

Student-generated design principles for transforming an educational technology module

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Abstract: This paper reports on research where student reflections were used to derive design principles for the transformation of an undergraduate module to better address issues around the use of educational technologies in teaching and learning. The emphasis of this paper is on the derivation of design principles from student reflections after participating in authentic, collaborative, tool-mediated activities. Students' reflective reports were analysed for their content using simple coding techniques leading to the identification of themes and the derivation of design principles. Findings show that learning activities grounded in a defined theoretical framework markedly improved the depth of student understanding of issues related to teaching and learning with technology. The authentic nature of the activities also contributed to the depth of student reflections which ultimately led to meaningful design principles based entirely on the experiences of students.

INTRODUCTION: RESEARCHING EDUCATIONAL TECHNOLOGIES IN TEACHING AND LEARNING

Over the past years I have been involved in facilitating an undergraduate module focusing on the use of educational technologies in the teaching and learning process. I have long moved away from my initial practice of teaching *about* technologies in the early years of the module, towards a practice of teaching *with* the technologies in order to highlight best practices and exemplars of good pedagogy. Despite this change in teaching focus I was still finding it difficult to address the one fundamental issue that should concern all academics, namely the issue of research and publication, and how this research could ultimately feed back into my practice. The issue was highlighted even further after I took part in a change laboratory workshop (Engeström, 2007) presented by one of my research colleagues focusing on the very notion of driving research initiatives with a sound theoretical grounding. In this change laboratory, faculty members collaboratively evaluated their recent publications and teaching practices using a theoretically driven teaching and learning framework in order to identify problems and the causes of these problem. During this workshop, the production (tool-mediation) and consumption (information as the object of the activity) subsystems of activity theory (Engeström, 1987) were used as lenses to identify issues associated with research. The theory-praxis contradictions related to research that emerged from this workshop were found to be related to research that has limited theoretical grounding, or research that is aligned primarily to address practice only. Based on my participation in this process it was evident that I had to reconsider my teaching approach and associated research. No longer could I merely focus on improving my practice without also making a significant contribution to theory. In other words, the democratic and collaborative interactions during the change laboratory workshop exposed potential models of future activity (Engeström, 2007) that helped me with suggestions to improve both my teaching and my research output, while at the same time adding to the body of knowledge in the field of educational technology.

Based on the scenario described above which was conceptualised by a small research group comprising myself and two other senior faculty members, we set out to reconceptualise the learning activities in an undergraduate module and began by introducing some basic theoretical frameworks that underpin the teaching & learning process in the field of educational technology. This was done with the ultimate goal of incorporating research into our practice. Design-based research, otherwise known as *design experiments* (Reeves, 2000; Brown, 1992; Collins, 1992), *development research* (Reeves, 2000), or *design research* (O'Donnell, 2004) was selected as a suitable design to address the goals of the research. Design-based research (The Design-Based Research Collective,

2003) was, ultimately, chosen to address the notion of teaching and learning with technology as a result of its potential to make improvements to the practice of teaching as well as to theory.

WHY TRANSFORM THE WAY WE TEACH USING EDUCATIONAL TECHNOLOGIES?

Since 2001, educational technologies, or what the South African Education Department refers to as “Information and Communications Technology” (ICTs) have become more commonplace in education. In 2003, the education department admitted that the process of teaching and learning was changing (Gauteng Department of Education, 2004) and since then it has become increasingly important for teachers to become equipped with skills in order to use ICTs in their professional teaching and learning activities. To this end, we facilitate a module in the undergraduate teacher development programme to address the use of educational technologies for teaching and learning. In the past, I implemented a project-based approach where students had to incorporate educational technologies into the planning and creation of a series of learning activities including the artefacts or ‘products of learning’ related to these activities. These activities or artefacts ranged from project plans to concept documents, videos, and presentations which were ultimately presented as part of an electronic project portfolio that highlighted the use of educational technologies in this process.

I was still, however, uncomfortable with certain issues within this module that seemed to perpetuate what (Amory, 2010a) terms a neo-liberal concept of learning. The module had moved away from a conveyor-belt driven behaviorist ideology but still included a lot of surveillance and automation (Amory, 2010b). Students wanted to be ‘spoon-fed’ and guided or led through the process of learning which meant that we were still very much ‘instructors’ for certain periods during the contact sessions. Due to the complex cultural mix within the class, and a vastly divergent access to educational technologies, certain learning activities also seemed to disenfranchise specific race groups and those who had limited access to the technologies. Similar scenarios have been reported within the South African context (Amory, 2010c). There was also a definite lack of exposure to collaborative tasks with students being used to working very much on their own. The most important issue that we identified was that students still wanted to perpetuate the notion of the *technology as a tool of instruction* (Lautenbach, 2010).

In order to address the outdated notion of technology as a tool for instruction it was our first priority to move away from the word ‘*instruction*’ towards the notion of ‘*teaching and learning*’ with educational technologies. When it comes to issues of pedagogy and the role of technology, some authors believe that technology can change pedagogical practices (Jung, 2005). Others maintain that computers can even teach in the absence of humans while some say that computers have the potential to mediate the very activities that define people’s everyday lives – “how they learn, how they think, how they socialise” (Weizenbaum, 1993). A more contemporary view on this matter is that technology should rather support complex human, social and cultural interactions (Amiel & Reeves, 2008) and to this end it was decided to adopt this viewpoint in the re-conceptualisation of the module. The other guiding factor in this re-conceptualisation process is the notion that learning should be *research-based* with *high theoretical and practical value* (Stokes, 1997). In researching this process it was, therefore necessary to ground the learning activities in theory related to the field of teaching and learning with technology.

INTRODUCING THEORETICAL FRAMEWORKS THAT UNDERPIN THE PROCESS OF TEACHING AND LEARNING WITH TECHNOLOGY

Introducing theoretical frameworks at an undergraduate level to pre-service teachers has proven to be a complex issue in the past. Informal discussions with lecturers within the Faculty of Education have led me to believe that the exposure to theory at the undergraduate level is minimal. Moreover, it has also been found that use of literature as a framework for the development of an argumentative style of academic writing and engagement with theoretical constructs is sorely lacking in most postgraduate research reports (Agherdien, Henning, & van der Westhuizen, 2007). When used, students struggle with the complexities of theoretical constructs. In many cases they have not had the opportunity to read and engage with theory in other undergraduate modules. A *lack of reading*

is blamed by some academics but I contend that students are often left in the dark regarding ‘*what*’ they should be reading. There is often not enough thought put into the choice of prescribed texts that are used in some modules and students are sometimes skeptical about what they see as unnecessary or meaningless texts. For this reason, grounding the educational technology module in some theory had to be carefully thought out and planned. On the one hand there was the risk of losing students through unnecessary complexity and on the other, the use of insubstantial theories that would not suitably address the issues at hand. Different ideas on what a theory really is also confounded the issue. To compensate for this we chose to introduce the students to the basic principles of only two theories. Discussion around these issues was maintained at a suitable level through the design of learning activities that prevented undergraduate students from engaging with the theories at a superficial level. On the other hand, the facilitators did not expect them to understand the underlying complexities of the theories. Only a basic grasp of the concepts and ideas associated with these theories was envisaged in introducing undergraduate students to theory at a basic level.

The first theoretical construct deemed useful to this study was the Vygotskian concept of *tool mediation* (Vygotsky, 1978). The Vygotskian *actor-object-tool* triad was presented to the students and simply described as a precursor to Cultural Historical Activity Theory or CHAT (Engeström, 1999; Engeström, Miettinen, & Punamäki-Gitai, 1999). The complexities of CHAT, where *tools* mediate activities within contexts that include *Community, Division of Labour* and associated *Rules* (Engeström, 2000 and 2001; Barab, Evans, & Baek, 2004; Roth & Lee, 2007) were not addressed in much detail but knowing that tool mediation was part of a greater body of knowledge, students seemed content in the reality that they were only expected to understand and incorporate a ‘part’ of the theory. They seemed safe in the knowledge that we were allowing them to grasp theoretical constructs gradually. Students were subsequently exposed to the notion of technology functioning as the mediating tool throughout all learning activities in the module. In these learning activities, the focus was not on the technology as object in an activity theory context (Amory, 2010c) but rather on the learning where the technology simply functioned as the mediating tool (Lautenbach, 2010).

The second theoretical construct useful to this study was the concept of *authentic learning* (Reeves, Herrington, & Oliver, 2002) as the *object of the activity* (in an activity theory context). The nine characteristics of authentic tasks identified by these authors were initially presented to the students as a theoretical construct (within an authentic task about authentic tasks) and subsequently throughout the module in all other authentic tasks and activities. These tasks had *real-world relevance* (were meaningful to students and could be applied to their current situations or contexts – that of pre-service teachers) but were *suitably ill defined and open to multiple interpretations* to enable students make their own meaning of the tasks and the methods they utilised to complete the tasks. Despite this, the authentic tasks were *complex* enough to elicit higher order thinking and *provided opportunities to include different perspectives*. The large and diverse group of students from a number of educational disciplines and subject methodologies required that the activities could be applied and *integrated across different subject areas* while also providing opportunities for *collaborative interaction*. Students were made aware of possible *competing answers or solutions* and were taught that there is not only one solution to educational problems. *Assessment was integrated* throughout the module activities and was not only limited to *products of learning* with educational technologies, but to *processes* involving these technologies too.

RECONCEPTUALISING AN UNDERGRADUATE MODULE: A METHODOLOGY TO ELICIT DESIGN PRINCIPLES

In this module, undergraduate student teachers participated in authentic, collaborative, tool-mediated (using educational technologies) learning activities as a purposeful teaching and learning strategy rather than a once off classroom technique. Using Stetsenko's (2005) notion of transformative action that “people constantly transform and create their environment” we were of the opinion that students would also create and constantly transform their learning, “consequently changing themselves in fundamental ways and, in the process, gaining self-knowledge” (Stetsenko, 2005; Stetsenko & Arieivitch, 2004). Stetsenko maintains that “an activist transformative stance suggests that people come to know themselves and their world as well as ultimately come to be human in and through (not in addition to) the processes of collaboratively transforming the world in view of their goals” (Stetsenko, 2005). To this end we maintained that student activity infused with authentic, practical, and social collaborative processes

would help them transform the way they saw educational technologies in their learning. Subsequently, students were exposed throughout the module to the theoretical frameworks of authentic learning and the Vygotskian actor-object-tool triad. This approach, based on the notions and processes of authentic learning and tool-mediation, drove the reconceptualization of the educational technology module and allowed me to *research* student experiences in this restructured module. These students were the first cohort to engage with the theory-based learning activities. Student reflections written as part of the final assessment were subsequently used in the research process to derive design principles to inform future implementations of the module.

In conceptualising this study we firstly drew on Boyer's (1955, 1956) notion of scholarship where it is noted that *discovery should be shared and teaching should be researched for its outcomes*. Boyer's notion of scholarship, as formulated while at the Carnegie Foundation, and in particular the scholarship of Discovery, Integration, Application and Teaching have particular relevance in this study. This work is revisited in the highlights of the Carnegie report (Boyer, 1991) where Boyer claims that Discovery (research) is mere pedantry if the other scholarships are not considered. For myself as researcher, and particularly in the context of this research endeavour, I concur that discovery should be shared through both publication and teaching. Furthermore, teaching should in turn be researched for its outcomes, not only in terms of its pedagogy, but in terms of the effects of its content.

Secondly, we draw on the work of (Stokes, 1997), who proposed that Basic Research and Applied Research are not at the opposite ends of a continuum, as is commonly believed. Stokes argues that the motivation for research may either be for 'fundamental understanding' or for 'practical use value'. These motivations can be combined in various ways, and he uses four quadrants to map the various levels. For example, the outcome of research could have a low or a high basic understanding value, or a low or high application value, or some combination thereof. Ideally, research should make a contribution to fundamental understanding (theory), as well as have high practical value.

Thirdly, we draw on the activity theory work of (Engeström, 1987), and in particular the notion that in the activity of teaching, knowledge production (as opposed to information consumption) should be achieved when tool-mediation overcomes the subject-object contradiction (Engeström, 2008). In other words, the undergraduate student teacher (the subject in activity theory terms) must start to see the educational technologies (the mediating artefacts) as tools and not as the object of the activity. In many cases this is the problem where students focus on the technology and not on the process of teaching and learning. For this reason, learning activities in this module were reconceptualised based on a simple theoretical underpinning and the technologies were relegated to the background of the authentic tasks with the focus mainly on the teaching and learning process.

In this research process we have also attempted to address the notion of *socially responsible research* (Reeves, 1995; Reeves, & Amiel, 2000) by addressing problems that detract from the quality of pre-service teacher training, especially those problems related to teaching and learning with educational technologies and teacher development in general. An eclectic, pragmatic, mixed methods approach is another option that could have been used to address this issue but for this first iteration of the research process we selected design-based research for a number of reasons. Design-based research (DBR) involves conceptualising research to coincide with the development of practice. The central notion is design. In education this central notion is, in fact, pedagogic design. In order to develop and study a theory-driven pedagogical intervention, (Barab & Squire, 2004) propose using design-based research "in situ." To this end, we set out to analyse the specific problem of teaching undergraduate student teachers about educational technologies. The design of the inquiry was based on the logic of design-based research as illustrated in Figure 1.

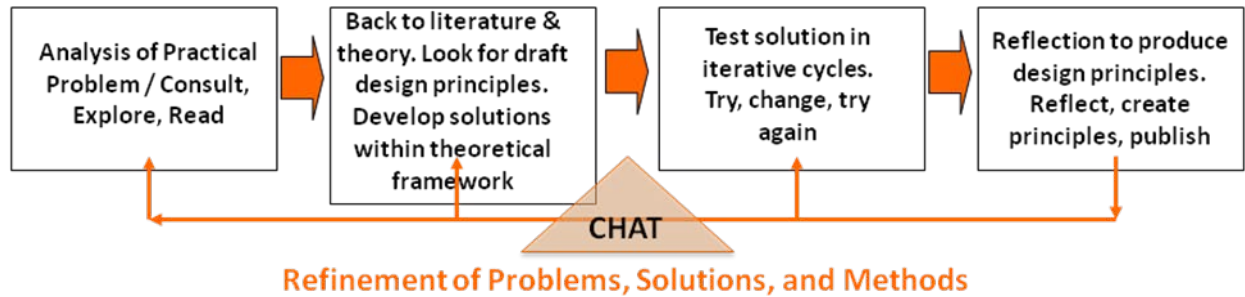


Figure 1: The design logic of design-based research (adapted from (Reeves, 2000))

We firstly consulted with the students personally and engaged with them in a discussion on the topic followed by an exploration of the literature related to this field. Based on these activities we subsequently set up the initial learning activities based on design principles derived largely from the literature. Most of these design principles were ‘common sense principles’ that should work in the design of any generic module on educational technologies. The only principles that were not addressed in this first iteration were those related to grounding learning activities in relevant theory. For this reason, the first iteration of the process was very much based on some theoretically grounded principles and some personal preferences and intuition. These activities were placed within an online course module within a course management system that was used to supplement the face-to-face sessions. Throughout the initial cycles of designing and re-designing the authentic learning activities we went back to the literature looking for clarity and attempted to develop solutions for the reconceptualisation of the module, but always within the parameters of the chosen theoretical framework. This first phase, symbolized by the first part of Figure 1, analysed a practical educational problem in a specific real life context and was typified by consultation with students, exploration of their ideas and their engagement with the tasks, and consultation of all available literature on the topic.

Phase 2 of the design, which is depicted by the second part of Figure 1, involved a qualitative analysis of student reflections on the teaching and learning process in the module. These reflections were provided by students as reflective reports submitted as part of their final examination portfolio. These reports were analysed for their content using simple *in vivo* coding techniques (extracting direct quotations from the text) which were then grouped into themes. Each theme was refined and re-written as a design principle using appropriate verbs (which is also very much in line with the notion of activity within an activity theory context. It must be noted that although we did not expose students to the full extent of activity theory, and limited their theoretical exposure to the Vygotskian mediational triangle we did use the framework of Cultural Historical and Activity Theory (CHAT) as the guiding framework and analytical lens in formulating the design principles. It was within this framework that we derived the draft design principles for the future implementation of the module. These principles have been implemented in the second iteration of the module this year and should lead to the formulation of the final design principles and the publications that will ultimately make another contribution to the theory in which this study was grounded.

FINDINGS AND DISCUSSION

Using Stokes’ quadrants as a guide, this research may be seen as having *high application value* with a *greater level of theoretical understanding* than in the past. This research, dealing with a real educational issue, addresses a complex educational problem in a real classroom context in direct collaboration with the practitioners (in this case, the undergraduate student teachers). The process has paved the way for improved teaching combined with research as an integrated phenomenon.

In this paper we have introduced a theoretically driven framework implemented for a dual purpose, firstly to ground the learning activities in an undergraduate module on the topic of using educational technologies for teaching and learning in theory, and secondly to improve the research endeavour in an Education Faculty by adding productively to the existing body of knowledge in the field. Furthermore, the academic and research endeavours underpinning this research regards discovery and teaching as a scholarly enterprise that leads to *production*. The

production of research output in this faculty has long been considered to be below par and I have confirmed in this research project that a theoretically driven research framework, using design-based research as an appropriate methodology, is an appropriate way to satisfy the demands of institutional managers to improve research performance. This production is evidenced in the formulation of design principles for the re-conceptualisation of the module. Using data derived from student reflections, a number of design principles for the re-conceptualisation of this module have been drafted. These preliminary design principles, and their origins in student reflective paragraphs, are described in the following section:

Comments like “*the module was relevant to modern day life*” and “this was relevant to my future career” led to the formulation of the first design principle, namely: **keep activities relevant**. This principle is indicative of the need for module facilitators to relate learning activities to what is happening in real life. Keeping up to date with modern trends, evolving technologies, and having knowledge of varying student contexts will help module facilitators to create tasks that are meaningful. A second related design principle is: **see authentic learning as the object of the activity** (This principle emerges directly from the theory used to underpin the student learning activities, namely the Vygotskian mediational triangle). Furthermore, principle three demands that facilitators **provide activities that model real life**. This principle sounds superficially like the first two (one could argue for example that words like relevant, authentic, and real life are very much the same) but this one differs in that it refers to learning by following examples of good practice and from the actual use of the tools. Students commented “*we could learn by example and model our teaching on good practice*” and “*we used different technologies that are applicable in everyday life.*” Other students claimed that they gained other real world skills beyond subject content and that “*it does not end in the classroom... it ends in the world out there*” once again confirming the need to make activities applicable to the world of the student.

A fourth design principle, related in many ways to the first one mentioned above but very different in one aspect is **keep activities relevant (and fun)**. The element of fun emerged in almost all of the comments made about the learning tasks that students had to complete. Students commented that creativity is essential to the design of a good authentic task: “*tasks were creative and made learning fun.*” They also added that the fun aspect “*made the tasks lighter and made learning easier and fun*” and that “*it made learning intriguing and fulfilling.*” Some suggested that “*it is better to use different and unique ways to maintain interest*” while others pointed directly to the role that educational technologies can play in these activities: “*technology allows for deeper learning and makes it more fun.*”

The fifth principle, **create opportunities for learning**, was derived from comments that were made about the actual learning activities that students found helpful. “*The practical nature was helpful as we normally learn facts and theories but struggle to apply them in our teaching*” speaks to the notion of moving away from trying to teach theories and rather including them as part of the integrated theoretical framework that drives the teaching endeavour. Another student commented on the freedom to derive their own meaning from the learning activities: “*I was amazed at the possibilities that authentic tasks and a constructivist approach had to offer.*”

The sixth principle reminds module facilitators to **contextualise learning activities**. Country specific innovations and differing contexts demand that we think critically about teaching and how educational technologies can be used to strengthen the local perspective. Students commented on the need to focus on country-specific contexts: “*we learned about innovative ways to implement ICTs in the South African context.*” In some cases students were very thankful that they had been expected to use the technology to explore and construct concepts and relationships in contexts that were particularly relevant and meaningful to them. Besides contextualizing the learning activities it also emerged from the analysis that it is important to **engage students in a variety of tasks**. Students admitted that “*learning was not monotonous*” as a result of the authentic learning activities that were implemented. They also recognised that “*teachers do not need to stick to one technique*” even when dealing with large groups of students. The eighth principle offers a suggestion to add to the variety of tasks mentioned above. We are reminded to **accommodate learner needs** and we are reminded that student needs are very different to those of students from a few years ago. Comments like “*learners are hungry for technology*” and the plea for lecturers to “*use the things that we love*” act as reminders that students wish to use the technologies that are familiar to them in their learning.

Theory informed the conceptualisation, implementation, delivery and assessment in this module and grounding the learning activities in a defined theoretical framework, albeit a simple one for the undergraduate level, seemed to improve the overall depth of student understanding of issues related to educational technologies in teaching and

learning. They recognised the teaching and learning strategy and were able to link this strategy to the theoretical principles underlying the learning activities. This is evidenced in statements like “*each task required us to incorporate technology somewhere in the activity*” and “*the module increased my computer skills without focusing on them.*” In fact, most students admitted in their reflections that they had experienced a marked improvement in their understanding of the outcomes of the module. Many students actually got straight to the point and admitted to now seeing educational technologies as tools or mediators in the learning process “*tasks varied and technology was always the tool*” and this can be seen as a huge change in their mindsets since the outset of the module: “*it is about using technology for creating the spaces for learning to take place.*” Students saw the potential of using a variety of technologies for teaching and learning ranging from the Internet itself and educational games: “*even websites can be used as a tool for learning*” and “*I learned many things while playing the game. The game was the mediator.*” From this evidence it can be seen that educational technologies have found their rightful place in the minds of students as *tool-mediators* rather than as the *object* of the learning activity. The design principle derived from this is ***promote the tool as mediator.***

Students also warn, however, that it is still important to ***develop a structure to underpin the activities.*** Students admit that “*having a framework to help me think was fantastic.*” Expecting students to learn without basic structure or guidelines is not recommended. Principle number eleven builds on the previous one and suggests that lecturers ***establish a schedule to actively engage students.*** It appears that students want to be actively engaged and do not mind a busy schedule if it is in fact meaningful: “*we were kept busy every week with tasks but they were still enjoyable.*” In fact students “*looked forward to learning each week*” and did not seem to notice the fact that they were actually engaging with learning activities on an ongoing basis. The comment that “*the activities were challenging to me and required lots of work*” also indicates the importance of developing a schedule but also shows that lecturers should ***expect more from students.*** Higher order thinking skills are evidenced in the statements: “*we had to critically engage with the text*” and “*we had to do things ourselves*” while the comment “*we gained self discipline and other skills when given the authority to manage our own learning*” indicates a maturity in the thinking of these undergraduate students.

The last preliminary design principle suggests that lecturers ***encourage collaboration and participation.*** Collaboration allowed students to share opinions and thoughts on course-related matters and allowed students to see that “*learners can also contribute.*” For some students this was a learning experience in its own right: “*I saw the power of learning together for the first time*” while for others it opened new doors to the potential of learning together: “*I would have liked even more collaborative tasks and to be able to discuss and hear others’ views.*”

In general, the authentic, participatory and collaborative nature of the module contributed markedly to the composition quality and depth of student reflections. This paper reported on the initial phases of an ongoing design-based research process which ultimately led to the derivation of design principles which were in turn both meaningful and grounded in theory. It highlights the generation of draft design principles from student perspectives. These principles have their origins in the specific theories underpinning the learning activities that were used in the teaching and learning process, and contribute once again in an innovative way to this same body of knowledge. This *theory-driven praxis* has resulted in *research* which makes a contribution to both educational theory and teaching practice. More importantly, this can be seen as meaningful research that is socially responsible, with a high theoretical and practical value.

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