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Developing a Lecturer Workshop for Using Tablets in the Classroom

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This paper is about a framework as heuristic to design and develop a workshop for academic teaching staff to use tablets for teaching and learning in the classroom at the University of Johannesburg (UJ). Theories of Cultural-Historical Activity and Engeström's activity systems are also incorporated, as are a critique and a critical analysis of the progressive development of a workshop focusing on tablets in the classroom. Currently, mostly first-year student lecturers are involved: 150 participants attended six workshops over six months. The research question incited the following design-based research: how is a workshop developed for lecturers to use tablets for teaching and learning in the classroom? The phases of this include a review of the needs analysis, formative development, evaluation of effectiveness, and documentation, which serve as the outline of this report. Findings and conclusions are presented around interactions, collaboration, use of open spaces, formative assessment, progressive skills development, and a short evaluation.

Technological developments in higher education brought about many infrastructural changes affecting the way we teach and learn. This paper starts by describing the context of the comprehensive University of Johannesburg, South Africa, and how its mission derived drives for using tablet devices in the classroom. The use of tablets in the classroom consequently demanded an interactive workshop to be designed and implemented with academic teaching staff. This task was accepted by the Centre for Academic Technologies (CAT) at the university. The research problem for this research is situated in the question: How is a workshop developed for lecturers to use tablets for teaching and learning in the classroom?

This paper describes how a newly implemented theoretical framework (CAT framework) is used as heuristic which encapsulates the Cultural-Historical Activity Theory (CHAT), Vygotsky's basic mediated action triangle, and Engeström's activity systems theory. Thereafter, the research design and methodology is discussed as design-based research also known as a design experiment. The phases of the design experiment set the layout for the sections in the paper to follow. A review of the needs analysis (phase 1) becomes a detailed discussion conceptualising, rationalizing, and applying theory into the design of the workshop. The second and third phases are integrated and, as far as possible, applied to the general design of the workshop. Attention is given to incorporating principles of scaffolding and flipped teaching, e-handout development, and the expected objectives the workshop attempts to achieve.

Thereafter, the sequence of activities is given in table format and focuses on interactivity and iterations. Findings and conclusions are presented under the following headings: "Interactions and collaboration," "Using an open space for video files," "Streamlining formative assessment," and "Progressive skills development", followed by a short evaluation. Thereafter, a summary of the paper is given.

Context and Rationale

In May 2011, University of Johannesburg (UJ) disseminated strategic drives to fulfill its mission by 2020. Eight strategic drives emerged, of which the second drive is related to teaching and learning with technology and is formulated as: "A reputation as a comprehensive institution with a unique identity in the higher education sector because of the stature and quality of its scientific and technology-rich programs and its scientific and technology-driven research, innovation, and technology transfer" (University of Johannesburg, 2011, p. 5). The second drive has further been motivating the setup and infrastructural changes needed to accommodate mobile access for staff and students. This manifested over four campuses, one of the largest wide area networks in the southern hemisphere which has also become Wi-Fi compliant with various hotspots. Moreover, tablet devices have been rolled out to all first-year students phasing through to senior students over the next three years. Therefore, the institution was infrastructural ready for pedagogies involving tablets in the classroom. Until 2014, tablets have not been used interactively in the classroom. Successively, since 2014 the roll out demanded teaching staff to be familiarized with using tablets. CAT at UJ accepted the task to professionally develop teaching staff in this regard.

CAT is a multifunctional professional academic support service center. One function is that of the Teaching and Learning Consultants (TLCs), who serve nine faculties. "[T]he role of the instructional designer is diversifying and expanding to encompass a range of tasks beyond those prescriptively described in a systems approach" (Visscher-Voerman & Gustafson, as cited in Seeto & Herrington, 2006, p. 741). The authors extrapolate that design for teaching and learning is evolving towards "more constructivist learning environments in higher education [which] has also

changed the traditional instructional design role…" and that "… this is perhaps evident in the change of title that is preferred by many such practitioners – from instructional designer to *educational designer* or *learning designer*" (Seeto & Herrington, 2006, p. 741). In this paper the term *learning designer* will be used.

The same authors advocate that a learning designer is often difficult to access, which is not the case at UJ. However, what limits most learning designers is the fact that they are usually involved in the process of designing and developing new pedagogies, delivery strategies, resources, and interactive and dynamic learning environments, yet, they are rarely involved during the implementation and evaluation stages of such learning environments. From this stance, Seeto and Herrington (2006, pp. 742-743) agrees with Reeves and Hedberg (2003) in that "… they can extend the reach of their evaluations and contribute to design principles regarding interactive learning systems through a process called development research." The authors concur that *development research* (also *design-based research* or *design experiments*) is an adequate research approach, which is "particularly suited to the exploration of significant education problems and technology-based solutions – the kind of challenge faced every day in the working life of a learning designer" (Seeto & Herrington, p.741). Hence, this research does not only deliver such a design-based description but also serves as an extension of the role of the learning designer as researcher. This paper is about the process followed through a design experiment extensively to develop a workshop for teaching staff, which will enhance and motivate the use of tablets in the classroom. The essence is to establish underlying pedagogical principles in teaching staff who endeavor to use tablets in the classroom with their students.

Theoretical Foundation

The literature which relates most to this research is situated around Design-based Research Theory, Activity Theory, and specifically Cultural Historical Activity Theory, as well as the flipped classroom approach (Rosenberg, 2013). These theories are considered in this research because they impact on interaction design and also on design interaction (Kaptelinin & Nardi, as cited in Codio & Quek, 2011). Codio and Quek (pp. 2-3) also explain that theory is important during the design of activities and suggest practical reasons to use theory when developing interaction designs. Subsequently, the named theories will be used in the following discussions and will be contextually related to this research as far as possible. This section will thus become the theoretical foundation to the sections hereafter as part of the design experiment used to conduct this research.

Cultural-Historical Activity Theory (CHAT)

CHAT is a complex theory with aims toward activity and interactivity. The constituents of activity theory are stipulated by Kaptelinin and Nardi (2006) and summarized by Codio and Quek (2011, pp. 2-4): "Activity theory [*per se*] emphasises the importance of studying real-life use of technology as part of unfolding human interaction with the world." Codio and Quek (2011, pp. 2-4) summarized the principles of activity theory to be: object-orientedness, internalization/externalization of activities, interpsychological versus intrapsychological functions, mediation, and development. In brief, the hierarchical structure of activity consists of three levels and five principles:

- Level 1 − the relationship between the activity and its motive;
- Level 2 − the relationship between the actions taken and the goals to be met;
- Level 3 − the operations taking place and the conditions under which the operations take place.
- Object-Orientedness: The principle directly aims to an object which exists in the real world. In this study the object would be a tablet which needs to be mastered.
- Internalization/Externalization: Activities occurring both internal and external of an activity system emphasizing conversion from one to the other. Thus, they cannot be analyzed as they are distinguishable but inseparable. The iterative nature of this design experiment makes this principle more apparent during the *development* and *evaluation* phases (see Figure 3).
- Interpsychological versus Intrapsychological Play: This is a dichotomous play between two stages of the development of mental abilities (Vygotsky, 1986). When mental abilities are shared between the learner and other people, these abilities become interpsychological. When the sharing (social distribution) of these mental abilities is no longer necessary, they become intrapsychological within the learner. In this study, the interchangeable play between interpsychological and intrapsychological manifests during the last two activities.
- Mediation: This is the interplay between internal and external activities, also the way in which an external activity is influenced as a direct effect of internal activities. Tools directly influence interaction with reality. Consequently, tools are created, adapted and

transformed while an activity develops and progresses. Tools therefore hold specific values and principles, which mediate an activity to ultimately lead to the objective of the activity. The mediated action is a process, however as human activity, it is actually a series of processes contained within a bounded system (Yamagata-Lynch, 2010, p. 20).

- Development: This brings forth which factors influenced human interaction with reality over time. Thus, the importance of understanding the manner in which the tools are used over time also gives us an understanding of how the tools become more useful and efficient. This interplay and *tool mediation* will become clearer as CHAT is incorporated in the activity design of this research.

Furthermore, the development of the activities and interactions of a workshop will largely be design-dependent on these five CHAT-related principles. However, these principles and their constituent elements are dynamic upon adaptation to the learning environment. This standpoint introduces *mediated action* as a concept and explains the interaction with artifacts, tools, and other people in an environment which results in individuals finding new meanings in their world – this is a semiotic process which enables human consciousness development (Yamagata-Lynch, 2010, p. 16).

Identification of Bounded Systems for Activity System Analysis

The third generation activity theory involves a researcher investigating an activity system by means of facilitation to help learners to experience change. Engeström (1999) postulated that researchers should analyze the interactions in such a system. It becomes inevitable that once interaction has taken place on both social and cognitive level, these activities have boundaries. Once the boundaries have been identified, further investigation can lead to further identification of potential development and changes in human activity and contextually in societal systems (Yamagata-Lynch, 2010, p. 25). Yamagata-Lynch agrees with Engeström: "In order to engage effectively in these types of studies, investigators need a framework that will help them identify boundaries within complex systems. This boundary identification framework will guide the investigators' design, development, implementation, and analysis processes" (p. 25). He further proposes that investigators should develop questions which address activities that mediate. Moreover, Yamagata-Lynch (2010, pp. 25-26) extrapolates: "Investigators then need to design the data collection methods to specifically capture information that will enlighten them about their participants' mediational processes." Amory (2012, pp. 4-5) summarizes the interactions of an activity system (shown in Figure 1) by raising the role of technology in such systematic interactions. He clarifies concepts which are often confused and interpreted from various perspectives, including the following:

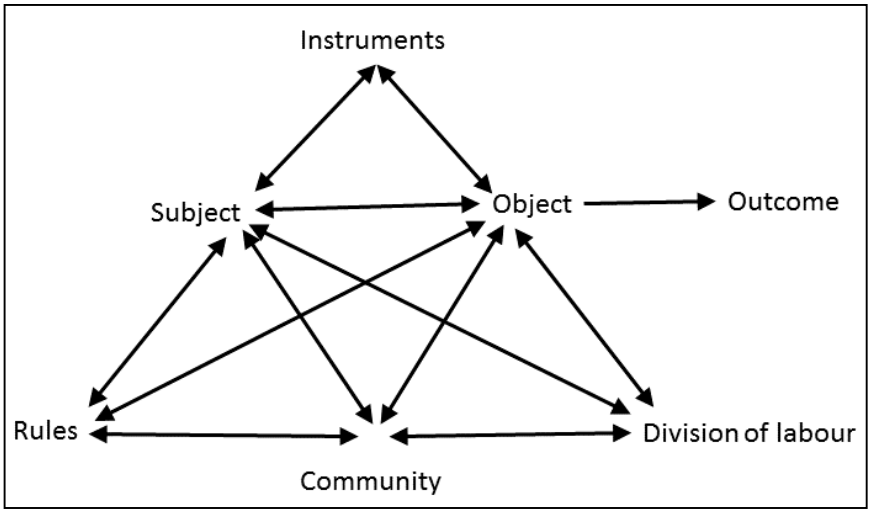
- Tool mediation: the concept of learning with technology (as opposed to learning from technology);
- Object of activity: learning from technology, and
- Actors: people who use a course management system. In such a course management system, three mediators of an activity are affected: "the *tool* that functions at the psychological level, the administrative *rules* that can be disruptive and stakeholder groups that play different roles (the *division of labour*)" (Amory, 2012, p. 4).

Considering the need to professionally develop teaching staff to purposefully interact with students in a classroom by means of a tablet, a workshop should thus be designed. This workshop needs to be activity-based and the activities should be authentic. This brief description of the immediate needs analysis gives way to make use of a heuristic based on CHAT. Such a heuristic is the CAT framework used by CAT.

The CAT Framework

This framework is rooted within the Vygotskyan paradigm of social constructivism. Later developments have brought about CHAT wherein other variables such as culture and history assume integral, interpretive roles. One such a role is technology as a mediating tool. However, the common interpretation of using ICT in education is often confused with the notion of learning *from* technology and not by learning *with* technology (Amory, 2012, pp. 4-5). He argues that technology holds the potential to support individual transformation but "the technological tools are mostly designed and used to support instructivist practices" (Amory, 2012, p. 5). He further poses that the social constructivist understanding of tool mediation (CHAT) and the familiar, collective use of educational technology (instructivist) could be solved if ICTs were to be used in teaching and learning as: information stream; enabler of communication; enabler of collaboration; information transformation tool, and professionalization tool. Amory (2012) concludes that: "[e]ducational technology can thus act as the mediating artefact to support knowledge construction in a designed activity system…" and that "[t]he use of

Figure 1
Activity System Diagram



*Note. Adpated from Engeström, as cited in Amory, 2012

CHAT, collaboration (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" (pp. 4-5) Therefore, the CAT framework is used as heuristic for this research. The CAT framework is given in Figure 2.

Learning by doing is the key concept substantiated by the paradigm of learning *with* technology and not learning *from* technology. Moreover, interactivity as key concept is integral to CHAT and needs to be incorporated as part of professional development. Interactivity in the classroom implies not only incorporating the latest teaching and learning technologies, but also shifting from a Socratic, chalk, talk, and demonstrative way of teaching to a diverse interactive learning experience for both lecturer and student.

Workshops and professional development learning experiences for teaching staff are developed according to the CAT heuristic and teaching staff is also familiarised with the concept. Original expectation as seen from what Reeves mention as teacher mishap ICTs e.g. as a substitute for a textbook etc. (Reeves, 2014a).

Research Design and Methodology

The research approach to this study is a design experiment. Many authors suggest this approach where new and innovative ways and working with new technologies are being discovered (Parker et al., 2013). Prevalent from a recent workshop presented by Professor Tom Reeves at UJ, Reeves (2014a) places emphasis on the use of tablets for teaching and learning and how acclimation to these new and innovative devices should be researched by using designed-based research. However, he emphasizes in another workshop (Reeves, 2014) that tool mediation is apparent as it is about learning *with* the technology and not about learning *from* the technology. Reeves further encourages three goals to be used during educational design research:

1. Examine what we believe about teaching and learning, what we believe about technology used for this purpose, and what we believe about our students. In this research, various learning theories will be used to clarify how a workshop can be designed as to familiarize lecturers on how to use tablets as a teaching technology in teaching and learning. This happens under the title of "Using Tablets in the Classroom." See Figure 3.
2. Encourage the design of authentic tasks that will support student learning. This places the focus on how tasks should be designed to have lecturers gain insight and knowledge about pedagogy for teaching with a tablet in the classroom with the aim of actual authentic learning to be implemented.
3. Educational research should be re-orientated from doing research about "things" to attempting research on the challenges which face us within the educational realm.

Figure 2

The CAT Framework (Amory, 2012)

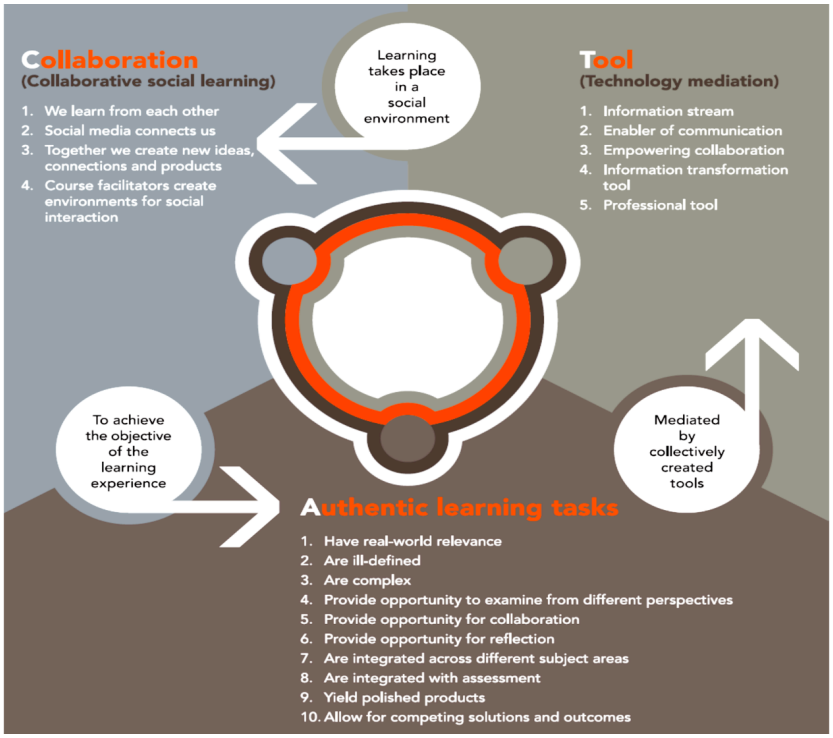
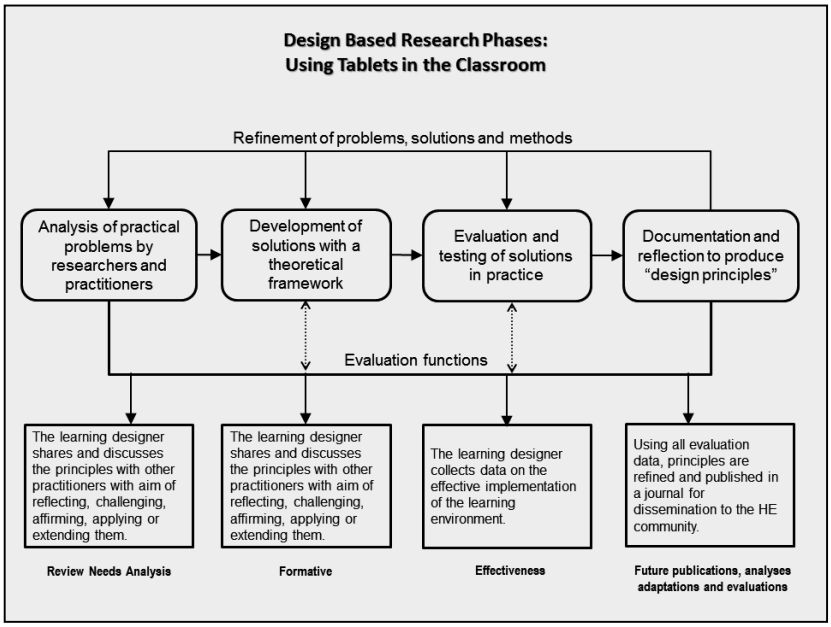


Figure 3



Design-Based Research Phases

Note. Adapted from Seeto and Herrington (2006, p. 743)

Reeves (2014) also mentions that the focus on over exhausted and inundated topics should rather focus research on problems that really impact on the South African education system.

Review of Needs Analysis

Apart from the second drive to roll out technology in teaching and learning at UJ, the basic need for teaching staff to acquire skills to basically operate electronic devices had always been the focus. This has been substantiated by training staff on how to become comfortable to use a device. The challenge escalated when sound pedagogical use of the learning management system (LMS) became priority because of an increasing number of students, limited number of venues, and a push from students who are *au fait* with using various technologies. Consequently, the LMS and face-to-face teaching are interchangeably used. Moreover, the CAT framework needed to be implemented to set the correct paradigm for UJ's *learning to be* philosophy. Another radical change also needed to be employed. This change is the perception of teaching staff that computer-related workshops are mostly based on click-and-show and show-and-tell methods. Therefore, a drastic shift from "how to" to exploring new technologies also needed to be initiated as continuation within the frame of reference constructed out of LMS and existing online use in blended learning.

Online teaching and online classrooms are thriving nowadays, and world-wide institutions are using massive open online courses (MOOCs) which are freely available (Rosenberg, 2013). However, to design a workshop, such as the one used for this study, becomes challenging as the LMS, in this case Blackboard, should also be incorporated as this is the only point of departure which the potential tablet users are familiar with. Therefore, when new technologies, such as tablets, are introduced, the reassurance is needed that online courses deliver the same quality efficacy as the courses presented in Blackboard. Pierce's findings support these claims which are positive on behalf of the students when the flipped classroom principle is used (Pierce, 2013, pp. 942-954). However, with the increase and technological savvy of our Y-generation students, the gap in digital competency is exponentially widening between them and the older generation that lectures and supposedly prepares students for a 21st century workforce. Because generation Y grew up with different technologies, they largely depend on these and also believe that these technologies better their performance. Kane (2014) describes this "tech-savvy dependency" as follows: "Armed with BlackBerrys, laptops, cellphones and other gadgets, Generation Y is plugged-in 24 hours a day, 7 days a week. This generation prefers to communicate through email and text messaging rather than face-to-face contact and prefers webinars and online technology to traditional lecture-based presentations." (para. 3). Many authors have written about the Y-generation and the means whereby teaching and learning should be adapted to compromise. However, in the 21st century the ability to communicate and work in an online environment is important and results in e-literacy and technology literacy (Becker, Fleming, & Keijsers, 2012, pp. 386-387). They explain that the "focus has now broadened to include technology as a critical literacy for all employees" (Becker et al., 2012, p. 387) and that this inclusion has impacted on previous generations in many ways.

The inclusion of technological literacy as a 21st century teaching skill has also impacted teaching staff at UJ and has become integral to CAT. Though an Australian study has been done on implementing the use of technology in professional development at a railway company, Becker and colleagues (2012, p. 387) mention crucial insight, which I feel is imperative to any needs analysis when it comes to the use of technology for teaching and learning − especially where different generations are involved. These insights are just as important when professional development for teaching staff comes to play at UJ. The authors make the following claims:

1. "Older employees often face the stereotype that they are rigid, do not want to learn, are resistant to using computers and have great difficulty using them, although this does not mean that older individuals are not interested in participating in e-learning at work" (Githens, as cited in Becker et al., 2012, p. 387). These can generally be seen as myths; however, at this stage it will enjoy some consideration regarding the needs analysis (as phase 1) of this design experiment.
2. "To implement e-learning successfully requires, amongst other things, senior management commitment, an understanding of cultural and technical obstacles and a need to be compelling to the target audience" (Henry, as cited in Becker et al., 2012, p. 387). In the case of this study, the implementation strategy for using tablets in the classroom has been an instruction from top management at UJ. CAT, as a support service center, assumes the role of developing staff to achieve this aim.
3. "If that audience comprises both older and younger employees, a further challenge involved addressing the needs and preferences of both whilst also acknowledging the importance of knowledge transfer between older and younger employees" (Becker et al., 2012, p. 387). In the case of this research, the development of the activities, planned for the workshop, must provide leverage for heterogeneous group work that includes all ages of teaching staff.

Thus, the technological literacy impact on the existing workforce of teaching and learning staff is inevitable when a needs analysis is discussed within the framework of this design-based research. Moreover, Becker and colleagues (2012, p. 387) prominently state that in all e-learning discussions a critical message is this: "Fundamental principles of adult learning, regardless of the delivery medium are still critical to any form of intervention." However, one prominent problem with designing a workshop for the purpose in this study is to cater for audience diversity in basic skills to use the device which mediates the learning interventions.

What about Scaffolding?

The concepts "workshop" and "seminar" have degraded over the past few years to a gathering where a lecture takes place in a more spontaneous environment. Workshops for professional development, in this context, is somehow interpreted as either a show-and-tell meeting or training on how to use software at navigation level. This phenomenon is inevitable when new technological gadgets are introduced. However, it becomes time consuming to bring a diverse audience on the same level to achieve the goals of the workshop. Usually, these intentions result in more workshops (on a more "advanced level") sometimes extending over a day or more. Apart from time consumption, members of different generations may either feel overwhelmed or become frustrated.

To save time on the design of lengthy workshops, a temporary solution for the overload-frustrated problem is proposed. The work of Mayer and Wittrock (2006) relates to scaffolding and problem solving centered on cognitive processes of the individual. They define problem solving as "cognitive processing directed at transforming a given situation into a goal situation when no obvious method of solution is available" (Kim & Hannafin, 2011, pp. 404-405). They also state that problem solving demands from a person that the "externally-manifested problems" be internally represented before aiming at a goal. Largely related to authentic learning, Kim and Hannafin (2011, p. 405) described "externally-manifested problems" as, for example, being "ill- or well defined problems, routine or nonroutine problems" and add on that this kind of problem solving happens through "planning/monitoring, executing, and self-regulating" cognitive activity (Mayer & Wittrock, 2006, p. 289 in Kim & Hannafin, 2011, p. 405).

However, the intention for developing basic skills in the workshop encapsulating this study embraces another argument as a prime from Vygotsky's work, namely the zone of proximal development (ZPD): "The link between scaffolding and ZPD provides conceptual and operational frames for design and study" (Sharma & Hannafin, 2007, p. 28). The two concepts encompass interactions between a professional and a beginner where the proficient person intervenes with a learner (the novice) to accomplish a specific task. The relationship between the ZPD and scaffolding is: "The ZPD thus supplies a conceptual framework for selecting and implementing strategies to support specific learning" (p. 28.). Consequently, in this study the flipped teaching approach was chosen to prepare teaching staff for a workshop on using tablets in the classroom.

The Flip Teaching Principle

Sharma and Hannafin (2007, p. 30) say that technology-enhanced scaffolding can be used as a motivation tool to entice and hold attention for an assortment of users and further motivate in that, "[b]y distributing extraneous cognitive load to the computer, learners and experts can both be freed to concentrate on rigorous higher order reasoning." Maybe one can hypothesize that this reasoning might contribute to a change factor implied with *technophobia* in so many cases, but that is another topic for research. Becker and colleagues (2012, p. 388) argue that regardless of the potential for differences, one cannot assume the younger generation to "… possess superior technological expertise." They further advocate that, when the focus becomes learning and information literacy, that "…just because learners may spend a lot of time using technology, this does not equip them with skills for using that technology specifically for learning or information gathering and evaluation" (Becker et al., p. 388).

However, technology-enhanced scaffolding is different from the classroom-based face-to-face interactions (Sharma & Hannafin, 2007, p. 30), and therefore, "[s]oftware constraints often limit dynamic scaffolding to interactions that can be anticipated in advance." Subsequently, in this research, the flipped classroom approach may enhance scaffolding in the sense of pre-workshop preparation so that basic skills on using and handling a tablet device may be assumed to be acquired to meet the aim of the workshop, i.e., to use the tablet in the classroom for the purpose of teaching and learning. Rosenberg (2013) argues that many people view the flipped classroom approach as untrustworthy, and others are "…holding it up as a potential model of how to use technology to humanize the classroom" (para. 5.).

Honeycutt and Glova (2014) describe the flipped classroom model in simple terms as follows: "[T]he flipped classroom has been defined as reversing what happens 'in' and 'out' of the classroom." They extrapolate that "… reversing homework and lectures

where students watch videos of lectures for homework 'out of class' and then engage in problem solving and analysis 'in class' [as part of learning events]" (para. 8.). From the literature (Becker et al., 2012, p. 388; Pierce, 2013; Rosenburg, 2013; Sharma & Hannafin, 2007, p. 30), the CHAT theory, the CAT framework, and the flipped classroom approach emerge to be the most appropriate for scaffolding a heterogeneous group, who has computer skills on different levels and needs to be prepared to use a tablet device as prerequisite for the workshop developed in this research. In addition, Blin and Munro (2008, p. 481) refer to Kaptelinin and Nardi (2006) and describe competencies needed within the context of this research, as the following:

1. *Tool-related competencies*: "include knowledge about the functionality of the tool, as well as skills necessary to operate it";
2. *Task-related competencies*: "include knowledge about the higher-level goals attainable with the use of a tool, and skills of translating into the tool's functionality"; and
3. *Metafunctional competencies*: "enable understanding of how to use functional organs, recognise their limitations, and knowing how to maintain and troubleshoot them."

Therefore, I argue that using the flipped classroom model might just be the impetus for scaffolding the skills required when new technology is introduced into teaching and learning to aim at higher-level use of technology and subsequently discover new pedagogies. In this research the aim, as part of the needs analysis, would be to have all workshop attendees on the same level of using a tablet device so that the "hands-on" aspect of the said workshop could deliver the rich learning experience expected. Moreover, it seems that recently commercial technological devices have become easier to use (Feinzaig, 2013). Already the field of natural user interface (NUI) is growing on a global level and can be seen in most of the recent everyday devices used. He clarifies that the combination of proximity and ease of use constitutes the natural computing category map. Therefore, my argument is that a carefully designed pre-workshop brief can be used to flip a workshop to subsequently scaffold teaching staff to be prepared when a workshop on using tablets in the classroom is presented.

A pre-workshop letter was developed from applications and setup installations that needed to be done in advance for being able to attend the workshop. The aim of this approach is to eliminate the expectations of a hands-on workshop which assumes show-and-tell or show-and-click for a tablet device. Rather, this flipped approach attempted for activities to take place not only in familiarizing users with a tablet but also to be a cause of (a) the object of the activity (i.e. to learn *with* technology) and (b) inter- and intra-psychological activities and assimilation to occur. The integrative design approaches for this kind of needs analysis as well as the interrelated design processes become apparent once the design process and the iterations thereof will be described. The next section in this research report is dedicated to the design process and its related iterations to commence the second phase of this design experiment.

General Design and Iteration of the Workshop

The design of the workshop, substantiated by reference to theory as well as contextual reasons for the type of activities chosen, comprise this discussion. Furthermore, where iterations have taken place, it is highlighted within context and augmented as far as possible.

Prior to the workshop, a "pre-workshop preparation letter" was sent out to all participants. This letter contained a welcome note, provided minimal instruction, and required applications to be downloaded. Taking into account that the letter serves as an authentic scaffolding tool, Bower (2008, p. 4) argues that various models for the choice of media are often used and mentions that "[b]y providing a prescription for selecting a single 'correct' media choice rather than scaffolding the media selection decision-making process, the expertise of the learning designer is devalued." He further argues that this "provide[s] tools for 'structuring and coordinating activity', and 'support community building'. These are unquestionably important characteristics for a learning environment; however, they are defined at a level above the attributes of the technologies. An environment can use the properties of technologies to construct tools that accomplish these aims, and evaluations should occur at this higher level; however, such features of a learning environment are complex manifestations of more primary technological facilities" (Bower, 2008, p. 4). Contrary to these complex exercises, the infrastructure at UJ is in place, teaching staff has been equipped with tablet devices, and Wi-Fi hotspots have been set up.

The first iteration was to add a QR code for URLs. Other uses of a QR code will be described later in this paper. Consequently, searching and downloading a QR code reader of choice was added to the list of activities in the pre-workshop letter. (The questionnaire is part of a different research project which will reveal results, other than design, from this research). The apps to be downloaded are mostly free of charge, and therefore a preceding suggestion in the letter was to do the workshop preparation at work at Wi-Fi hotspots. Moreover, ensuring generation theory (discussed in section 4.1), collaboration, and sharing of knowledge as characteristics of authentic learning were provided (see 3.3 and Figure 2). This strategy attempted to

eliminate expectations of workshops becoming show-and-tell of how tablets may be used in a classroom. The activity sequence for the actual workshop will now be described.

E-Handout

The concept of an "e-handout" has not been defined. However, for the purpose of this paper, I will define it as an electronic document designed for the purpose of guiding learning in a learning environment where electronic access to digital support learning material is possible. The e-handout contains hyperlinks in various ways in order to pedagogically cause interactive knowledge construction in a micro-curriculum guided by goals and objectives. The e-handout is not the same as an e-book or iBook where content becomes part of the sequence of learning events and hyperlinks are constructed around content. For the workshop developed in this paper, the sequence of interrelated learning events are given to participants as an e-handout. The e-handout was placed in an open space namely, Dropbox. A shared Dropbox folder could be opened with a tablet and a Wi-Fi connection directly from the participant's e-mail inbox.

Objectives and Sequence of Activities of the Workshop

According to the needs analysis and review, a rubric was given as part of the e-handout. The rubric was suggested by Professor Alan Amory (Director of CAT) and also serves to give various examples of how technology could be used in the classroom. The same rubric was also used for self-assessment at the end of the workshop. The rubric has been converted into an online checklist to make peer and self-assessment easier. At this stage of the development and evaluation of the workshop, no changes have been made to the assessment procedures and activities followed. The rubric, also an outline of the objectives of the workshop, is stipulated in Table 1. To avoid tedious discussions on the activities, their design and the relevant iterations which occurred during the design process, I have summarised all of these learning events in Appendix A.

Findings and Conclusions

Most teaching staff initially needed perceptual change for attending workshops and seminars. This became the first need to be addressed during development of the activities. The approach of the flipped classroom with a pre-workshop letter was well accepted, and lecturers came prepared, not estranged, to use a tablet. Initial expectations were that a "hands-on" method covering outcomes such as touching, tapping, and finding or downloading applications were thus compromised where necessary. Many inquired whether laptops are sufficient for the workshop. This emphasized a ready to "listen and take notes" notion. However, the title of the workshop suggested pedagogy to underpin the workshop. Evidently, most of the participants were *au fait* with the general navigation and working of the tablet device. Extra devices were made available for those participants who did not receive one. Hence, everyone attending the workshop was relatively on the same level of readiness. Participants not fully comfortable with the pre-workshop arrangements were assisted before the scheduled times.

Another iteration intervened, namely, that a QR code reader/scanner was needed for two activities. Furthermore, the participants suggested an online community of practice in Blackboard wherein apps are shared, discussed, and recommended for different uses in different subject areas. This community is presently running and frequently visited – which became a topic for further research to follow. Apart from these general phenomena and conclusions, more details on findings are discussed in the next few paragraphs.

Interaction and Collaboration

Interaction and collaboration occurred both on- and offline during *Activity 2*. Participants introduced themselves, although more time was awarded to online introduction. It was expected at first not to be easy in the electronic learning environment because users had to find their way about in the discussion forum. However, this was unexpectedly not the case: the discussion board became threaded with replies to introductions of others. I am of the thought that familiarity with social platforms such as Facebook have already familiarized participants with online social interaction. As the participants were in a close physical environment, a simultaneous online conversation took place. Responses recorded by means of pre- and post-workshops questionnaires revealed that collaboration took part among lecturers to complete the tasks in the pre-workshop letter. The reader should take in regard that the data aims more at the Technology Acceptance Model (TAM) which is not the focus of this paper.

Using an Open Space for Video Files

Video file-types from vlogs (e.g., YouTube), are more easily accessible from a shared folder in open space, e.g., Dropbox. The design principle of less clicks and faster downloading of video, I suppose, elicited this iteration. The first link to the video used in *Activity 3* determines the path to the final video: viewing of a video should not result in a map for a treasure hunt! Alternatively, video links can be hyperlinked to a shared folder in a reference list provided proper referencing. However, in this study, the video

Table 1
Rubric – Examples of Ways in Which Technology Could Be Used in a Classroom

	Application	Integration	Creation
Administration	• Taking register	• Using the Blackboard grade centre • Student e-submissions • Evaluation of Blackboard user reports	• Online interactive marking • Peer online assessment • Assessing students who might be at risk
Information	• Announcements • Reporting test/assignment results • Distribution of e-rubrics for assessment • eLearning guides	• Display of web content during class • Student use of search engines to find information • Discussion forum	• Use of an electronic rubric for assessment • Use of Twitter feed in class • Exploring institution databases during class • Using research software during class
Communication	• Use of email, calendar and SMS	• Social networking • Group discussions	• Online tutorial facilitation • Group assessment by students
Collaboration		• Group assignments • Team teaching • Online discussions	• Team teaching • Intra-institutional interactions • Peer reviews • Group projects
Transformation			• Re-representation of concepts • Authentic tasks and assessments • eProductions of relevant artefacts
Professionalization			• Data analyses using research software • Use of "tools-of-the-trade" (e.g. CAD)

Note. Developed by Amory (2014).

was an integral part of the activity. Therefore, a hyperlink was added in the e-handout. Moreover, the video could be replaced in another context as a reusable artefact. Open space gives immediate access to a questionnaire, formative assessment, or discussion as integrated interactivity. The questionnaire (voting poll) and responses were, in this case, recorded and released to the group at once. Icons were appropriately used in the e-handout accommodating different learning styles while providing an example for the same reason. Hyperlinks served the same dual purpose. This tendency had an impact on requested further workshop development. This will be discussed in the final paragraph of this section.

Streamlining Formative Assessment

Activities *3a* to *3c* (indicated in Appendix A) were seeded with notions for formative assessment and immediate feedback. The groups further concluded that tablets can be shared with different login credentials during interaction. I further conclude that expensive devices, such as clickers, can be substituted with mobile

devices (smartphones and tablets) to convey "expensive" pedagogies to students. Furthermore, a projected QR-code is easy to scan with tablets and smartphones. This procedure extensively reduces turnaround time for reading and responding, resulting in more focused learning. Ultimately the participants become more involved in the actual activity than with navigational obstacles and downloading time. Likely, financial strain on students is eliminated as expensive devices such as clickers and PDAs have limited multiplicity as opposed to smartphones and tablets. Moreover, bulky devices are not generally owned by students and are mostly used explicitly for gathering field data, which can only be analyzed and discussed after the actual data gathering exercise (Clark, 2007, pp. 7-13). Divergently, quick data gathering in a classroom may promote and stimulate discussion or debate. This occurrence, within its unique context and relevance to current issues, leads to a classic authentic task whereby students are guided towards implicit activities with deeper reflection. Therefore, such authentic tasks answer questions to whether intervention with a poll has pedagogic value. It further largely contributes to better affordances for using tablets in the classroom.

Progressive Skills Development

Activity 4 presumed an accumulation of various skills acquired during the workshop. However, it was expected that participants should gain more soft skills and thinking skills during on- and offline interactivity within a group. In an assumption to establish this expectation, a mini e-Portfolio should have been compiled within 45 minutes of group work linking onto the next activity where the e-Portfolio is presented to other groups in the same workshop.

Provision was made for submitting the final portfolio in Blackboard as an attachment in a forum prepared for this purpose. Interestingly, participants started to send portfolio information to other group members by using email and open spaces in the *cloud*. It was argumentatively decided not to make it mandatory to use the Blackboard option. It became apparent that the actual, true use of a tablet manifested once the collaboration within the groups started: authentic learning and creativity elicited problem solving skills, thus allowing for finding solutions on how to construct a portfolio. Interactivity within a group caused for the exchange of data by sending files electronically among different group members. Subsequently, files were exchanged via email, Dropbox folders were created and shared, and even presentations were backed up. It became noticeable that the users quickly got acquainted with the basic use of downloaded applications, specifically *Keynote* and *Prezi*. The assumption can be made that the pre-workshop preparation (flipped principle) largely contributed to acquiring these skills. Collaboratively, group members quickly associated icons with relevant meaning and function and could easily apply these according to their needs. Therefore, the submission of the final, polished product (e-Portfolio) via Blackboard is proposed to be a suggestion to participants rather than an instruction. One can further conclude that true facilitation took place in this workshop mediated by the e-handout. Moreover, group members became progressively autonomic once challenged with the variety of activities.

Evaluation

The workshop has shown to be highly interactive and effective, and thus far no further iterations are required. However, the implementation of using tablets in the classroom assumes many pedagogical approaches and should not be regarded as a panacea for educational challenges and learning sequences, but rather as a step closer to a *superior ratio decidendi.* This research gives leverage for more to follow. Further investigation is needed on the following:

1. The effect of visited hyperlinks and color difference (visited hyperlinks), as well as the impact on the learning sequence − especially the relationship to HCI (human-computer interaction);
2. Designing and implementing a possible rubric for assessing workshops of the same nature as the one used in this research;
3. Focusing on teaching staff, TAM (Technology Acceptance Model), and the effect on using new technologies in the classroom for teaching and learning.

The interventionist nature of the workshop provides exploration for many inseparable issues, such as those stipulated above. More so, these issues have now escalated to requests for more tablets-in-teaching related workshops.

Requests for Further Workshops

Workshops are currently being developed on creating electronic educational artefacts, related activities, and e-handout design and development. "Design" becomes the focus of these workshops which will be reported on once these workshops have been implemented.

Summary

Technological development in higher education has brought about many infrastructural changes, including changes to the way we teach and learn. This paper started by describing the context of the comprehensive University of Johannesburg, South Africa, and how its mission derived drives for using tablet devices in the

classroom. The use of tablets in the classroom consequently demanded an interactive workshop to be designed and implemented with academic teaching staff. The Centre for Academic Technologies (CAT) at UJ has accepted this task, developed workshops, and implemented this workshop. The research question addressed in this paper was: how is a workshop designed for lecturers to use tablets for teaching and learning in the classroom?

This paper described the theoretical framework (CAT framework) and how it was used as a heuristic condensing the Cultural-Historical Activity Theory (CHAT), Vygotsky's basic mediated action triangle, and Engeström's activity systems theory. Thereafter, the research design and methodology was discussed as a design experiment. The phases of the design experiment set the layout for the sections in the paper. A review of the needs analysis (phase one) became a detailed discussion conceptualizing, rationalizing, and applying theory into the design of the workshop. The second and third phases of the design experiment were integrated and were applied to the general design of the workshop. Consideration was given to incorporating principles of scaffolding and flip teaching, e-handout development, and the expected objectives of the workshop and what it attempted to accomplish. Thereafter, the sequence of activities was presented in table format wherein interactivity and iterations on the activities became the focus. Finally, findings and conclusions were presented.

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Appendix A
Sequenced Activity Analysis

Activity in sequence	**Expected result from interactivity** What is expected from the interaction?	**Online resources**	**Iteration(s)** What needs to be addressed? Possible (new) solution Effect/Evaluation of iteration	**Attempted objectives** According to Table 1
Setting the paradigm • Presentation in *keynote* about mobility and cloud computing. • Photos of the Google centre.	• Realizing affordances brought about by tablet devices. • Mobile collaboration and wireless data transfer. • Presentations with a tablet.	• Presentation from a shared folder in *Dropbox* downloaded in a pre-downloaded application (app) of choice. • *Keynote* was used.	• Reduced to a diagram • Accessible from e-handout as a hyperlink. • Additional resources under a new heading as hyperlinks in e-handout.	• 2,3,5,6
Activity 1: Registration • Log on to a portal (uLink). • Taking an attendance register in class from device. • E-mail inbox: spreadsheet, with register.	• Class attendance register recorded with mobile device. • Students use a mobile device to register class attendance. • E-mail accessed via Wi-Fi.	• An application built, generating an attendance code. • Code captured by students (securely logged in on a portal). • Students "sign up" within window period. • Lecturer receives updated spreadsheet via e-mail.	• Hyperlink in e-handout login page. • Footnote on the e-handout also hyperlinked. • QR code embedded scanned from the presentation screen.	• 1,3,6
Activity 2: Introduce yourself The workshop participants had to introduce themselves by using Blackboard discussion forum.	• Blackboard (Bb) Learn mobile app (part of the pre-workshop downloads). • Awareness that the mobile app looks different when accessed on a tablet. • Establishing communication in an online environment to precede future collaboration. • Promoting interaction and collaboration both on- and offline.	• Bb Learn application. • Pre-designed module in Blackboard for discussion.	• Access to Blackboard for workshop interaction(s). • Initiating a discussion in Blackboard.	• 2,3,4,6
Activity 3(a):	• Tablet to watch	• Link to a vlog	• Link in e-handout to	• 2,5

Video Video on social media and mobile devices are used in a classroom.	videos. • Students referred directly to video in the classroom. • Video can be incorporated into presentations with a tablet.	directly related to the activity.	YouTube. • Speeding up downloading, the video was shared in Dropbox..	
Activity 3(b): Short Questionnaire A voting poll with four questions on viewers' opinion about the video (Activity 3(a)). "YES/NO" answer choice.	• Demonstration of formative assessment. • Classroom interaction. • Stimulating discussion.	• Google Form recording responses. • Llink in e-handout. • QR code on e-handout.	• The hyperlink to the Google Form is effective. However, faster access with a QR code was generated as intervention. • Purpose of intervention: to demonstrate that the Google Form (poll questionnaire) could be directly accessed if the enlarged QR code is scanned from the projector screen with a tablet camera and pre-loaded scanner.	• 1 – 6
Activity 3(c): Results of Poll The results of the poll are immediately made available and visible.	• Immediate results from the *cloud*. • Formative assessments more frequently resulting in immediate feedback.	• Google Forms; the immediate results with spreadsheet.	• The same Google response worksheet to be used for every workshop intervention. • Choice of open space not limited to example.	• 1 – 6
Activity 4: Mini e-Portfolio The ideal number of group member: From the CAT heuristic (Figure 2), this activity is designed prompting the group that the portfolio should contain: i. A photo of the group ii. The names of the group members and the subjects taught by each member iii. 5 ideas from	• Interactive collaboration progressing to online interaction. • Natural division of workload to occur – members of the group are automatically assigned to different subtasks. • Capabilities of the tablet not been covered to emerge in an interactive manner. • Self-assessment during workshop.	• Wi-Fi/ Internet connection. • Mobile browser. • Presentation application. • Bb Mobile Learn. • Access to e-mail.	• Tendency: participants to use cloud space for sharing. • Allocated discussion facility in Blackboard was alternatively used for backup.	• 1 – 6

the group on how tablets can be used in the classroom iv. A picture of students using tablets in a learning situation. e-portfolio upload in allocated space.	• Providing opportunity to reflect. • Sharing information. • Transforming information. • Basic cloud computing.			
Activity 5: Presentation Each group presents the mini ePortfolio using a tablet.	• Acquire presentation skills. • Solve problems by compiling presentations. • Tablet connection to data projector. • Stimulate discussion. • Stimulate reflection. • Share ideas on pedagogy. • Peer assessment. • Deliver a polished product.	• Projector connection.	• No iterations were needed for this activity.	• 2 – 6