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Leveraging Emerging Technologies to Address Specific Learning Challenges and Derive Authentic Learning in Mathematics for Business at Africa University - Zimbabwe

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Abstract
Emerging Technologies have been put forward by many theorists and researchers in the field of education as the key to 21st century pedagogy alternative, with promise to address learning challenges and provide a platform for authentic learning. This paper reports on use of Emerging Technologies to address learning challenges and derive authentic learning in a Mathematics for Business undergraduate course at Africa University. The research was motivated by an authentic learning challenge based on assessment results and feedback from current and past participants of the course. Following the identification of the learning challenge and educational goal an affordance analysis matching learning tasks with technologies was performed using an affordance analysis model by Bower(2000). The research objectives were to Observe the interest of emerging technologies, Assess student motivation to adopt and use emerging technologies, and Evaluate pedagogical impact of using emerging technologies. The key findings were students were generally keen and motivated to the use of emerging technologies, however the pedagogical impact could not be ascertained in this early and first phase of the research. Further research is required to determine the pedagogical impact, this will involve taking the students through full semester learning cycle up to assessment and compare the results and also administer a suitable framework to evaluate authentic learning.
Keywords: Emerging Technologies, Pedagogy, Authentic learning, Mathematics for Business

Introduction

ICTs in education, particularly Emerging Technologies have been put forward by many theorists and researchers in the field of education as the key to 21st century pedagogy alternative, with promise to address learning challenges and provide a platform for authentic

learning. This is against a background of global call by all stakeholders in the education to revisit the current mainstream pedagogy approach based on behaviourism.

Use of emerging technologies in education continue to receive attention "… there is a growing trend in English-speaking education [UK and USA] systems to assume a technology rich environment for learning, and to investigate the impact of particular pedagogical approaches or learning strategies within that context."(Association for Learning Technology(ALT), 2010, p.5). A related study by N'ngambi et al (in press) on the use of emerging technologies in South African higher education, also confirmed a positive motivation and adoption rate of emerging technologies. What is not clear to many stakeholders is "What works, in what context(s), to what extend – if there is evidence – why and/or how?" (ALT, 2010,p.6). Through a series of reports ALT presents the following research based evidence: Evidence of general performance enhancements through e-learning Evidence of benefits from institutional (strategic) approaches to learning; Evidence of enhancements to the student experience of learning; Evidence of generally enhanced learning outcomes; Enhanced learning outcomes from specific types of technology and intervention; Evidence concerning access and assessment.

To advance the knowledge and application of Emerging Technologies, this research study is set to investigate the use of Emerging Technologies at Africa University in Zimbabwe to explore the use of Emerging Technologies to address specific learning challenge in Mathematics for Business and also promote authentic learning.

Theoretical Framework

The research is modeled and structured around Emerging Technologies, Social Networking, eLearning Models and Frameworks, and Authentic Learning. Through a synthesis and analysis of literature I contend that these themes may be presumed to be the necessary and sufficient framework to guide in using emerging technologies in an authentic context and generate authentic leaning outcomes. The following theories are the pillars of theoretical framework of this research:

- Cognitive constructivist theory (Bruner,1978)
- Model of online learning (Terry Anderson)
- Authentic Learning theory (Herrington, 2009)

Bruner's Theory of Constructivism

Bruner's theory of constructivism also referred to as "Bruner's theory of Representational Media" by some researchers, was influenced by earlier theoretical work of Lev Vygotsky (1896-1934) [theory of social cognitive growth], and Jean Piaget (1896-1980) [theory of individual cognitive development]. His theoretical framework supports the belief that learners construct new ideas from concepts based upon existing knowledge. (Yilmaz, 2011).

Through studying the behavior of children Bruner concluded that development is not to be seen as "structural construction". He noted that it occurs within the context the learner relates to personal experience on the subject being introduced. The child constructs the world by successfully representing it in enactive, iconic, or symbolic medium (Bruner, 2006). In Bruner's exact words, each of these three modes, or media of representation "… places a

powerful impress at different stages and their interplay persists as one of the major features of adult intellectual life" (Bruner, 2006).

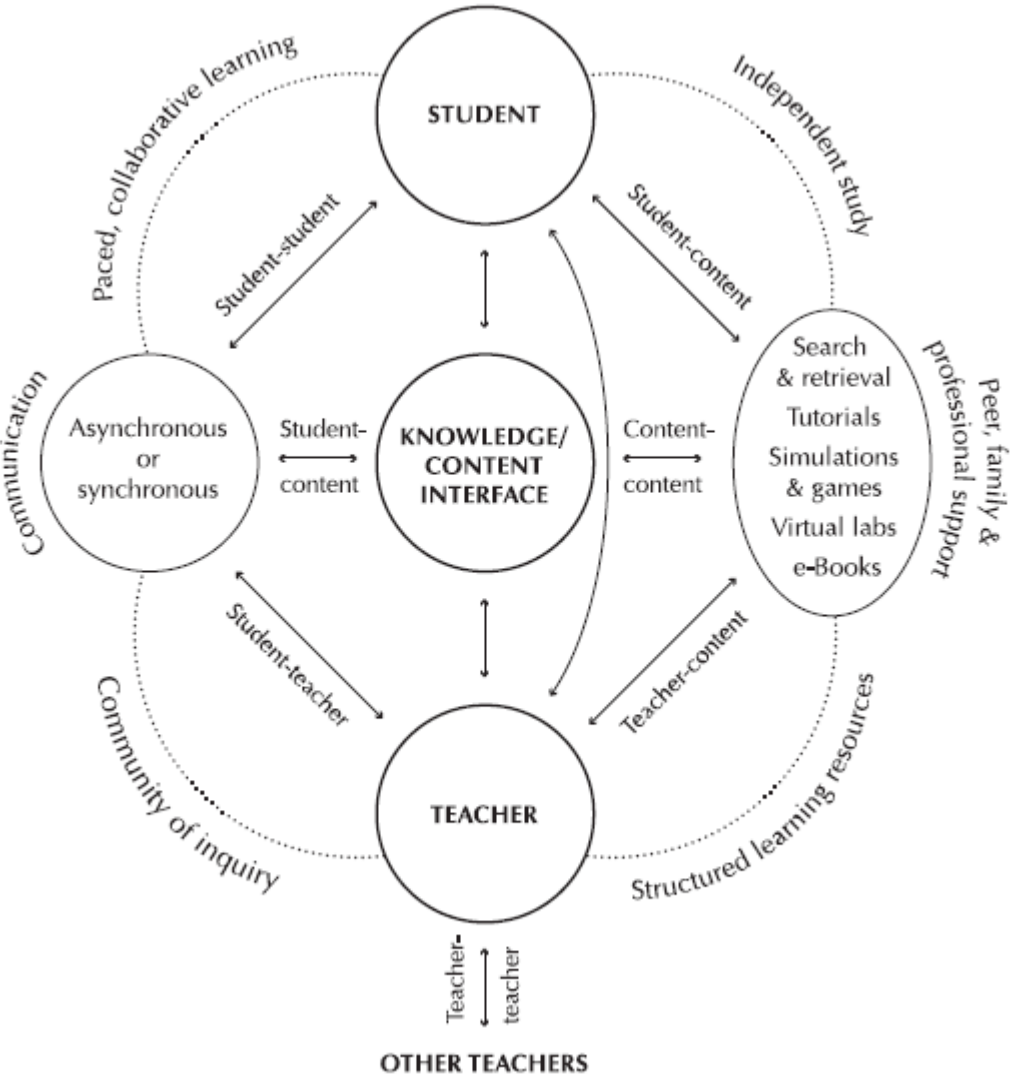
Not every theorist agree with Bruner, for example David Ausubel (1918-2008) [advance organizer theory], disagrees with Bruner's theory of discovery knowledge. Instead, he contends that learning has to be sequential and placed in context. Both Bruner and Ausubel agree that new information must be processed in a way that makes meaning to the learners by relating the wider background context of the learners.

New information must be processed in a way that makes meaning to the learners by relating the wider background context of the learners.(Bruner(1978), Ausabel(1918-2008)). This concept is applied in this research by putting all the problems in the context that every student has strong background experience as shown by the sample authentic linear programming task below. The tendency of most writers and examiners is to use first world scenarios involving banking, investment, which an ordinary undergraduate student in Africa may not have adequate background and experience.

Model of online learning (Terry Anderson)

Terry Anderson's model is centered on the role of interaction in online learning. It is all about defining and valuing interaction in Online Learning guided by the fact that learning is learner centered, knowledge centered, assessment centered and community centered (Anderson, 2002).

Figure 1. A model of online learning showing the types of interaction



Source: Anderson (2002)

In this research Anderson's model was used as a guiding framework to diagnose, identify and describe the learning challenge in a way the linked the learning challenge to a number of possible researched solutions. "Sufficient levels of deep and meaningful learning can be developed, as long as the three forms of interaction (student-teacher, student-student, student-content) is at very high levels" (Anderson, 2002).

Through an analysis of levels of interaction the learning challenge was effectively identified and documented.

Authentic Learning theory (Herrington, 2009)

Jan Herrington, 2009 in her authentic learning theory contends that an authentic task meets the following 10 important elements: Real-world relevance, ill-defined, complex, provide different perspectives, collaboration, reflection, integrated and applied across different subject areas, seamlessly integrated with assessment, create polished products, allow competing solutions and diversity of outcome

It is important to note that for a task to be authentic it does not have to strictly comply with all the 10 elements. Compliance to any logically related elements and contextually relevant to the educational goal and environment is a necessary and sufficient condition for the task to be called authentic.

The 10 elements prescribed by Herrington(2009) are used as guidelines in designing the learning tasks. It is on the basis of this theory that the tasks in the research are referred to as "authentic learning tasks" and equivalently the learning outcomes are also referred to as "authentic learning outcomes".

Methodology

The research was motivated by an authentic learning challenge based assessment results, analysis of course evaluation forms, and direct feedback from current and past participants of the course. Following the identification of the learning challenge and setting of the educational goal an affordance analysis matching learning tasks with technologies was performed using an affordance analysis model by (Bower, 2000). Bower's framework was complemented by the Hanbook of Emerging Technologies for Learning by Sienmens & Tittenberger (2009) to identify and shortlist possible technologies. Ultimately the Wiki(complemented by a smart phone) was selected as the ET that provided the most attractive net affordances in the context of the research environment, time frame and prescribed authentic tasks.

Teaching and Learning Challenge

A significant number of students come from non- English speaking countries, and start their degree programs soon after only one semester of intensive English. From the direct feedback and assessment results the learning challenge is business and technical language practice and experience gap. The initial intensive language course groups together students from all faculties from Humanities to Business Sciences and Health Sciences. The initial emphasis is standard conventional reading, writing and communication skills. This invariably leaves a glaring gap on business and technical language for students who come to the Faculty of Management and Administration and other faculties where Mathematics for Business is compulsory. Some foreign students have carried over this subject right up to final year.

Basing on the initial works of Moore, Anderson (2003), defined six types of interactions as outlined and described in the theoretical framework section above. Deeper and more meaningful learning takes place with the enhanced level of each type of interaction. "Sufficient levels of deep and meaningful learning can be developed as long as the three forms of interaction (student-teacher, student-student, student-content) is at high levels" (Anderson, 2003, p.54).

Based on Anderson's framework of interaction, the learning challenge was diagnosed and identified as follows:

- Low levels of teacher- student interaction. (there was low level of interaction between the students and teachers. The classroom interaction centered on explained concepts, principles, and formulas on a few selected cases, with the assumption that all students had no glaring technical and business language understanding and experience gap).

- Low levels student-interaction. (The normal class and social interactions does not provide adequate platform for students to engage and debate issues around individual core academic challenges)
- No platform for systematic collaboration and reflection. (A platform for systematic collaboration for students, teacher, tutors and other interested stakeholders that might add value, interest and motivation to the learning process.)

Educational Goal

- To foster and achieve authentic learning by providing Emerging Technologies tool(s) for students to apply knowledge gained in Math for Business and Economics to resolve real world problems.

Findings and Recommendations

The research investigated the interest of Africa University students on emerging technologies, willingness of the students to adopt emerging technologies as learning tools, and the pedagogical impact of using emerging technologies. The conclusions and recommendations are shown against each research question.

RQ1: Are Africa University students interested in emerging technologies?

The concept of emerging technologies was introduced to a class of 136 students from the three out of four faculties at Africa University. All the 156 students expressed interest and, 87% of the students went on to visit the pilot wiki AU-MMS105 on Wikispaces.com. Students proceeded to request membership. However the membership at this initial pilot phase was limited only to nine students. This provided sufficient field evidence that Africa University students are interested in the use of ICTs in education and emerging technologies.

Despite the overwhelming interest not all students were able to navigate their way on the net and find the wiki site. This points out to a digital literacy gap. These students included students from Faculty of Humanities and Social Sciences and Faculty of Education were there are no computer labs. This is not unusual, a research conducted by Czerniewicz & Brown (2013) into digitally mediated learning in South Africa revealed a subgroup termed “digital strangers” lacking both experiences and opportunities and did not have access to technology off campus.

To complement the interest of Africa University students on emerging technologies I recommend the rolling out of a comprehensive digital literacy program with emphasis on ICTs in education with are special focus on emerging technologies. This will set ground work for a successful 21st century aligned pedagogical reform.

RQ2: Are Africa University students willing to adopt emerging technologies as learning tools

All students involved in the pilot phase expressed the willingness to continue exploring further problems after the initial three linear programming problems involved in the pilot study. The fun and flexibility of addressing their core learning challenge using emerging technologies and their smart phones as the main tool generated fun, excitement and seamless learning.

Africa university is recommended to adopt more emerging technologies to support teaching and learning. Clickers are one good et example that can help students that have language skills gap as their learning challenge. Clickers are small handheld devices which allow students

to answer multiple choice questions in class in an anonymous way, allowing the immediate display of results. The relevance of clickers to pedagogy is "they encourage student participation through the anonymity they offer, which is especially important when the language of learning and teaching is not the students' first language "(Gachango et al., 2011, p.1)

A research on the use of clickers conducted by Gachango et al (2011), investigated the use of clickers on three levels: (a) "students' general attitudes towards clickers to improve their attention, linked to simplicity, novelty, and fun," (b)"students perceptions towards clickers as a tool to promote participation," and (c) " students perceptions towards clickers as a tool to encourage active discussion and peer learning." The study proved that clickers have their usefulness for enhancing interactivity and participation in large classes. The research also confirmed an overwhelming interest of et and high motivation and willingness to adopt as learning aids by students.

These findings and many more not included in this study are necessary and sufficient to prove that students are willing to adopt emerging technologies as learning tools and should motivate africa university leadership to introduce et as mainstream teaching and learning aids.

RQ3: What is the pedagogical impact of using emerging technologies?
Although usability of the selected emerging technologies could be confirmed the effective utility could not be ascertained at this stage.

The second cycle of the research will at prioritize the measurement of the pedagogical impact of using emerging technologies by providing the following empirical measurements: To what extend have the use of ET impacted the outcome of final assessment results, and To what extend have ET contributed towards authentic learning.

Elsewhere particularly in the USA and UK there is a lot of empirical evidence in support of positive pedagogical impact of using emerging technologies to support teaching and learning. In response to the following question on the impact of emerging technologies on pedagogy "What works, in what context(s), to what extend – if there is evidence – why and/or how?" (ALT, 2010, p.5). ALT presented the following research based evidence: Evidence of general performance enhancements through e-learning Evidence of benefits from institutional (strategic) approaches to learning; Evidence of enhancements to the student experience of learning; Evidence of generally enhanced learning outcomes; Enhanced learning outcomes from specific types of technology and intervention; Evidence concerning access and assessment. This evidence shows that emerging technologies have positive impact that extends beyond pedagogy to operations and strategic management.

In South Africa Bozalek et al (in press), conducted a study on emerging technologies for authentic learning, that surveyed higher education institutions in South Africa. The study confirmed that use of emerging technologies resulted in highest levels of authentic learning, and there was a positive correlation between increasing use of emerging technology and levels of authentic learning. The research confirmed a dual relationship between emerging

technologies and authentic learning and that increasing use of emerging technologies will invariably increase levels of authentic learning

The biggest problem with the current pedagogy at Africa University seems to be adherence to status quo. It is that lack of effort to incorporate other pedagogy and learning theories that seem attract many questions on behaviorism. “The approach taken by many teachers in universities today is simply a result of the way they were taught. They are perpetuating a tradition of formal university teaching that has ignored the substantial insights gained from more recent theory and research into the way people learn.”(Herrington & Herrington, 2006, p.2).

The growing influence of constructivism as a philosophical approach to learning, and a wide range of research studies and papers investigating alternative models of teaching and learning over the last decade, have prompted many teachers in universities to implement more “authentic” teaching and learning environments.” (Herrington & Herrington, 2006, p.3).

The recommendation to Africa University and any other institution of learning is to create a comprehensive
plan of action to adopt emerging technologies to support teaching and learning. One good reference is University of Botswana (UB), in 2001 created an Educational Technology Unit (EduTech) in the Centre of Academic Development (CAD). EduTech implemented a university-wide e-learning initiative (UBel) that provided a strategic plan to develop technology-enhanced education (Gachago et al., 2005).

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