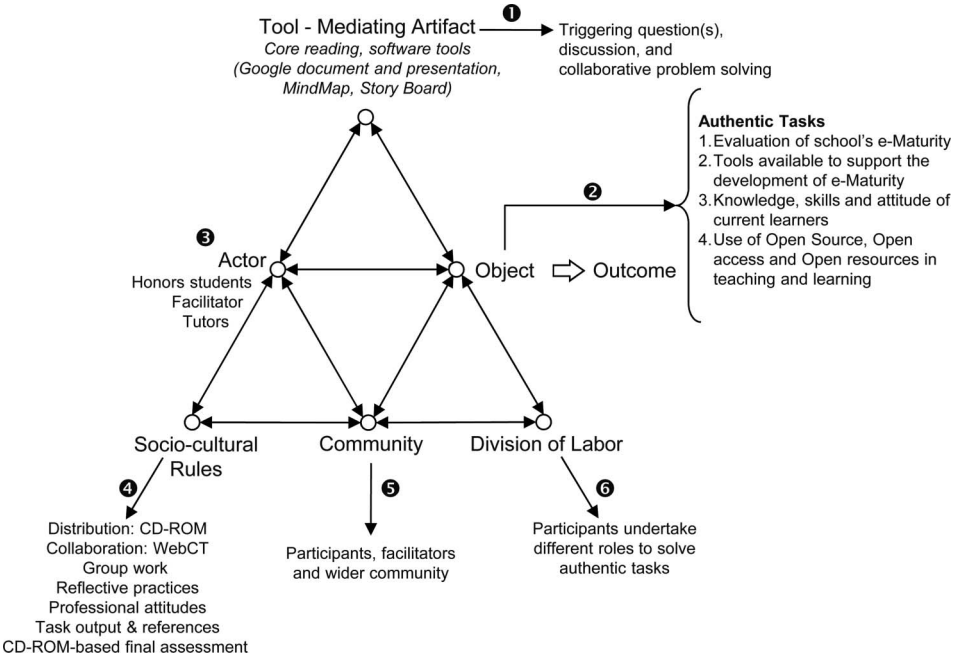

Figure 3. Activity system diagram describing the initial design of the course.

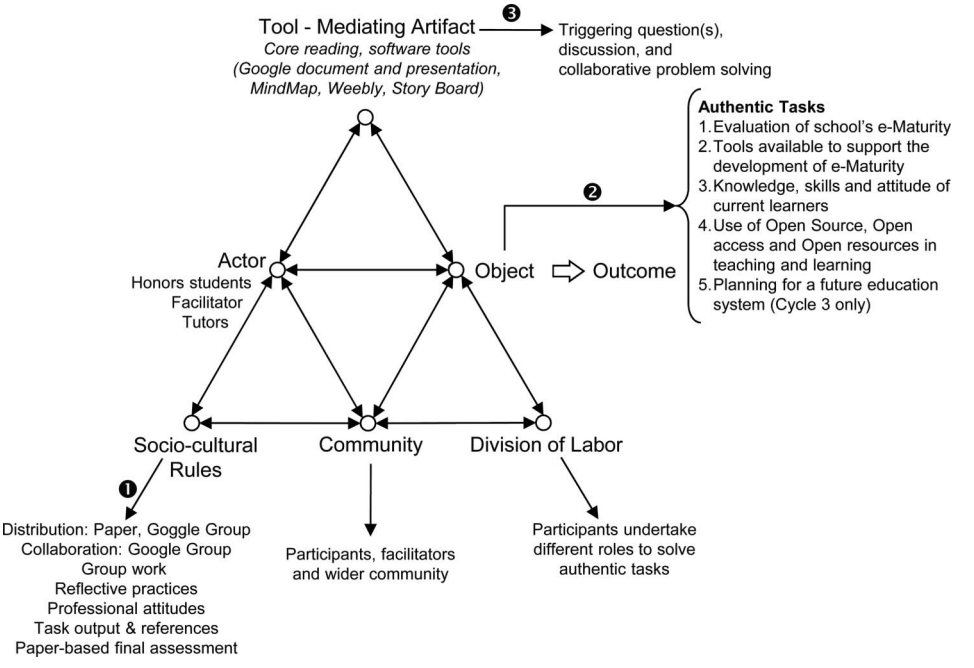

Figure 4. Activity system diagram describing the design of the course after three design iterations.

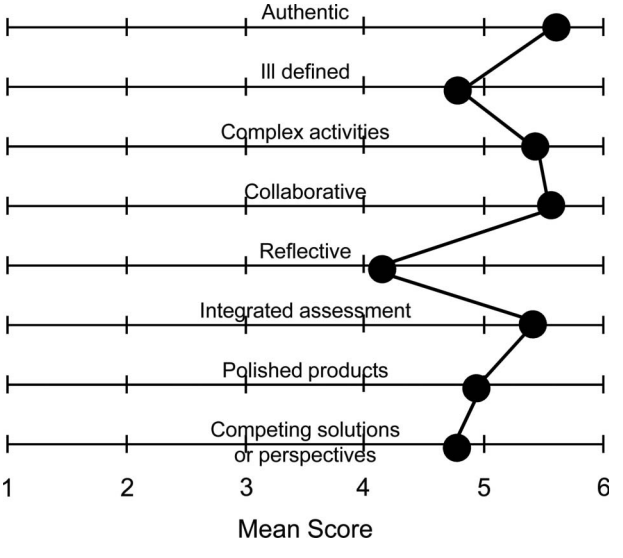

Figure 5. Student assessment of the authentic task design principles.

Context of the study

The course on ICT in teaching and learning reported in this article is one of six courses that are part of the Bachelor of Education (Honors) program. I designed and taught the course from 2008 to 2011. Two cohorts of students (teachers and district

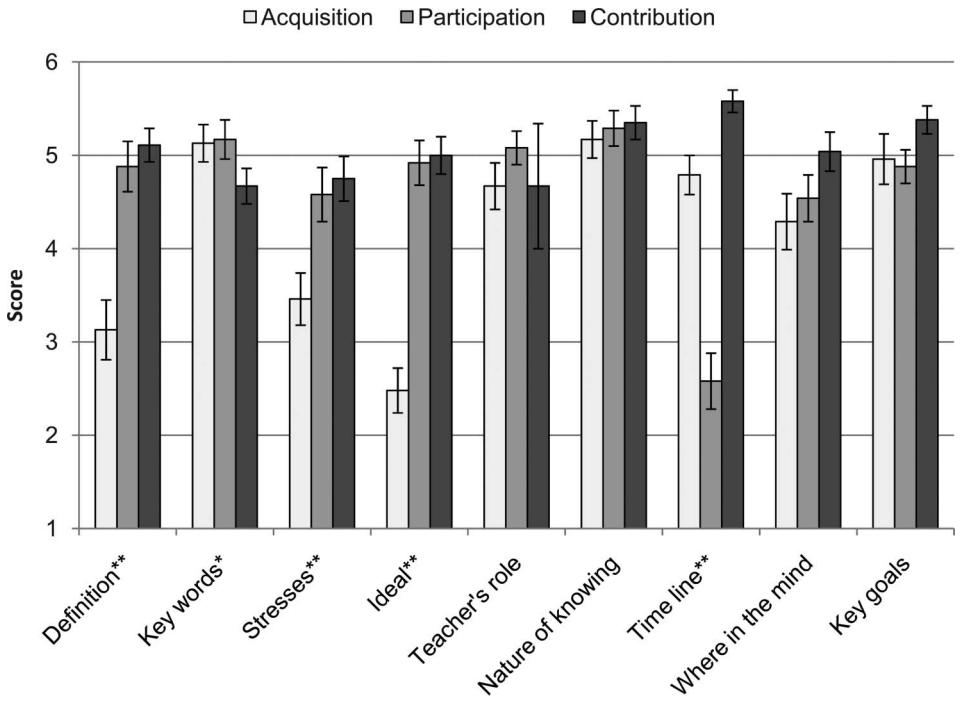

Figure 6. Student assessment of the acquisition, participation, and contribution models of learning (**Friedman's significance < 0.001, *Friedman's significance < 0.05).

officials) from 2008 ($n = 67$) and 2010 ($n = 27$) participated in the research. Students were expected to spend a minimum of 200 h on course assignments and to participate in ten 2-h contact sessions on Saturdays over two semesters. The course made use of continuous and a final summative portfolio assessment. The continuous assessments were the authentic tasks that students, working in groups, undertook during the course. For the final portfolio assessment, students individually provided a brief introduction describing the evidence that they included in their portfolio to demonstrate what they had learnt (knowledge and skills) from the course, selected and improved three of their group assignments to take into account peer and lecturer critiques, and wrote a critical review of the course using a rubric aligned to the course content.

The design of learning activities

The design of learning activities in the educational ICT course has changed over the past three years. Although the design template has remained constant, the emphasis of the learning activities focused strongly on the authentic task, associated activities, core references, and production and communication tools – the CAT framework. In addition, changes in design were informed by classroom observation and discussion, self-reflection, and surveys of student opinions (see below).

The core readings, communication, and production software (Figure 3❶) acted as the mediating artifacts (*tools*) required for investigating and reporting on the *object of the activity* – an authentic task (Figure 3❷). During the contact sessions, the students worked in groups supported by the lecturer (as facilitator) and postgraduate

tutors (Figure 3❸). Assessment criteria, the *Rules* of the activity, included the delivery of materials and tasks via CD-ROM, communication tools that are part of WebCT (an LMS), group work, reflective sessions, the assessment of professional attitudes and products outputs, and the presentation of a portfolio of work for final assessment on CD-ROM (Figure 3❹). Many of the tasks required that students interact with the larger teaching community, especially when they conducted research at their schools (Figure 3❺). It was also common practice that students undertook different subtasks within any single authentic task (Figure 3❻).

The initial design of the course (Figure 2c) included four authentic tasks related to e-Maturity – ''the capacity of a school to make strategic and effective use of ICT in order to improve educational outcomes'' (Becta, 2007); ICT tools for teaching, learning and administration; digital natives; and use of open source, open content and open access in teaching and learning (see Table 1 for a full description of the authentic tasks). The software used to answer each task was different and varied from a widely used tool (word processing and presentation software) to unfamiliar tools, including software used to create mind maps, web pages, and story boards. All the tools used in the course are freely available and released under non-proprietary licenses. The word processing and presentation software are from Google (http://docs.google.com), Mueller's FreeMind (http://freeming.sourceforge. net) for mind mapping, and Storyboard (http://multimedia.journalism.berkeley.edu/ tutorials/starttofinish/storyboarding/) for the creation of outlines for a documentary video. Tools selected were from the familiar (text-based work processing), through graphic depiction of knowledge (mind mapping) to the more complex task representing ideas in a script containing words, pictures, sounds and filming instructions.

During the first year of delivery of the course it became obvious that the complicated university registration processes to gain entrance to and the retrieval of forgotten passwords to the LMS were far too confusing and time consuming. In addition, the students found navigation in the system complex. To overcome this problem, a CD-ROM with all the tasks was distributed to students (Figure 2e). However, students forgot to bring the disk to class or did not remember that all the required reading was stored on the disk. Therefore, the mode of communication and distribution were changed in later iterations (Figure 2f) of the course. During the first session, all the students opened a GMail account and registered for a Google Group created for the course. When students lost, or forgot, their login name or password, the process was simply repeated. The Google Group was also used to distribute all the tasks and associated readings. In addition, each task was printed for distribution during the contact sessions (Figures 2f and 4❶).

The course made use of a portfolio of work for the final summative assessment. This portfolio needed to include group work that was improved by individuals and a critical assessment of the course. During the first implementation cycle, participants presented their portfolio on a CD-ROM disc (Figures 2c and 3❹). However, many of the participants handed in blank disks, or copied the link and not the file itself to the disk. During the second iteration, students were requested to submit their portfolios on paper (Figures 2f and 4❶).

Another problem with the design was the last task that asked the students to negotiate the knowledge domain related to open source, open access, and open content, and to design a documentary script for the Department of Education. Both the theory and practices associated with the two domains (openness and video scripting) made the task complex and difficult (Figure 2e). During the most recent

Table 1. Description of the authentic tasks used in 2008 and 2010.

Year	#	Authentic task description
2008, 2010	1	The school governing body has requested that your school put in place a five-year plan to design, implement, and evaluate the use of technology to support teaching, learning, and administration. Your principal has asked you to present to the school an appropriate evaluation instrument to conduct a base-line study at your school to determine the e-maturity of the school. After appropriate evaluation of the tool, your principal wishes you to undertake the base-line study and to present your findings as a research paper (constructed using word processing and spread sheet software)
	2	Use of information communication technologies in teaching and learning includes delivery of information, communication tools, development of social network through collaboration devices, and tools to transform information streams into more meaningful individually, or group, constructed knowledge. The predominant world view of e-learning is information distribution, or redistribution, and the use of technology as a surveillance device that supports Taylorism (production-line). The school board has requested that you develop a presentation to inform them of technological approaches/solutions that could be used to support the development of e-maturity within the school
	3	A number of your school colleagues are very concerned that the world views of their students are incongruent with their current teaching approaches and this is leading to acrimonious interactions in the classrooms. They also report that many students are very good at pattern recognitions, sense making in complex environments, and multitasking. You offer to undertake a small research project to better understand student world views as part of post-modernity. Your research results should be presented as a mindmap
2008	4	The open-source movement supports the development of software engineers in a collaborative, democratic, and negotiated system. Allied to the open source movement are concepts of open content and open assess. Open Software–Open Content–Open Access practices fundamentally challenge current globalized hegemonies and could impact and change educational practices. You have been invited by the Department of Education to prepare a script for a documentary to illustrate the role of Open Source, Open Content and Open Access in twenty-first century education. You will use a storyboarding approach to develop the script
2010	4	The open-source movement supports the development of software engineers in a collaborative, democratic, and negotiated system. Allied to the open source movement are concepts of open content and open assess. Open Software–Open Content–Open Access practices fundamentally challenge current globalized hegemonies and could impact and change educational practices. You have been invited by the web administrator of your school to develop a number of HTML pages for your school to show how Open Software and Open Content can be used in administration, and teaching and learning at your school
2010	5	You have been invited by the Department of Basic Education to prepare a script for a documentary on learning with technology in the twenty-first century classroom. You will use a storyboarding approach to develop the script

iteration (Figure 2f) of the course, these two activities were separated. First, the ideas related to open source, open access, and open content were used to develop web pages using *Weebly*, and the last task was to design a video script integrating all the concepts of the course (Figure 4❷,❸).

Table 2. Analyses of students' opinions from 2007 and 2010 to a number of questionnaire statements on the design and delivery of the ICT course.

Item	Score ± SE	
	2007 ($n = 67$)	2010 ($n = 27$)
Finding information for myself is a good way to learn**	5.16 ± 0.12	5.36 ± 0.18
Working in groups supported my learning	5.02 ± 0.13	5.05 ± 0.32
Working in groups is effective	4.53 ± 0.17	5.00 ± 0.27
By the end of the module, I learnt more than I expected**	4.90 ± 0.14	4.82 ± 0.28
I also learnt form information that other students found	4.95 ± 0.11	4.77 ± 0.25
I did not like the way the module was presented in the beginning, but I am now comfortable with it**	4.35 ± 0.15	4.27 ± 0.35
I would prefer to be given all my learning materials**	4.66 ± 0.16	3.95 ± 0.35
I think the lecturer should have taught more**	4.29 ± 0.19	3.86 ± 0.35
I would have preferred that the classes were more structured	4.39 ± 0.17	3.41 ± 0.35
The lecturer should decide who are in groups**	2.65 ± 0.22	1.91 ± 0.27

Note: **Wilcoxon significance < 0.005.

Table 3. Descriptive statistics for different courses.

Course	*N*	Mean	SD
Educational ICT	30	60.73	10.66
Research methodology	30	56.07	16.48
Education theory	30	50.07	11.33

The design of the course has therefore gone through a number of iterative redesign phases. The use of the course by the students is explored in the following section.

Evaluation of the design of the learning activities

Background

In this section, a number of research instruments were used to evaluate student opinions of the course and determine student performance in relationship to other courses that are part of the degree.

Research instruments

Three instruments were used to elucidate student opinion of the course. The first instrument (Figure 2d,g), answered by both the 2008 and 2010 cohorts, explored their opinions of the course using an open and Likert scale (1 – strongly disagree; 6 – strongly agree) items (Table 2). The open-ended items asked participants about their views of the course design and on intra-student communications. The scale questions related to the course design and use.

The second instrument (Figure 2h), answered by the 2010 cohort, asked participants to evaluate the course against the 10 authentic learning criteria

(Figure 5). This instrument also made use of Likert scale statements similar to the previous instrument.

The third instrument (Figure 2i), based on Stetsenko's (2008) acquisition–participation–contribution framework, was answered by the 2010 cohort (Figure 6).

Final examination results in this and two other course (research methodology and education theory) read by the 2008 cohort were used to evaluate student performance in relation to the educational ICT course (Figure 2j, Table 3). A number of criteria were used to identify other courses for this comparison of performance: contact time, identical student registrations, design of learning activities (authentic learning vs. lecture instruction), and assessment practices (portfolio vs. closed-book examination). The research methodology course taught students quantitative and qualitative research methodologies through the use of data they had collected and analyzed themselves – students had to demonstrate practical use of research methodologies. The assessment for this course was a portfolio that included a research report. The other course, education theory, is a typical lecture course that included essay writing and a final closed-book examination. The research methodology course could therefore be viewed as equivalent to the educational ICT course reported here.

Open-ended questions were coded using content analysis and statistical analyses were done using PASW Statistics (SPSS) version 18 from IMB.

Course evaluation – student opinions

Both the 2008 and 2010 students answered a number of questions related to the presentation of the course (Table 1). As the scale questions had a low internal consistency (Cronbach's alpha = 0.3), the responses were analyzed in relationship to analyses of the open-ended items. While both cohorts liked finding information themselves, the 2010 cohort responses were significantly more positive. Both cohorts rated working in groups as an important aspect in learning and wanted to decide on the members of their group. They thought that by the end of course they had learnt more than they had expected (the two cohorts were statistically different). Yet, some of the participants thought that they needed a more structured environment, access to all references and would have preferred lectures. These results are supported by the analyses of the open-ended questions where some of the participants wanted lectures and demonstrations. With respect to communication, most of the participants used cellular phones to communicate with each other and some used email.

Course evaluation – authentic learning

The 2010 cohort of participants reliably identified, and rated highly, most of the items of the internally reliable authentic learning instrument (Figure 5, Cronbach's alpha = 0.86). Students found that there was insufficient emphasis placed on reflective practices during classroom interactions and were less positive in terms of the production of polished products. However, most of their scores were towards the strongly agree side of the scale.

Course evaluation – acquisition-participation-contribution framework

The Stetsenko's (2008) acquisition, participation, and contribution framework was converted into nine criteria by three modes matrix of scaled statements that the

students in the 2010 cohort answered (Figure 6, Cronbach's alpha = 0.85). Most participants thought that the key definition of learning was about participation in a community and about collaborative practices ($p < 0.001$). However, they thought that learning was about knowledge, concepts, facts and content, cooperation, and construction, and were less positive about cultural tools and transformation ($p < 0.05$). Learning that stresses bonds between individuals and collective learning for change were rated significantly higher ($p = 0.001$) than learning that stresses the individual mind. Students were not able to differentiate between acquisition, participation, and contribution positions related to the role of the teacher, the nature of knowing, and where in the mind learning takes place. However, the contribution dimension for the best way to learn (self- and community development) and the time line of learning (planning for a future taking the past and present into consideration) were significantly more important to the participants.

While there were differences in the students' perceptions in relationship to acquisition, participation, and contribution modes of learning (Figure 6), they thought that contributing (5.03 ± 0.12) to knowledge development was more important than the acquisition (4.12 ± 0.13) and participatory (4.69 ± 0.11) modes of learning (Friedman significance < 0.001).

Course evaluation – performance

A 1×3 repeated measure analysis of variance tested for significant differences between three different courses (educational ICT, research methodology, and education theory). The means and standard deviations are presented in Table 3. There was a significant effect for course design, Wilks' Lambda = 0.48, $F(2, 28) = 15.35$, $p < 0.0001$, and multivariate partial eta squared = 0.523. The pair wise comparisons indicated that the education ICT and research methodology courses were significantly different to the education theory course ($p < 0.0001$ and $p = 0.006$, respectively) and that the educational ICT and research methodology courses were similar ($p = 0.25$).

Discussion and development of design principles

To overcome teaching and learning approaches that see technologies as tools for instruction, I argue that the activity framework of Engeström (1987) provides an appropriate heuristic for the design of classroom learning and teaching. In addition, the *object* of every learning activity is neither the motive of the learning (Kaptelinin, 2005), nor the consumption of information and educational technology. Rather, authentic tasks (Reeves et al., 2004) become the *object of the activity* and texts, educational technology, language, and cultural *tools* mediate the development of appropriate outcomes. While educational technologies are mostly designed to support instructional regimes of teaching and learning (Amory, 2010), I argue that when technology functions as a *tool*, it mediates knowledge construction. Consequently, learning and teaching should ideally be about contributing to society rather than the acquisition of information or the participation in the learning processes, as posited by Stetsenko (2008). The principles associated with activity theory, authentic learning, and tool mediation, the CAT framework, were used to design and deliver an Honors course on educational ICTs.

The work reported here is part of a design-based research inquiry with the intention to develop design principles to support future learning task design. Declarative principles include, knowing that:

- activity theory supports course design and evaluation;
- authentic learning tasks promote effective learning; and
- educational technology (as tools) mediates knowledge construction.

Therefore, a number of procedural principles also apply:

- use the activity diagram as a heuristic to conceptualize course design;
- implement authentic learning tasks as the *object*;
- incorporate educational technologies as tools to facilitate knowledge construction (a *learning with technology* position);
- reject course designs when education technology functions as the *object* (a *learning from technology* position); and
- use the activity diagram as a device to evaluate course design.

The design and evaluation of the ICT learning tasks are supported through the use of the activity diagram. Defining the *object of the activity*, the *tools* and the *rules* of the course supported students in their understanding of the requirements and allowed them successfully to complete the assignments. Due to the participants' inexperience in using educational technology, it was difficult to negotiate the institutional LMS but easier to make use of Google Groups. This system was easier to use due to the facilitator having direct control over the system and, in addition, demonstrated to the postgraduate student participants how they, as teachers, could use Google Groups in their own classrooms. While the students were not familiar with the participation, acquisition, and contribution framework (Stetsenko, 2008), they identified with many of the concepts and rated the contribution mode of learning as the most important aspect of teaching and learning. However, many of the participants firmly supported the idea that learning is about individual learning of information and skills. This is rather disconcerting that 10 years after the introduction of a social constructivist schooling system in South Africa, practicing teachers and district officials cling to instructivist notions of teaching and learning. More effort needs to be made to foster the idea that learning is about contributing to knowledge construction and the community.

The use of authentic learning tasks (Reeves et al., 2004) in the course allowed the learning objectives of the courses, the *object of the activity*, to be separated from the task. While participants found the approach difficult at the start of the course, by the end they argued that they had learnt more than they had expected to learn. The students were also able to identify the components of authentic task design and brought to the fore that more emphasis should be placed on reflective practices.

Technology was used in different ways within the course and included technology that supported the information stream (course readings available in Google Groups), communication (Google Groups and cellular phones), collaboration (Google Groups), and information transformation (Google documents, Google presentation, FreeMind, Weebly, and Story Board). The use of software tools to transform information form one form (normally text) into other representations (presentations, mind maps, web pages, and a story board) supported the learning

process and knowledge construction, and limited information replication. These products also supported the participants in their real-world activities.

This work, however, neither investigated how this design impacted on learning outcomes nor systematically evaluated long-term knowledge acquisition. However, student performance in this course was similar to the research methodology course and statistically better than the education theory course.

Work presented here integrated a number of contemporary ideas into teaching and learning task designs to develop a theoretical framework that supports learning mediated through the use of educational tools that support collective knowledge construction. This framework includes activity theory where the *object of the learning activity* is an authentic task supported through *educational technology tools* to transform not only information, but the world views of participants. In conclusion, additional research should be undertaken to more fully investigate the use of the CAT framework to support teaching and learning with technology, the applicability of this model to different learning situations, and to understand the learning process associated with such designs.

Notes on contributor

Alan Amory is currently Director of CenTAL at the University of Johannesburg and is interested in activity theory, the use of ICTs to support cognitive development and the role of computer video games in teaching and learning.

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