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ICT in education: Reflections, evaluation and design

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The International Journal of Education and Development using Information and Communication Technology (IJEDICT) is an e-journal that provides free and open access to all of its content. It aims to strengthen links between research and practice in ICT in education and development in hitherto less developed parts of the world, e.g., developing countries (especially small states), and rural and remote regions of developed countries. The emphasis is on providing a space for researchers, practitioners and theoreticians to jointly explore ideas using an eclectic mix of research methods and disciplines. It brings together research, action research and case studies in order to assist in the transfer of best practice, the development of policy and the creation of theory. Thus, IJEDICT is of interest to a wide-ranging audience of researchers, policy-makers, practitioners, government officers and other professionals involved in education for development in communities throughout the world.

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- Please use Arial 12-point font for the Title, which should be in bold "title" (upper and lower) case.
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  In this way, information technology can be seen to effect and influence changes in organisational structure (Orlikowski & Robey 1991).

  Edwards (1995, p.250) views the globalising of distance education as "invested with the uniform cultural messages of modernity".

  Globalisation, especially in relation to open and distance education, will reduce the tolerance of difference and so "how can local issues and contexts be addressed?" (Evans 1995, p.314).
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Editorial: ICT in education: Reflections, evaluation and design

Stewart Marshall
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Welcome to Volume 10 Issue 4 of the *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*. This issue brings articles from or about Barbados, Guyana, Jamaica, Jordan, Kenya, New Zealand, Nigeria, Pakistan, South Africa, Spain, Sweden, Thailand, Trinidad and USA.

"Frontrunners in ICTL: Kenyan runners' improvement in training, informal learning and economic opportunities using smartphones" by Per Olof Hansson and William Jobe, looks at how mobile technology shapes, changes, and develops informal learning outside the classroom and school environment. In this study, 30 Kenyan elite runners with a simple Android smartphone and free Internet for one year.

In the article "Technology-supported classroom for collaborative learning: Blogging in the foreign language classroom", Dorota Domalewska examined the phenomenon of blogging as a technologically enhanced support to develop interaction and interrelatedness among learners in a foreign language course. The findings of the study revealed interaction between bloggers was limited.

The article "Effectiveness of Web Quest Strategy in acquiring geographic concepts among eighth grade students in Jordan" by Zaid Suleiman AL-Edwan, reports on a study of 119 students in the scholastic year 2013-2014. The results showed differences with statistical significance between the means of the students' scores on the test acquiring the geographic concepts' attributed to the teaching method in favor of the experimental group.

"The effect of computer based instructional technique for the learning of elementary level mathematics among high, average and low achievers" by Muhammad Tanveer Afzal, Bashir Gondal and Nuzhat Fatima reports on the study of two urban and two rural schools. The results revealed that teacher facilitated mathematics instructional method produced better scores when compared with CAI and traditional instructional methods of teaching mathematics for low and average achievers, but no significant difference was observed between instructional techniques for high achievers.

The article "Evaluation of a pilot project on information and communication technology for rural education development: A Cofimvaba case study on the educational use of tablets", by Acheson Charles Phiri, Thato foko and Nare Mahwai, used the Cofimvaba ICT4RED initiative as a case study to ascertain how teachers accepted the introduction of tablets at their schools for teaching and learning. The results showed that most teachers embraced tablets and were using them in the classroom, for their own professional development and personal use.

The article "Synchronous e-learning: Reflections and design considerations" by Filiz Tabak and Rohit Rampal is a personal reflection on the design, development, and delivery of online synchronous conferencing as a pedagogical tool complementing traditional, face-to-face content delivery and learning. The purpose of the paper is to demonstrate how instructors can combine

collaborative and virtual learning principles in course design

The integration of educational technologies presents challenges and concerns in relation to students' learning. In the article "Students' experiences of learning in a virtual classroom", Dilani S. P. Gedera uses Activity Theory as a research framework to develop a better understanding of students' experiences of learning with the specific online learning technology of Adobe Connect virtual classroom.

"Measurement invariance of the UTAUT constructs in the Caribbean" by Troy D. Thomas, et al., employs confirmatory factor analysis to evaluate the factorial validity and the cross-national comparability of the UTAUT constructs with respect to mobile learning in higher education in four Caribbean countries. Except for the measurement of one factor, the UTAUT constructs exhibit adequate reliability and validity.

In "Exploring interactions of cultural capital with learner and instructor expectations: A case study", Roxanne Russell asks: How do bidirectional flows of cultural capital interact with learner expectations and instructor preconceptions in the case of a cross-sector, cross-border training program? Researchers and practitioners concerned with education in a globalized context may consult findings here to deduce a set of criteria underlying these learners' expectations for this NASA branded program and preconceptions of the instructors about the learners that may help instructional designers prepare for comparable cross-cultural training programs.

In their article, O. A. Lawal-Adebowale and O. Oyekunle report on the "Agro-students' appraisal of online registration of academic courses in the Federal University of Agriculture Abeokuta, Ogun State Nigeria". The results showed that the use of online registration tool was appraised valuable for convenient course, and there was reduction of attendant stress/rigour of manual course registration. It was concluded that online registration of academic courses in FUNAAB is a worthwhile development.

"Creation of audiovisual presentations as a tool to develop key competences in secondary-school students. A case study in science class" by Ángel Ezquerra, Javier Manso, Mª Esther Burgos, and Carla Hallabrin, describes a proposal to develop key competences through project-based learning. The project's objective is the creation of a digital video. The results showed an important improvement in both the digital and science competences.

The journal now has several sister publications (all free to read and subscribe):

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- *ICT for Education and Development* - a daily, magazine style curation http://www.scoop.it/t/ict-for-education-and-development
- *Communication, Education and Development using ICT* - http://cedict.blogspot.com/

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Original article at: http://ijedict.dec.uwi.edu/viewarticle.php?id=1955

International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2014, Vol. 10, Issue 4, pp. 4-20

Frontrunners in ICTL: Kenyan runners' improvement in training, informal learning and economic opportunities using smartphones

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ABSTRACT

The primary aim of this research was to study how mobile technology shapes, changes, and develops informal learning outside the classroom and school environment. In this study we provided each of the 30 Kenyan elite runners with a simple Android smartphone and free Internet for one year. This research project was a developmental intervention with a participatory action research approach, and aimed to facilitate innovation and examine how the runners developed their training, informal learning, and economic opportunities using a smartphone. Logs and tracking of smartphone usage recorded quantitative data, and interviews and participatory observations gathered qualitative data. Key findings were that the smartphone improved the runners' training and race performance and created business opportunities. Second, a smartphone with an Internet connection empowered marginalized groups and augmented informal learning opportunities. Third, that a smartphone was not a significant technological hurdle for impoverished or uneducated individuals. Fourth, the participants were able to learn with little or no guidance or scaffolding. Fifth, the tracking log data indicated both a breadth and depth to individual learning. This participatory action research made a significant impact on the participants' lives and the most common statement from the interviews was the statement "it helps us a lot".

Keywords: Mobile learning; informal learning; smartphones; Kenyan runners; ICT4D; M4D

INTRODUCTION

Kenya is one of the poorest countries in the world. Kenya is ranked 143 (of 187 countries) on the Human Development Index (UNDP, 2012) with a life expectancy rate of 57 years and an average of 7 years of schooling, despite a government subsidy that makes primary school free. Approximately 67% of the population actually graduate from secondary school (UNICEF, 2008). The GNI per capita is 1,492 USD while 20 % of the population lives under the poverty line (UNDP, 2012). These facts highlight the extreme poverty and high dropout rates in Kenya and place Kenyans at the bottom of various world-ranking lists. However, mobile use and technology in Kenya move in opposite directions. Kenya has more than 29 million mobile subscribers and mobile penetration is at around 75% (Communications Commission of Kenya, 2012). Furthermore, Kenyans are avid users of mobile banking due to the ubiquitous use of Safaricom's M-Pesa text message payment system (Donner, 2010). Mobile web usage is on the rise and email and social media such as Facebook dominate current web use (Jensen, 2012). Further, smartphone adoption, especially of less expensive Android handsets, is increasing rapidly (Adam, Butcher, Tusubira and Sibthorpe, 2011).

All the aforementioned trends with mobile penetration and smartphone adoption in Kenya create an optimal environment and opportunity to study the effects of how mobile technology and m-learning can affect lives with little costs. Furthermore, as Kinuthia (2009) concludes, ICT plays an important role for leveling the playing field for marginalized groups and communities, but these groups lack the necessary technology. Moreover, Traxler (2013) argues for an analysis of evidence in research projects of mobile learning in Africa. This research project provides the technology and attempts to understand the smartphone usage of Kenyan runners and analyze how such mobile technology impacts and affects their daily lives. Therefore, the research question is: How can an inexpensive smartphone and simple native/web apps affect Kenyan runners' training, informal learning, and economic opportunities?

RELATED STUDIES

Johnson, Smith, Willis, Levine, and Haywood (2011) state that mobile devices with Internet access will soon outnumber computers because of the wide range of activities feasible when using mobile devices. Access to inexpensive, powerful mobile devices as well as the Internet is important in an African context, especially in remote areas. The impact of mobile phones is immense, and "mobile phones for development" (M4D) or "ICT for development" (ICT4D) are concepts that focus on small scale projects in developing countries by implementing mobile technology with the purpose to improve social and economic development and inclusiveness (Hellström, 2010). There are many examples of benefits such as: basic health information (m-health) with mobile applications (Chang et al., 2012), SMS requesting to test HIV-status, mobile money transfer (M-Pesa in East Africa), and mobile education (m-literacy) in South Africa that improving youth literacy using m-novels (Vosloo, 2010). Another local solution was provided in the post-election violence in Kenya in 2008, and modern technology was used to report crime, abuse, and insecure areas (Ushahidi, 2012). A number of studies exist that deal with informal learning and mobile technology. They range from educational games on mobile phones (Kukulska-Hulme et al., 2009), audiovisual support for visitors in going through the museum (Naismith and Smith, 2009; Vavoula and Sharples, 2009), m-fishing to improve fish harvests and access to fresh fish at a low price, increasing income for fishermen (Greenberg, 2012), and peasants in rural areas by communicating with urban businessmen on commodity prices and market opportunities (m-agriculture). These studies of mobile devices and informal learning show that, with increased information, more efficient agriculture and higher incomes for peasants develop (Hellström, 2010; Kala, 2012).

Pupils in schools may use mobile phones for language training, math calculations, answering teachers' questions through quizzes, or searching for geographic information and GPS coordinates. Several studies (Shih, Chuang and Hwang, 2010) indicate that students cooperation increases with the use of mobile phones in learning, which in turn develops students' ability to identify problems and think critically. Mobile phones in education are perceived as motivational, and more importantly the student (and teacher) have familiar relationships with their personal mobile phones (Kukulska-Hulme, 2007). Teachers can even provide rapid feedback on the students' learning by using text messages.

Edwards (2000) discusses the pedagogical effects of globalization and technology. A school teacher is no longer an undisputed authority. This fact reshapes learning from formal learning with formal instructors and objectives to more informal learning with modern technology. ICT changes the perspectives on learning to a learner-centered approach that focuses on individual learning and collaborative learning (Sharples, Taylor and Vavoula, 2007; Thomas and Brown, 2011). This perspective provides increased student motivation and higher learning engagement because the student monitors himself/herself and sets his/her own goals. Additionally, Edwards and Usher (2000) argue that, in a virtual classroom, the focus moves from the instructor as the

principal expert for transmitting knowledge and validating input to the learner who pursues an assortment of locally defined educational goals in a variety of ways.

The starting point is what the learner considers as essential, and it is not limited to a classroom or other physical environments for learning. Learners can access content from the Internet and communicate with a teacher anywhere in the world (Unwin, 2012), wherever the learner has access to the technology and the Internet. However, studies in India found that children with limited skills gain more from teacher-centered education, and another project in Asia found that the use of mobile phones in an educational setting was not effective (Valk, Rashid and Elder, 2010). The students learned more from printed materials and peer feedback (Valk, Rashid and Elder, 2010). However, the mobile phones in these cases were simple and perhaps not able to support appropriate educational needs.

Formal, non-formal, informal and m-learning

The distinction between formal, non-formal, and informal learning is not as distinct as it may appear. In short, it is a matter of control of the learning process and the aims of learning (Clough, Jones, McAndrew and Scanlon, 2008). Formal learning has explicitly expressed aims, and the instructor defines the process. Informal learning, which can be divided into intentional and unintentional, has in it the aims and processes defined by the learner (Clough et al., 2008). Unintentional, informal learning has a non-prescribed process and aims are unspecified. Non-formal learning lies in between formal and informal learning. Non-formal learning involves people who voluntarily and intentionally plan learning, outside of a formal institution, in order to develop essential competence. On the other hand, informal learning is learning that takes place in daily activities and, in this research project, the type of learning involved is on the threshold between non-formal and informal learning.

Keegan(2005) gives his definition of mobile learning as learning on devices with what a lady can carry in a handbag or a gentleman in his pocket. Such a definition excludes a laptop, but perhaps includes, for example, tablets. However, mobile learning is not just combining mobile with learning, but results in e-learning via mobile technology (Traxler, 2009). One needs to focus on learning that can reach remote parts of the world (geographically or socio-economically) with mobile tools and wireless technology and therewith enhance learning. In this study, mobile devices (smartphones) are regarded as tools to support learning anywhere and at any time (ubiquitous learning). A learner is continuously on the move and always able to gather information through the smartphone based on his/her current context. With traditional e-learning a learner is stationary and uses a fixed learning structure. The approach of mobile learning is that a learner, to a greater extent, “owns” the framework due to its spontaneity and informality. Learning is embedded in the daily activity and based on needs, which allows learning to take place in an appropriate and meaningful social context. Mobile technology enables people to gain and share information wherever and whenever they have a need. Thus, the usage of mobile phones challenges the formal educational setting, not only because the technology is new, interesting, and fun to use, but also due to its significant learning contribution. With increased connectivity in a mobile age learning frequently takes place more often from mobile devices than from ordinary books (Traxler, 2009). Opportunities and possibilities exist of using many of the inexpensive, smart devices with Internet connectivity in developing countries but are yet to be evaluated (Donner, 2008; Duncombe, 2011).

THEORETICAL APPROACH

Clough et al. (2008) claim that mobile phones used by adult students and experienced mobile users support both informal as well as collaborative learning, though the latter is more complex to

analyze. However, Koole (2009) contributes with a comprehensive framework (The Framework of Rational Analysis of Mobile Education or the FRAME-model) that analyzes the interactions between a mobile device, a learner, and social aspects. Koole (2009) uses a Venn diagram (Figure 1) that shows the relationships between the learner aspect (L), the social aspect (S), and the device aspect (D).

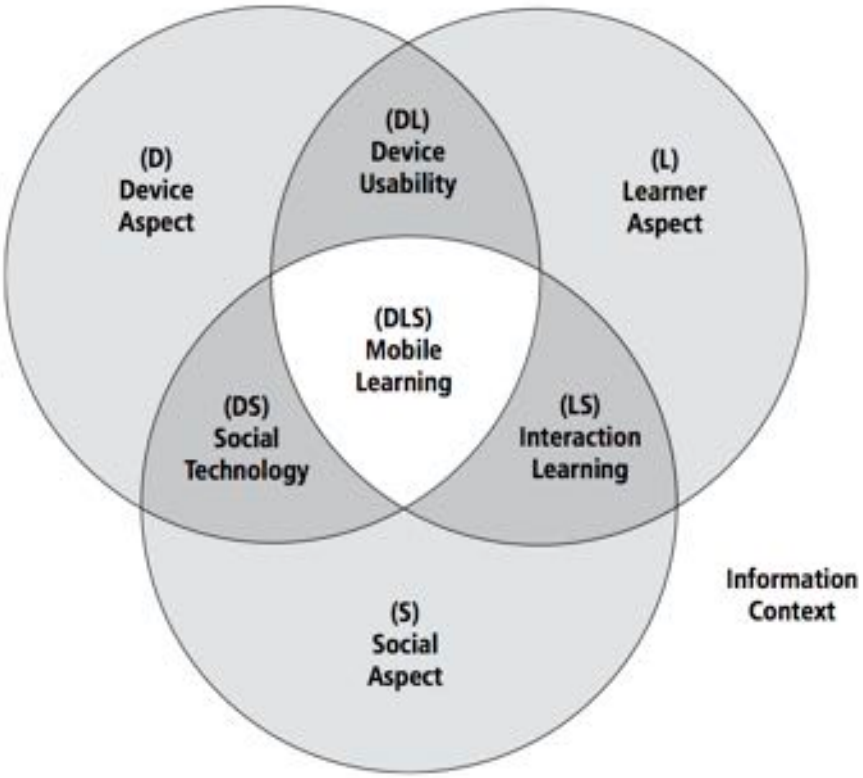

Figure 1: *The FRAME model (Koole, 2009, p.27)*

The core of the model is mobile learning (DLS), but the three aspects overlap each other. Koole (2009) defines each aspect and intersect, viz., device aspect (D), learner aspect (L), social aspect (S), device usability (DL), interaction learning (LS), social technology (DS), and mobile learning (DLS).

i) The device aspect refers to the physical characteristics of the hardware such as size, weight, touchscreen, and storage as well as the usability of the software.
ii) The learner aspect describes how learners use previous understanding, and how they develop skills and concepts.
iii) The social aspect addresses communication, cooperation, and interaction.
iv) The device usability (DL) intersect consists of both the device and learner aspects. This intersect combines the physical characteristics of the mobile device with a learner's mobility, access to information on the move, and comfort, which are all significant for usability.
v) The social technology (DS) intersect describes information exchange and communication collaboration between multiple users of a mobile device. This intersect also considers the connectivity of a system (e.g. WiFi and Bluetooth) and collaborative tools.

vi) The interaction learning (LS) intersect refers to individual, collaborative, and socio-cultural learning. This intersect relates to Vygotsky's (1978, 1986) zone of proximal development, which is what a learner is initially able to learn in an environment together with peers, adults, or other experts, and later able to perform individually. This process is a learner-centered approach where the learner is not a passive recipient in learning activities, but rather an active participant. Authentic learning tasks are the key and, through technology, the learner can cooperate and collaborate with others in problem solving activities. By assessing the utilization of all components in a mobile learning setting, the effectiveness of learning experiences can be discussed. Smartphones support the learning process, and in this study they are tools used for learning and social processes.

However, there are shortcomings regarding the effectiveness of mobile phones for learning. For instance, what happens when the learner does not find what he/she is looking for and there is no tutor to assist? This may happen even in a formal school environment, but in such cases there are teachers, supervisors, and peers to assist with an assignment. However, Koole (2009) argues that mobile learners can gain immediate and ongoing access to information, peers, and experts (not necessarily teachers) to validate the relevance and importance of online information because mobile learning is a process defined by social, cognitive, environmental, and technical factors.

This leads to an exploration of what acquired skills and tools are required to navigate in "knowledge-rich environments". One can consider the Internet to be such an environment, if the learner is able to identify relevant and accurate information. Bransford and Schwartz (1999) claim it is not enough to reproduce "knowing that" or apply "knowing how". Instead one must be capable of "knowing with". This capacity can be explained as one associates, interprets, or judges situations based on previous experiences, which affect what learners notice in subsequent events. It is nevertheless important in a changing society that learners first generate their own ideas about phenomena, and contrast their own thinking with others to enable critical thinking and create diverse viewpoints about issues.

CASE STUDY AND KENYAN RUNNING

The FrontRunner project had a target group that consisted of Kenyan runners from the slum of Kibera in Nairobi (East Africa's largest slum) and from Ngong town (20 km outside Nairobi). The runners were chosen as the primary target group because they had little formal education, and they were a close-knit social group with no previous experience with smartphones. They were also highly motivated to try new technology in order to improve their training and income earning potential. In total there were 30 runners (21 men and 9 women) in the 19-34 age level, and the majority had not completed secondary school. All the selected runners were part of a larger training group but for this particular project their coach chose them. The runners were chosen based on their performance and attendance in training. The runners were semi-elite (in terms of racing results just below the elite level), elite on the national level, or world-class elite (competing professionally in international races). The vast majority of the target group concentrated on running the marathon (because there is more prize money in the marathon) and trained 2-3 times per day/6 days a week, to realize their potential and fulfill their goals. The runners were committed and proud to be athletes, and strove to make their country proud of them. All the runners came from poor backgrounds, and running was their chance to earn money. Some of the runners succeeded in the struggle to be a top athlete and earn a significant income, while others did not succeed.

All the runners in the target group already had a simple mobile phone, but they had never used a smartphone. The target group had limited computer skills (computer skills are not taught on a

regular basis in schools and students are instead instructed to go to Internet cafes) ranging from nothing at all to sending an email or doing simple searches on the Internet. Hence, it was important to keep the technology as simple as possible. Therefore, at the start of the project only the standard Android apps were available. The reasons for this were: a) pedagogical because the technology should facilitate the project rather than dictate outcomes b) practical, as too advanced smartphones could become a serious barrier to engaging with a mobile learning activity, c) security because a simple smartphone minimized the attraction value for others and reduced the risk of theft.

All 30 Kenyan runners were provided with a simple Android smartphone (Huawei Ideos costing $80 USD) and free Internet time (1.5 GB traffic/month). The research institutions backing this research effort paid for the smartphones and Internet time. Attempts were made to gather corporate sponsorship, but all efforts failed. The lack of corporate sponsorship prohibited the purchase of more expensive and advanced smartphones, but allowed the study to proceed without being beholden to partners with vested interests. In total, 29 of the 30 smartphones were tracked, and all aspects of telephone usage were recorded by a locally installed app and sent to servers when a data connection was available. The one smartphone that was not tracked had hardware issues that prevented tracking, despite numerous attempts to repair it. Due to a variety of technical issues, all the activities were not successfully logged for the entire year. However, the tracking for all 29 smartphones was for at least 4-6 months of the entire period, and 3 smartphones were tracked for the entire time period. This tracking meant that the number of text messages, calls, GPS-locations, applications used, and web pages accessed were recorded and stored for each runner. The tracking log data even provided the specific dates and times of use. This concrete data supplied important, objective information that balanced the subjective images that emerged in the formal interviews, as well as provided security measures if the telephone were lost or stolen. The participants were well aware of the tracking, and it was thoroughly discussed both within the groups and with the researchers. Permission from each runner was given in a written, informed consent letter.

Naturally tracking and logging personal information creates an ethical discussion of the research design, and it was continuously discussed during workshops, meetings, and interviews. Our educational institutions approved the informed consent forms in October 2011. In November 2011, at the start of the study followed by the distribution of the smartphones, the runners first read the consent letter themselves. They then had the consent forms read aloud and thoroughly explained to them in both English and Kiswahili prior to signing. In addition, the exit strategy for this study was that after the research period expired (Nov. 2012), the participants would be allowed to keep the smartphones for use as they wished.

This study was an exploratory case study (Yin, 2009). The method used was participatory action research (PAR) that aimed at deeply delving into a phenomenon and exploring the details of a situation in order to understand and empower participants (McTaggart, 1997). It was an intervention (with the target group receiving the smartphones to learn and achieve something with it, so it had a specific purpose. The runners' use of and learning with the smartphones during daily activities was analyzed in order to enhance educational opportunities outside the formal sector. Furthermore, specific informal and non-formal learning activities were planned and completed, however, it was difficult to know to what extent the participants were empowered by the research process (Simonson and Bushaw, 1993), although new ideas arose during discussions/workshops (five visits to Nairobi during the project) with researchers and other participants. Initially, the researchers assisted with the basics of smartphone usage and suggested different learning activities. However, inspiration and guidance for other activities came from peer collaboration.

Participatory action research requires fieldwork, though the researchers' time in the field was not continuous. The researchers chose to follow the project on site in different periods and not as permanent participants in the field, and were in Kenya five times in order to perform workshops, interviews, and address any hardware issues with the smartphones. However, further data collection was made possible in addition to the fieldwork and interviews (individual and group) by using e-mail, web surveys, and the continuous logging of the smartphones. The qualitative data were reviewed and categorized several times and the mobile log data were thoroughly checked to see that they were in sync with the categorizations. Furthermore, both a within-case analysis and a cross-case analysis were used to examine different perspectives on the same issues (Patton, 2002). By grouping together data from different participants to themes or patterns both evidence and rival explanations of the research design and its findings were investigated. The analyses of all the interview data and log data were broadened and strengthened because one researcher focused on the technical aspects of smartphone usage while another focused on the learning aspects.

RESULTS

The results are presented below within the FRAME theoretical framework discussed earlier. The empirical data are presented according to the device, learner, and social aspects. All quotes from participants' interviews use pseudonyms to hide actual identities. The data sometimes overlap, but the interactions and intersects presented previously in Figure 1 are also discussed in order to take this into account.

Device aspect and usability

Results from this study indicated that smartphones could support learning and had an important role to play in informal settings. Many of the runners lacked computer skills and the telephone tracking log data supported this fact because the fourth most commonly used application on the smartphone was the "settings" application. This fact indicates the participants' need to frequently access the settings on the phone to determine how some aspect of the telephone functioned. However, they did not express anxiety about getting started with the device. Instead they showed enthusiasm and motivation to understand their smartphone and frequently assisted each other. In a very short time, all the runners had an e-mail and Facebook account, downloaded different apps for training, took and shared pictures, listened to music, and browsed the Internet. One runner (Eric, personal interview) claimed he learned by exploration- "You do it yourself, when you not busy you sit down and click on a program and you are following things." In several cases, the runners even taught family members the capabilities of a smartphone.

The runners developed skills on how to use the smartphone and established areas for further exploration. They exchanged ideas with each other about different applications, which ranged from games and other leisure applications to technical and educational applications. The telephone tracking log data showed a great diversity in websites and applications. For example, the participants surfed over 1800 unique URLs (website addresses) and used 182 unique applications during the course of the study. The most frequented websites were Yahoo, Google, and Facebook. The most frequently used applications were the "contacts", "telephone dialer" and "application launcher". A list of the most 10 frequented websites and used applications along with total usage statistics can be seen in Table 1 below. Many of the runners also downloaded the Bible, so that they could read it whenever they had time. Frequently, they read the Bible (220 distinct uses recorded) on their phones while attending church services on Sundays. Web searches were mostly done in English, though some runners translated to Kiswahili with "Google translate" before searching.

Table 1. *Summary of the top 10 websites visited and applications used along with total usage statistics for the successfully tracked time periods for all 29 smartphones.*

Top 10 most visited sites (1800 unique sites visited in total)	**Number of unique visits**	**Top 10 most used phone applications (182 different apps used in total)**	**Number of distinct uses**
Yahoo sites	28,483	Contacts	73,560
Google sites	19,803	Phone dialer	72,764
Facebook	11,634	Application launcher	69,483
www.safaricom.com (Telephone company)	2,598	Phone settings	18,164
YouTube	2,456	Web browser	16,219
www.standardmedia.co.ke (News site)	2,246	MMS	16,192
Twitter	1,731	Photo Gallery	8,739
www.netlog.com (Dating site)	1,708	Music player	6,918
Wikipedia	1,282	Facebook	5,663
www.nation.co.ke (News site)	1,279	Google search	5,161
Total number of visits for all sites	**180,728**	**Total number of distinct uses of all applications**	**346,831**

The runners were asked about their learning and when they used their mobile devices. According to them, learning happened all the time, and their "in-between time" was used unintentionally. By filling the space between ordinary activities like training, eating, and meetings, the smartphone afforded opportunities to be informed and stay connected. They were connected with family and friends as well as the Internet around the clock. The runners updated their statuses, and increased their communication with others. Their communication was mostly by phone and chat in the local community. They also assisted each other with technical and language problems, and shared advice on new applications. The runners communicated with the outside world mostly by Facebook and email and some even used Twitter. The smartphone became a part of their daily activities and was always with them. Internet cafés (Cyber in Kenya) were no longer necessary for the runners to access the web, thereby saving money. A runner (Eric) stated in the web inquiry: "On a typical day, I wake up and read inspirational quotes from the Internet. Then all day long I do send e-mails and receive them at my time and place. No more Cyber cafes now."

Learner aspect and interaction learning

The low cost associated with learning with a smartphone was especially beneficial in a developing country such as Kenya. Education in Kenya is costly after the primary school level and even has pedagogical challenges. Pupils mainly memorize information and reiterate it in national examinations. The runners realized that to learn with a smartphone it was not possible to memorize knowledge as in formal schooling. Instead, they had to explore and experiment themselves in order to understand the smartphone. Technical support for the smartphone and applications was a challenge, but the participants realized that they needed minimal instruction to work with the smartphone. One runner (Emmanuel, personal interview) said, "I have not learned anything about computer so this phone is the first teacher to teach me about computer."

Other common tasks and skills that the runners developed were, for example,

(i) searching for races in foreign countries;
(ii) getting inspiration online from other Kenyan runners;

(iii) watching races on YouTube;
(iv) finding advice to prevent injuries, finding health related issues (such as diet and exercise);
(v) reading news, and
(vi) watching videos.

Within three months, the runners were watching TV on their smartphones and one runner said (Susan, personal interview) that she did not have a TV and "before the smartphone I could go to the neighbor, we watch the television from there or sometimes I heard from other people what is going on".

The runners initially indicated (interviews in the initial phase of the project) that their main interest was running and that they were not interested in political issues, "We don't follow politics". One reason was that politicians were seen as corrupt and liars. Nevertheless, we could see that the runners gradually showed an increased interest in their surrounding world. For example, the telephone tracking log data (Table 1) showed that the runners frequented many news sites from their smartphones, with the website *www.standardmedia.co.ke* being the 6th most visited web site overall, with over 1600 individual visits. The runners not only followed headline and sports news mostly within East Africa, but also worldwide. When the runners gathered for training (they nearly always train in groups), they discussed the latest news. One runner even claimed (Benjamin), "I'm now reading the Washington Post", which was completely new to him. Before, during, and after training sessions the runners not only discussed the latest news, which they of course even did before, but now they did so with increased knowledge and accuracy of current events. Increased access to a variety of news sources was very critical considering the violence that took place in Nairobi and Kenya's ongoing war with Al-shabab in Somalia.

As Maurice stated, "From now I'm well updated. Whatever, we are used to books that were written some many years ago, but currently we have this. You just click and then you are well updated". Curiosity stimulated their learning and one runner (Eric) argued: "Like on Sunday. The pastor was talking and gave us education, and he gave us a story of a fight between Muhammad Ali and Frazier. You see when he was talking, it was very short, and it was something you like to find out more, so immediately after church I went out to my car and read the whole story. Very entertaining. So it is quite helpful. You cannot imagine life without these phones now".

Furthermore, the runners improved their skills in English and were eager to learn more, and the smartphone satisfied their curiosity. Some participants translated phrases from other languages (for example Spanish) and thereby widened communication with people they could not have communicated with before. The runners improved on their basic computer skills and explicitly expressed a desire to further develop their computer skills and even improve their Human Rights awareness. Another learning outcome was location awareness. The runners used the GPS during training sessions (4914 separate application were recorded), and after training they explored details in connection with the map and route generated from their run. Some of the participants even used their smartphones and GPS to find and visit new locations in Nairobi.
This learning and new knowledge spawned new ideas, which ultimately resulted in even more e-mail, Facebook messages, web searching, and sharing of training routes. One runner (Dennis) wrote in an e-mail before a planned workshop in Kenya: "You are welcome in Kenya. Come having it in mind that you have the burden of initiating the awareness forums." One trend that emerged from the participatory action research was that the availability of ICT had a social impact and empowered the runners.

Social aspect and social technology

The participants incorporated the smartphones as per their sociocultural context, and found new ways to exploit this technology. However, the main advantages highlighted by the participants during both group and individual interviews were the effects of training. The runners' own training improved with the use of the smartphone with running apps such as RunKeeper and MyTracks in their daily training. They had better access to data from their training and could view it afterwards in order to analyze and make necessary adjustments. The runners' speed and endurance increased because information such as pace, total time, and distance were continuously available during the training session, and several of the runners reached the Kenya national championships in track and field for the first time. One runner (Nicholas) argued, "Since I got the smartphone I became so motivated and nowadays I train twice a day to increase my speed. I'm faster than I used to be with the help of the timing." Before using the smartphone, the runners claimed, "we just used to run" without tracking the distance or speed of a run. Now they were better prepared and informed before, during, and after training.

Another reason for increased race performance was access to detailed information about races that was previously not possible. Before road races the runners searched for course details such as course profile, course record, average temperature, and altitude in order to better prepare for a race. If the race was an international race, the runners also searched for general information about the culture and city where the race took place. Additionally, the runners also stated that their long training runs (30-40 km run) were not as monotonous when you could listen to music at the same time. Usually one of the runners in the group acted as a DJ and played music through the speakers of his/her smartphone.

An example of increased personal expression and access to an extended social network with the smartphone came from the first interview. One of the female runners (Patricia) said,

> *"For me, I was going to Cyber café. To click and write for races that I wanted to run. But for now, I'm very happy, for having this phone that has meant a lot of change in my life. Because now, when I want to Google something, finding it, even if it is in midnight, it is no problem."*

A few months later, the same runner informed that she was soon leaving for a foreign country. The reason was that she had been browsing on her phone and came in contact with a race organizer in that country, and they had arranged several races for her. Previously, only agents arranged international races. Now the runners could create, collaborate, explore and control the process themselves by using a smartphone.

The smartphone also provided some basic tools for creating business opportunities for a better life. Some of the runners used the camera in the smartphone to do business. By taking pictures of ceremonial contexts or solemn occasions, they were able to print the pictures and sell them to the guests. The majority of the runners also started doing business through their running. They organized urban tourism called "slum runs", where tourists could safely run with elite Kenyan runners through local slums. Tourists in Nairobi were paying for "slum walks", which were guided walks through the slums of Nairobi. In Nairobi the visitors gained safe access to local people through a NGO to visit homes and projects in the slum. The "slum run" had the same theme and access, but instead explored the slum while running with local runners. The smartphone was used to book and manage planned runs as well as track the actual route, and all contact with the customers was managed through the devices. These "slum runs" not only generated income, but also created learning opportunities and enhanced interaction between tourists and citizens. These runs generated income for the runners and even enhanced language skills and knowledge of their surroundings because they stopped frequently to explain local points of interest. The

runners, tourists, and even local inhabitants learned from one other through dialogue while interacting in their native surroundings and sharing aspects of each other's culture.

The "slum runs" revealed that runners in the project were confident using the smartphone and ready to seize business opportunities. The runners also expanded their horizons and envisioned alternative opportunities to their running "careers". With increased information and knowledge they anticipated other possible careers, such as physiotherapy or business, for additional income beyond just running.

A short summary of the primary implications for the runners' smartphone usage on economic opportunities, informal learning and running performance is shown in Table 2.

Table 2. *A summary of implications the smartphones have had on the runners' training, economic opportunities and informal learning*

Economic opportunities	Performed "slum runs" for income. Sold pictures taken with their smartphones Rented the smartphone to other runners who did not have one. Charged fees for using the smartphone as a tool to learn skills/gather information.
Informal Learning	Increased awareness of their surroundings. Increased awareness of current events. Improved English language skills. Improved navigation. Improved online banking. Improved digital literacy. Learned to create and maintain a digital presence.
Running performance	One male runner has 2 wins and 2 top 10 finishes in international races and now has a manager Two female runners are living and running internationally in Denmark and Mexico respectively. One male runner has won races in Scandinavia and now has a manager. Four runners have participated in the Kenyan national championships.

Understandably, a direct correlation between smartphone usage and increased running performance is difficult to prove. However, according to the runners themselves in interviews, the smartphones helped immensely by improving their ability to time runs, measure total mileage per week and search the web for training and diet advice when training for races. Therefore the runners were better prepared for races using the newly acquired data from the smartphone instead of their previous "we just run" approach. The smartphones also assisted in planning for races by searching for and studying the race profile and competitors. Finally, the smartphone gave the runners the key ability to find and contact race managers (for example in Denmark and Mexico), who are vital for a Kenyan runner to compete internationally. The assumption is that the combination of all these factors contributed significantly to the runners' overall performance and subsequently their running achievements.

ANALYSIS

The process in participant action research is initiated by the researcher, but designed together with the participants, and aims to action implications (Whyte, 1991). Thus, the participatory action research method in this case impacted the outcome. However, the impact of these acquired new skills and knowledge from intensive usage of the smartphones was not intentionally preplanned or designed. It was instead a result of the collaboration or dialogue between researchers and participants to improve life conditions. Hence, this process was greatly influenced by the participants and new ideas arose during the fieldwork. Some of these ideas were implemented in reality as a Human Rights education platform and slum runs. Regarding increased confidence and faith in the researchers and collaboration, the Kenyan runners developed a higher self-esteem concerning the usage of technology. Therefore, the mobile log data showed significant use of the smartphones, and interviews verified increased learning and knowledge.

The target groups in this project had a limited, formal school background, but exhibited an increased interest in education and learning. This research project contributed to new ways in using smartphones in mainstream school education and to achieve a more blended approach between formal and informal learning. Learning with the smartphone was not planned, sometimes unintentional, and not intervened by teachers. Additionally, it was individualized and diverse and consisted of real life learning, which was relevant, interesting, and significant for the learner. Learning could be delivered “just-in-time” or “just-for-me” and many of the runners remarked that the smartphone kept them busy and entertained (Traxler, 2009). Furthermore, the device aspect had a significant impact on usability (Koole, 2009). The smartphone reduced boredom and facilitated relaxation with music, reading, and/or surfing the web between training sessions. In order to enhance knowledge and select relevant and reliable information, some kind of support or scaffolding was needed. This support was either guidance from a friend or relative, or support from the application itself, one that did not require high-level skills. Additionally, the participants in this case study had an active, self-motivated learning process and they were not simply passive recipients of the researchers’ objectives or intentions.

The core of Koole's (2009) FRAME-model is the integration of mobile technology, learning capacity and social interaction. This case study showed the smartphone was a significant and appropriate tool for learning and collaboration. The device itself had significant impact on the usability. The Kenyan runners were comfortable with their smartphones. The participants operated and interacted with the smartphone easily, and the existing screen size and speed of the Internet was acceptable. In order to deepen knowledge and select relevant and reliable information, some kind of support or scaffolding was needed. This support was either guidance from a friend or relative, or support from the application itself, which did not require high-level skills. Additionally, the participants in this case study had an active, self-motivated learning process, and they were not simply passive recipients of the researchers' objectives or intentions. The participants learned by discovery, intrinsic motivation, and prior knowledge. They stimulated understanding with multimedia and had a willingness to adopt new information whenever possible.

However, conveying the concepts was difficult because of the social processes that dominated the running community. The smartphone created a bridge between learning and increased social interaction. Though the learning interaction was generally learner to content and action-oriented, there was a need to utilize a variety of learning situations and interactions in order to select relevant information. There is a distinction between knowledge production, where a teacher determines what should be learned, and what we encountered in this project, which was knowledge navigation where someone who knew more assisted the learner (Koole, 2009). Koole (2009, p.39) notes, "In knowledge navigation, learners acquire skills to appropriately select, manipulate, and apply information to their own unique situations and needs." Bransford and

Schwartz (1999) also describe this behavior referring to "knowing with". The usage of a smartphone coupled with Internet access challenged the runners to question their own assumptions, and they actively sought out others' opinions in the pursuit of learning and increased understanding.

Pupils in schools, particularly those in developing countries, are not frequently exposed to ICT, and therefore a smartphone could be one tool for those with limited technical knowledge to improve digital literacy. With the introduction of new technologies such as smartphones, a more flexible learning environment was available and the smartphone with suitable mobile applications worked as a catalyst for immediate learning. A majority of the runners had only a primary school educational background and limited academic skills in English. In the observations it was noted that if they did not properly translate something, then they probably did not understand the content. This fact minimized the learning effect in the sense that the learner just did what they used to do without utilizing the smartphone. The deciding factor was that the learner interpreted and understood information with the goal of creating knowledge. From the interviews and observation emerged a concern that a critical view of Internet content was not instinctive for the majority of the runners. This inclination is inline with by an Italian study of adolescents that found a lack of critical thinking regarding Internet information (Calvani, Fini, Ranieri and Picci, 2012).

As previously stated, the runners frequently searched for information, read online news, and generally created an online presence to a great extent. However, Internet access was costly and in this project the researchers provided the participants with free Internet during the project period to alleviate this issue. Wi-Fi hot spots existed in the Nairobi area, but only in the more sophisticated locations like hotels and coffee shops. Therefore, it was not a feasible long-term option for our target group. Another negative device aspect of this project was the battery life of the smartphone, which did not last long, especially if a mobile data connection, GPS, and other energy consuming applications such as video were used. The issue of poor battery life was compounded in this case because some participants did not have electricity and were forced to pay to charge their smartphones at charging stations. The poor battery life and high power usage of a mobile data connection and videos increased the runners' need to charge their smartphones more often than with a simpler mobile phone. This increased cost might also have reduced their usage of power hungry applications.

Finally, in spite of the roadblocks, the participants were convinced that the smartphone not only assisted them in information seeking and training, but also reduced corruption and cheating. Money transfers, banking, and bookings using the smartphone minimized opportunities for corruption. Smartphone transactions reduced cash transactions and thus reduced the risk for traditional bribery. Thus, technology was used by young adults within sociocultural circumstances in which technologies existed and through which they attained their meaning (Rangaswamy and Cutrell, 2012). The participants relied heavily on the technology and less on institutional entities. The runners developed skills as informed citizens, and they did not only master the tool, but even maneuvered more independently in society.

CONCLUDING REMARKS

Nowadays many people access the Internet with a mobile device and this fact is transforming learning. A smartphone in the hands of Kenyan runners, or any Kenyan citizen, has a strong potential for changing life conditions and increasing both informal and non-formal learning. The use of a smartphone was a part and parcel of the daily activity of the runners, and it enriched their everyday lives. The smartphones created increased awareness and the most common statement in the interviews was "so it helps us a lot". The runners' motivation to use modern technology to

improve their own training and racing as well as learn new skills via the smartphone increased dramatically and their self-esteem grew.

From the findings and analysis of this study the following five major conclusions are

1. the smartphone improved the runners' training and race performance and created business opportunities;
2. a smartphone with an Internet connection empowered marginalized groups and augmented informal learning opportunities;
3. a smartphone was not a significant technological hurdle for impoverished or uneducated individuals, and most issues were solved locally;
4. the participants were able to learn with little or no guidance or scaffolding;
5. the tracking log data indicated both a breadth and depth to individual learning due to the diversity and number of web sites and applications used.

In short, this project showed that mobile technology with an inexpensive smartphone could support poor people in their learning with little need for intervention or training. It was the equivalent of giving them a computer connected to the Internet around the clock.

Some limitations to advanced learning that still remain are

i) A lack of computer skills and language, although the learners mostly solved such issues by consulting a friend who knew a bit more, so-called peer tutoring.
ii) Physical limitations like the cost and access to the Internet and electricity.

These ubiquitous technologies in developed countries were too expensive and unstable to maximize the effects of a smartphone and need to be addressed by future interventions. Finally, runners are icons in Kenyan society, and even in this project their competitive spirit motivated them to succeed regardless of hurdles. Now the runners are even motivated to be role models outside of principal activities, in the form of frontrunners in ICT and development.

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Technology-supported classroom for collaborative learning: Blogging in the foreign language classroom

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ABSTRACT

This study examined the phenomenon of blogging as a technologically enhanced support to develop interaction and interrelatedness among learners in a foreign language course. A corpus of 62 blog entries and 30 comments the bloggers left on each other's blogs were analysed to find out whether blog may be used to promote connectivity and collaboration among students. The findings of the study revealed interaction between bloggers was limited; thus, the study indicates the restricted use of blog as a tool promoting collaboration in the foreign language classroom. Furthermore, the results identified some of the problems related to technology-based learning and teaching.

Keywords: *blog; collaborative learning; technology-supported learning; Foreign Language Learning; web 2.0.*

INTRODUCTION

Technology has been applied in Foreign Language instruction for the last 30 years when Computer-Assisted Language Learning (CALL) was developed and implemented in education. Th-is early approach aimed mainly at individualized interaction between the learner and the computer program used to supplement (Beatty 2013:8) or replace the traditional teacher-student interaction, for example thanks to various education apps for mobile learning or interactive animatronic toys that promote interactions between the individual and the toy (Beatty 2013:9) . The numerous benefits (e.g. self-paced and guided learning, immediate feedback, repetitive practice, self-access) encouraged educators to further develop more sophisticated tools that can support learners in their learning. Despite reluctance of many teachers and limitations of learning programs resulting in restraining of students' learning and narrowing the potential of educators (Bowers 2011) , technology-assisted education has been growing in popularity and a continuing advancement in information and communication technology (ICT) has enhanced the quality of education producing a substantive gap between conventional approaches and new technology supported teaching and learning.

Technology assists students in the learning process modifying the way learning is delivered. Now learning has become a personalized and meaningful experience that meets learners' needs as opposed to traditional teacher-centered and text-based education that places primary emphasis on "conveying fixed bodies of information and viewing students as passive recipients of knowledge" (Alavi 1994, p.160). Hence, irrespective of their personal differences, preferences and histories, technology helps to deliver individualized content at the time and place students select (e-learning and mobile learning) thus increasing their learning spaces by taking learning out of the classroom. However, technology-supported learning can also be integrated into classroom teaching offering curriculum abounding in varied activities catering for the needs of every student (blended learning). The term blended learning is applied to learning that uses a variety of "the most effective training solutions, applied in a coordinated manner, to achieve learning objectives" (Wilson & Smilanrich 2005, p.3) usually with the computer or another mobile device that serves as a medium of

facilitating learning and meeting the learning objectives. The most effective application of technology in education is connected with a variety of tools and methods it offers since no single teaching method can meet the needs of various learners (Wilson & Smilanrich 2005, p. 12). Thus, not only does blended learning offer highly individualized instruction but also promotes autonomous and active learning.

Technology supported classroom

Learning always takes place in context and nowadays this means technology-rich context. 75% of American teenagers own cell phones with cell-phone texting becoming a favorite channel of communication between teenagers (Lenhart 2010). Adolescents find their cell phone an indispensable communication channel; they use electronic communication devices mainly to reinforce their relationships with friends (Subrahmanyam & Greenfield 2008). Undoubtedly, mobile devices have changed the world, learners' interaction with the world, as well as the way information is delivered and consumed. Since one of the aims of education is to prepare students for the world and competitiveness of workforce, new technology should be incorporated into the modern curriculum.

An important consideration is how to use technology so that it supported learning and teaching. Web 2.0 tools can be used to address learning outcomes. Web 2.0 (also referred to as the New Web) refers to new Internet tools and technologies that allow their users to go beyond being passive recipients of information, but becoming active and interconnected in the process of receiving, digesting and evaluating information. Most of these tools are free and available to all (Solomon & Schrum 2007); they can be accessed after following a self-registering procedure. Web 2.0 tools include blogs, wikis, photo and video sharing, RSS, and social networking applications.

Technology-supported learning may seem as an isolated activity, but in order to be used to the best benefit of the students, it should be turned into a collaborative task. In fact, learning is effective when it is a social activity. Collaborative learning is group-based learning where learners join their efforts, initiative and work in educational endeavors. In order to turn learning into a social activity, it cannot be based on drills and meaningless, automatic exercises. Social learning involves project-based learning where technological devices serve as tools that support learning. Learners cooperate in order to recognize, analyze, and solve problems. Learning is enhanced when information is presented in the social and meaningful context, which allows to assimilate new information into the already existing schemata hence increasing students' performance in the target language. Having a goal to achieve, students make use of their knowledge and resources available; they develop skills and gain more knowledge while developing and nurturing relationships with other classmates.

Implications of Web 2.0 tools for education are numerous. Web 2.0 tools boost students' creativity (e.g. when they prepare presentations or design web sites) and promote communication and collaboration with other students all over the world (thanks to such tools as blogs, wikis as well as thanks to uploading photos, videos or podcasts). Moreover, new technology allows students to get immediate feedback, which boosts their motivation, interest, and encourages them to research the field they are learning about more thoroughly (students find it easy to study a problem as all concepts on the Web are interconnected through hyperlinks). Thus, learning with Web 2.0 technologies promotes multiple skills, literacy, critical thinking, reasoning, analyzing, organizing information, selecting valuable information, communication, creativity, autonomy, and collaboration. Finally, computer-mediated learning helps to prepare students for lifelong acquisition of knowledge.

A weblog (blog) is an often-updated website that displays entries usually in a reverse chronological order that can be commented by visitors. Blogs usually combine text, graphics, and topic-related

hyperlinks. The popularity of blogs proves that writing is a pleasant activity rather than a tedious task; furthermore, blogs are highly interactive tools (Efimova & De Moor 2005) that combine words and images. When used in a foreign language classroom, students are encouraged to write, revisit, reflect on the feedback, and comment on each other's work, they find the writing task interesting, purposeful and relevant. Hence, blogs have a potential for increasing student interaction sharing and social skills (Gedera 2012). Blog-based activities include writing class-related information and reflective journals, stories, discussion topics, but blogs can also be used to communicate with the parents. Students can also peer review and comment on other students' work, collectively prepare writing assignments or projects.

According to Campbell (2003), there are three types of education blogs for ESL students. First, the tutor blog is run by the teacher in order to give course information, to provide links for self-study online materials, to offer extra reading practice of both the blog post and other related articles linked to it. Another type of blog is the blog run by individual learners or groups of learners as a form of writing and reading practice. Finally, all students contribute to a class blog that not only provides current information on the course and homework but also gives the opportunity to develop research, reading and writing skills. Thus, blogging activities give writing a meaningful purpose. Furthermore, students' motivation is boosted when their posts are read and commented on by authentic audience.

When blog-writing activities are integrated into the course, students develop more positive attitude to learning and motivation to communicate and share ideas with their classmates (Dujsik & Cai 2011; Gedera 2012); an increase in motivation and confidence stems from the awareness that their blog is read and commented on by their peers (Muangnakin 2012). What's more, the students may develop confidence and reduce anxiety when they are prompted to analyze their classmates' strengths and weaknesses in writing (Li 2009).

Lundstrom and Baker (2009) investigated the relationship between commenting on their peers' writing and the students' writing skills. The study showed that both offering and receiving feedback is beneficial; however, the learners who provided feedback surpassed their classmates in writing abilities, which may result from the development of critical thinking skills that commentators make use of while working on their own papers.

However, frequently students need to be encouraged by the teacher to start and comment on each other's blogs; that is why blog-based tasks need to be carefully structured: open discussion questions should be asked, the workload should be evenly distributed, the teacher needs to take an active part in the discussion moderating interaction between students and inviting engagement (Forster & Tam, 2006).

Difficulties of Using Blogs

Despite multiple benefits, technology-supported learning offers several limitations. Some students might be anxious of writing and posting a text that contains various errors; they can be inhibited to post comments on their classmates' blogs. Liu and Hansen (2002) claim that the students' feedback may be constrained by the following factors: learners' cultural backgrounds, their communicative ability and the mode of peer feedback. Other drawbacks of introducing blogging activities in the classroom include feeling anxiety when commenting on their classmates' papers (Amores 1997), decreased motivation when comments prove to be either vague or spiteful. As claimed by Gedera (2012), some students find it difficult to offer constructive criticism on their peers' posts without being rude or hurting the others' feelings.

METHOD

Research Objectives

Taking into consideration the benefits of Web 2.0 tools cited above, the present study sets out to investigate how active and creative the students are when they are engaged in a blogging activity. Literature on blogging in the EFL/ESL context reports contradictory results for the use of blogs to promote collaborative learning. There is a large body of research that support the use of blogs to promote writing skills; however, the present study focuses on the phenomenon of blogging as a technologically enhanced support to develop interaction and interrelatedness among learners in a foreign language course, particularly by the means of providing and receiving feedback on students' work. The aim of the study was to carry out an analysis of interaction among bloggers through the comments they leave on each other's blogs in order to find out whether blog, which is a highly interactive tool (Efimova & De Moor 2005), may be used to promote collaboration in a foreign language classroom. The following research questions guided the study: (1) how are the students involved in using blogs for creating the learning community? (2) what is the nature of the students' comments?

Participants

The participants in this study were students enrolled in a Foundation Course held in a private university in Thailand. This preparatory English course with a duration of 12 weeks provides students with the necessary language skills before they undertake undergraduate or graduate degree studies abroad. A total of 12 students participated in the research; the criterion used in selecting the study sample was linguistic proficiency of the students (above pre-intermediate). The criterion of linguistic proficiency was used in order to ensure the participant are able to express themselves in a foreign language. The results of the placement test the students took prior to enrolling in the Course were consulted in order to determine their proficiency level. Participants in the study were all Thai and either high school graduates (9 students) or holders of bachelor's degree (3 students); they ranged in age from 18 to 25 years. All participants gave their consent before taking part in the study.

Design and procedure

Traditional Content Analysis was used to analyze the blog entries and comments. Content Analysis has been chosen as a research technique as it provides "the systematic, objective, quantitative analysis of message characteristics" (Neuendorf 2002, p.1). Furthermore, this method was the most suitable to meet the objectives of the research as the blogs created by the subjects were simple in form; they did not include hyperlinks to other websites and the distribution of comments was fairly limited. The researcher coded the most important structural features of the blog, including the number of entries and comments each student posted, average length of entries and comments, age of the blog and content type of comments (e.g. informative, relationship, personal). The analysis of the interconnectedness of the comments made by the bloggers was conducted in order to examine the extent to which blogs can be used as a tool of connectivity and collaboration between bloggers in the context of Foreign Language Learning.

The materials in this study consisted of 12 blogs (a corpus of 62 blog entries posted by 12 students). An experimental blog-based environment was organized in which students were asked to write at least 6 entries and comment on each other's contributions. The subject matter of entries reflected the content of the course the students were studying, but the students were encouraged to post their reflections and comments.

The primary aim of the technology-based learning was to facilitate learning and increase student-student interaction. To ensure the educational and communicative aim was fulfilled, a course web site (Learning Management System - LMS) was built in which learners could interact and learn. LMS offers students personalized content, multiple teaching materials, games, and discussion forum that facilitates learning both in and out of the classroom.

RESULTS

First, structural analysis of blog entries has been carried out. Apart from the computation of words, the age of each blog has been recorded as well as the number of comments and inclusion of images. The age of the blog was calculated by counting the days between the day when the first and last entry was posted, with the average blog age at 12,58 days. Table 1 presents the results of the analysis.

Table 1: *Average Number of Words in Blog Entries*

	no of entries	average length of entries (in words)	age of the blog in days	no of comments posted	inclusion of images
blog 1	6	40,33	28	5	yes
blog 2	5	40,2	7	0	yes
blog 3	6	74,5	1	0	yes
blog 4	6	56,33	1	0	yes
blog 5	2	88,5	14	1	yes
blog 6	3	47,33	1	0	Yes
blog 7	6	59,66	7	0	yes
blog 8	4	25,75	7	0	yes
blog 9	6	58	28	10	yes
blog 10	6	53,66	28	8	yes
blog 11	6	57,16	1	0	yes
blog 12	6	95,66	28	6	yes
mean	5,17	58,09	12,58		
total	62			30	

As displayed in Table 1, most students have met the course requirement and published the minimum number of entries, that is 6 entries ranging from 18 to 168 word contributions. However, most of these were quite short (the average length of less than 60 words). Even though the study took 5 weeks, the frequency of posting both entries and comments was very low. The age of as many as 4 blogs was 1 day, which means the students have created their blogs in order to pass the course. Low frequency of posting shows the students' lack of involvement in the task and motivation to join the learning community. All blogs were accompanied by appropriate images; choosing the right pictures and ornaments provided the students with an opportunity to extend their writing skills. However, only the most active learners have posted comments on their classmates' contributions; less than half of the posts received responses in the form of comments. Table 2 presents the detailed analysis of the learners' comments.

Table 2: *Structural Characteristics of Comments*

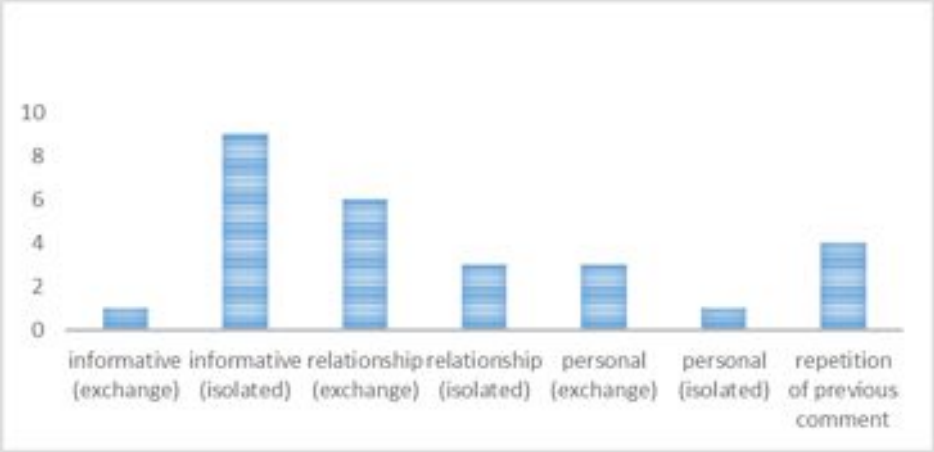
	no of comments posted	frequency of posting comments in days	average length of comments	no of comment responses	frequency of comment responses
student 1	5	3	6	3	1
student 2	0			0	1
student 3	0			0	
student 4	0			0	
student 5	1	1	8	0	1
student 6	0			0	
student 7	0			0	
student 8	0			0	2
student 9	10	4	5,22	1	1
student 10	8	3	6,75	1	2
student 11	0			0	
student 12	6	2	4	2	2
mean	2,5	2,6	6,55	0,73	1,43
total	30			7	

Only 5 out of 12 students initiated interaction with their classmates by posting comments on their blogs. This number and the frequency of posting comments (Table 2) shows students' low involvement in the activity. Most students wrote their blogs on several days rather than posting regularly; moreover, they commented on and replied to any comments on a single day or in two days. None of the students replied to their classmates' entry if it was posted on another day than their original entry or comment was posted, which suggests they did not read the comments their classmates posted on their blog entries. The students treated blogging as another teaching activity rather than a forum for exchange of opinions and information. Hence, the idea of creating a community of active members with shared interests and goals has failed. This is further proved in the thematic analysis of blog comments (Table 3).

Table 3 presents information on the nature of each comment content. In social networking sites comments perform the following functions: informative, building relationship, personal. Following these characteristics, the coder has classified the comments according to the function they fulfill. Figure 3 also shows whether the comment that has been posted sparked off other comments (exchange) or whether it was an isolated post.

Furthermore, Table 3 shows that the great majority of comments were isolated comments posted by individual learners. Only one fifth of all posts have been commented on. All of the comments were very brief; the longest comment consisted of 12 words ("Why you want to know my address? I dont live Bangkok."). The shortest one was a one-word comment posted by 2 different students ("Good").

Table 3: *Content Type of Comments*



Most comments posted by the learners were isolated; they did not generate any discussion. The students most frequently posted comments that were informative in nature: they referred to the information presented in the entry (e.g. “Fry rice. Good a food.”) or posed a question for information (e.g. “Why you wanted to go there?”). Other comments aimed at building relationship with the classmates through an invitation or offer (e.g. “why not go chiang mai with me”), positive comment (e.g. “Petch you very good boy”) or opinion (e.g. “petch i think fry rice it’s best thai food”). Personal comments included asking questions about personal information (e.g. “What’s your address?”) or giving personal information (e.g. “I like play golf”). Some comments were a repetition of the previous comment, most probably due to involuntary clicking on the ‘post’ button.

DISCUSSION

Technology-supported classroom offers flexibility, creativity, and enhanced learning process. Numerous studies (Ali-Hasan & Adamic 2007; Goldman et al. 2008) indicate that blogs, being one of social networks, present considerable opportunities for interaction that is often characterized by high degrees of reciprocity and consistency. Blogs are collaborative in nature as each post can be co-written by members of a larger community who post effective comments rapidly.

Blogs, as a means of instruction, provide opportunities for increased learning spaces and student participation as each student created their own blog. Students assume responsibility for their own learning and take control over the content and form of their blog and comments. However, the present study indicates that blogs do not offer ground for enhancing interaction between learners. The results of the study indicate that interaction between bloggers was limited. The subjects rarely commented on each other’s blog and their comments were not conversational in nature. Most students approached the blogging activity as a necessary evil (posting comments on blogs was one of the course requirements) and posted the minimum number of entries, each entry being fairly short yet sufficient to get a passing grade. Furthermore, the frequency of posting both entries and comments was very low. Very few students initiated interaction with their classmates by posting comments on their blogs. Even when comments were posted, they were isolated in nature and did not invite other bloggers to participate in discussion. Hence, increasing collaboration between foreign language learners through blogging activities proved to be impossible to achieve.

It remains to explain why the classroom blog used in the study provoked little interaction between students although numerous studies indicate increased engagement and activity of participants (Dujsik & Cai 2011; Gedera 2012). First, writing blog and commenting on each other's posts did not generate a high level motivation. The students, whose level of proficiency was pre-intermediate and intermediate, could have found it easier and more accurate to communicate in their native language either face to face or through various social networking sites. Thus, the learners were more likely to look for face to face relation or social networks in their native language to strengthen their relation with other learners. Moreover, they could have felt uneasy to offer comments on their classmates' blog entries as they might have been subject to criticism (of their content or structure) offered by the teacher or other students. This explanation is supported by the finding of the study carried out by Amores (1997) who points at anxiety as a major demotivator in posting comments of their classmates' papers.

In the study the teacher acted as moderator of online activities. However, instructional use of blogs will be increased if one of the students was the moderator for the course blog rather than the teacher thus making the blogging activity more learner-centered. The change of moderator could develop the students' involvement in the activity.

Furthermore, blog, especially if it is written in a foreign language and thus requires a great deal of consideration of the content of the comment, proves to erect a barrier to post candid comments on the classmates' entries. Blogs and other social networking sites create a ground for communication where objectivism is hard to achieve and where feelings are easy to conceal. Genuine conversation in the classroom that is provoked by various communicative activities proves to be a better means of practicing the foreign language.

PEDAGOGICAL IMPLICATIONS

Modern technology offers ample opportunities to support and enrich formal instruction. Technology-supported learning offers integration of learning with student needs and cultural experiences; it plays a substantive role in developing autonomous life-long learners that possess skills and knowledge necessary for achieving success in modern rapidly changing world. Finally, technology-assisted instruction promotes collaborative work as students communicate with each other in new meaningful contexts and communicative activities are necessary to be employed in the classroom because the learners' competence develops as their need to use the language increases.

Technologically-supported collaborative learning enhances language development as students learn in social interactions; commenting on each other's work prompts learners to share their experiences, reflect on their own and their classmates' work and analyze it thus developing their critical thinking skills. Despite the numerous benefits, the present study reveals the restricted use of blog as a tool promoting collaboration among the students. Low interaction between the learners can be attributed to low level of motivation and confidence, the feeling of uneasiness while commenting on their friends' posts or inadequate language skills. When they were engaged in the blogging activity, the students frequently fell back on their native language, especially in order to offer numerous comments, share experiences and develop rapport with their classmates.

A limitation of the present study was the relatively small sample size, which makes it difficult to generalize the results to the overall population. Further research is needed to better understand the potential of introducing blogging activities in the foreign language classroom. Study carried out over a longer time frame and larger sample will allow to fully examine social interaction and educational opportunities of blogs.

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Effectiveness of Web Quest Strategy in acquiring geographic concepts among eighth grade students in Jordan

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ABSTRACT

This study aimed at identifying the Effectiveness of using Web Quest Strategy in acquiring the geographic concepts among eighth grade students in Jordan. The study individuals consisted of (119) students in the scholastic year 2013-2014. Four sections were randomly selected from two schools divided into experimental and control groups. They were distributed to the experimental group that consisted of (58) male and female students taught by Web Quest Strategy, and a control group that consisted of (61) male and female students taught by the traditional method. To achieve the study objectives, teaching plans were prepared according to the Web Quest Strategy and testing the acquisition of the geographic concepts. The study results showed the presence of differences with statistical significance at significance level (α =0.05) between the means of the students' scores on the test acquiring the geographic concepts' attributed to the teaching method in favor of the experimental group. But the results did not reveal the presence of differences with statistical significance between the means of the students' scores on the test acquiring the geographic concepts' by the eighth basic grade students attribute to the gender variable or to the interaction between the teaching method and gender.

Keywords*: Web Quest Strategy, Geographic concepts, Eighth Basic Grade.*

INTRODUCTION

The new vision of developing education focuses on knowledge economy in Jordan by employing technology in education and preparing a generation of learners able to deal with technology and use it effectively. Undoubtedly, raising the level of outputs is the basic goal of the development process that requires students who know about the modern technology to help them construct the knowledge and employ it in their life.

One of the basics of developing education in Jordan was the focus on the concepts and the cognitive structure to be presented in a way that assures the learners' effective role in learning by depending on their activity, work and practice which help them to understand and apply these concepts. Developing education also focuses on using knowledge in life and employing the concepts and the cognitive structures in dealing with daily practical problems and situations (Al-Ziadat & Qatawi, 2014).

Educators confirm that helping the students at different studying stages to learn the concepts in an effective way is a fundamental objective of the basic education, and learning the concepts facilitates learning the educational content, increasing its fixation in the memory, improving the students' abilities in achievement and education, and employing the educational experiences (Qatawi, 2007).

The concepts considered the important component in the content of Geography subject. Learning and developing these concepts is considered one of the teaching objectives of Geography subject, teachers of Geography need to know how to use the teaching method in teaching the geographic

concepts. It is worth mentioning that learning the geographic concepts has a great importance; studying the cognitive concepts of any subject starts by clarifying the basic concepts to enable the students the ability to use them (Ababna,2006; Al-Zydat & Qataqi, 2014).

Published in 2005 by the Textbooks And Curricula Directorate in Jordan, the general frame of the Geography subject makes the student aware of his social, political and economic role in his society. It also helps him in understanding the relations between time and place, and scientifically explaining the natural and human phenomena. Therefore, these objectives cannot be achieved unless modern strategies in teaching Geography are used.

Al-khidr (2014) and Al-Kasab (2011) pointed that one of the important challenges facing achieving the Geography Subject's objectives is the lack of using modern strategies in teaching. As many researchers stated, the common method in teaching Geography depends on memorization and drilling that make the students rely on the teacher in obtaining the geographic concepts and take them away from enquiry, research and thinking skills (Al-Edwan& Al-Shra, 2008).

So, those who are interested in teaching Geography seek to find strategies and methods of teaching suitable to the modern technological developments, on the one hand, and to the tremendous scientific progress in the geographical information on the other hand (Abdalbasit,2003).

In 1995, Bernie Dodge and Tom March from San Diego State University developed a form of a lesson plan that incorporated links to the World Wide Web. Students were asked to complete some project and to solve problems. The scenario they were given was intriguing and motivating. The students were asked to build and analyze the information that they collected on the Internet and to fined solution to the problems (Gokalp,2011).

Web Quest Strategy is considered one of the most important strategies that links between the educational planning of the educational process in an accurate form and between using the Internet. It is considered a constructive educational pattern that based on the learner model as a traveler and explorer, and it assured the interaction between the learners and the teacher during the educational process. Additionally, it reflects the idea of the modern teaching that relies on the latest technology as a source of knowledge (Lacina, 2007; Wang & Hannafin, 2008).

The Web Quest Strategy is defined as purposeful educational activities, guided by enquiry that depends on searching processes in the Internet to reach the correct information with less time and effort and to develop the students' mental capabilities. It is an educational mean which aims at presenting a new learning system through integrating the Internet in the educational process, it is a flexible learning mean that can be used at all stages form school to the university, and even in all the courses and majors (Al-Hila &Nofal,2008:206)

Sen & Neufled (2006) see that this strategy is a cognitive journey in the Web to reach the correct information with less effort and time to develop thinking, this strategy makes the learning process an interesting process to the students that increases their motivation and participation in the classes.

Schweizer & Kossow (2007) assured the same idea as they also believe that Web Quest Strategy is a logical method used for the cognitive sailing in the Internet to deepen the students' understanding and expanding their thinking. And Halat (2008a) considered it as a teaching approach based on the student and on the constructive theory, thinking skills, and on the cooperative learning.

Joma`& Ahmad (2012) worked on the concept of the Web Quest Strategy which is one of Piaget's most important educational applications that is based on his assumptions in the mental growth. This assumption states that educational applications affect greatly the methods of teaching. This means that the learner constructs his knowledge by himself and he can reconstruct it through the process of the social negotiation with others. And one of the assumption bases is that ideas are not given to the students but they have to build their own concepts and knowledge created through their thinking and self activity (Zeitoon,2007).

The web quest idea can be summarized in building oriented activities and performances that investigate an issue or a specific topic, which are in great portion specialized and pre-selected sites over the internet. It has been classified in to two types (Gokalp,2011):

- Short-term web quest that its time extends from one class to three classes, often its objective is to provide the students with the knowledge and understanding.
- Long-term web quest, which its time period ranges from one week to full month, it is about questions that require higher thinking skills (Such as analyzing composing and evaluating).

The web quest consists of the following elements (Ismael & Abdo, 2008).

- Introduction: that provides the students with the cognitive background about the lesson's topic in a way that induces their motivation.
- The Task: it is the most important and basic part of the web quest and includes the sub tasks, such as the collection, design, creative production, persuasion and issuing the rule, and other tasks.
- The process: at this stage the mechanisms are determined and explained clearly to the students, also the steps they will make to accomplish toe educational tasks.
- The Sources: at this stage a list of available sources is determined which cover the students cognitive needs, to be designed professionally and reliably.
- Evaluation: this stage considers an important component of the web quest, so the students will be able to perform the self-evaluation and compare what they had learned and accomplished and the teacher evaluates his students, work at the previous stages.
- Conclusion: at this stage we should place a set of recommendations regarding the web quest work, and about the students work and the results they had reached, encouraging them to apply what they had learned of experiences to other settings.
- The web quest strategy characterizes by its capability to greatly increases the students, attention about it contains of the sites, pictures, maps, figures, models, sounds, videos and other features, while the advantages of web quest strategy in education represent the following (Saleh,2012):
- Encouraging the collective work and exchange of ideas between the students.
- Enabling the students the opportunities for searching deeply for specific topics.
- Equipping the students with searching skills over the internet web.
- Encouraging the students, self-evaluation.
- Dealing with the information sources regarding the quality and efficiency.

The results of the studies assured the effectiveness of using Web Quest Strategy in developing the students' learning skills, thinking skills and achievement. For example, the study of Brunton (2005) concluded that the achievement of the eighth grade students in science attributes to the integration of technology using Web Quest Strategy and the students who were taught by using Web Quest Strategy showed positive attitudes towards the Science subject. And the study's results of Michelle & Eula (2005) showed the superiority of the students who studied Math by using Web Quest Strategy over the students who studied by the traditional method. The results also showed differences attributed to the gender variable in favor of the females. And the results of Jadallah (2006) which carried out in Jordan revealed statistically significant differences in achievement in the intermediate and delayed exams of the students who learned by Web Quest

Strategy and they have positive attitudes towards Chemistry subject. And the study recommended the necessity of having training courses in Web Quest Strategy in the programs of the Educational Sciences Colleges.

The results of Ikpeze & Boyd's study(2007) which aimed to measure the effect of the scientific tasks based on Web Quest Strategy on developing the sixth grade students' higher order thinking skills. The results revealed that there were differences between the experimental group who taught using Web Quest Strategy compared to the control group that taught by the traditional method.

While the study of Ismael & Abdo (2008) showed the impact of using Web Quest Strategy in teaching Science on developing methods of thinking and the attitudes towards using it by the female students of the Educational College at King Abal-Azeez University-Jeda'h. The results were in favor of the experimental group compared to the control group.

Al-hila &Nofel' study (2008) showed statistically significant differences in favor of the control group which learned through using Web Quest Strategy in developing the critical thinking, there were statistical significant differences in favor of the experimental group in developing the achievement in course of Teaching Thinking of the students of University Educational Sciences (UNRWA) in Jordan compared to the control group.

Halat (2008b) conducted a study aimed at identifying the impact of Web Quest Strategy on developing the motivation and the attitudes of the students of the basic education section in Math. The results revealed positive attitudes towards Math between the experimental group which studied by using Web Quest Strategy and the control group that studied by the traditional method in favor of the experimental group.

The purpose of Cokalp (2011) study was to investigate the effect of the web quest based instruction on ninth grade students, achievement and attitude towards force and motion subject. Study sample consisted of (226) ninth grade students from eight classes of four high schools in Ankara. The students in the experimental group received web quest based instruction, and the students in the control group received traditional physics instruction. The results showed significant mean differences of the achievement in favor of the experimental group, but no significant difference was found for the attitude towards force and motion between the groups.

The results of the study conducted by Joma'& Ahmad (2012) showed statistically significant differences in the achievement of the third-level students in College of Science at the University of Sulaimani-Iraq, in the course of Organic Chemistry in favor of the experimental group which studied using Web Quest Strategy compared to the control group.

The study of Saleh (2012) concluded the effectiveness of using Web Quest Strategy in stimulating the ninth grade students' academic attitude towards learning Math in Tulkarm Governorate - Palestine. The students expressed their preferences according to the use of the Web Quest in learning Math.

The researcher concluded that most of the previous studies which addressed Web Quest Strategy were in the scientific subjects as the studies of (Michelle & Eula, 2005; Jadalla, 2006; Ikpeze & Boyd, 2007; Ismael &Abda,2008;Joma`&Ahmad,2012), showed the effectiveness of Web Quest Strategy in increasing achievement and developing thinking skills in the scientific subjects. But the researcher did not find -according to his knowledge- any study addressed Web Quest Strategy in the humanities and social sciences particularly in Geography subject. so the researcher was encouraged to identify the effectiveness of the Web Quest Strategy in acquiring the geographical concepts in order to keep up with the modern trends in teaching Geography. And the researcher has gained the benefit from the previous studies in developing the tools of the study and preparing daily planning of a lesson according to the Web Quest Strategy.

Based on what has been mentioned, the researcher sees the necessity taking into account the technological changes, carrying out experiments to obtain benefit of these technologies to improve the students' level of acquiring the geographic concepts. Therefore, the objective of this study is to identify the effectiveness of Web Quest Strategy in the geographic concepts' acquisition by the eighth basic grade students in Jordan.

STUDY PROBLEM & HYPOTHESIS

The interest of developing the educational process has been increased in Jordan with the call for the necessity of using different methods of teaching; improving the educational process is linked with its transformation from depending on the traditional method that focuses on memorization and drilling to learning that stimulates the students' desire in discovery through different situations and activities.

Based on the change and the development in the Geography curricula for the eighth grade in the shadow of the knowledge economics era, it is no longer relevant that the students sits as receptor of information, rather there should be the confirmation on the students as the axis of the learning and teaching process.

Many studies and educational researchers as the study conducted by (Al-Edwan and Al-Shar'a, 2008) indicated that the achievement and the attitudes of the tenth grade students towards the geography subject were weak and negative. Also, the study by (Al-Kasab, 2011) showed the low academic achievement of the students in the geography subject, and the weakness in acquiring the Geography skills, low motivation to learn towards the Geography subject. From this point came the researcher's feeling the presence of a problem in teaching the Geography subject, and the necessity to search for teaching strategy that follow the knowledge explosion age and works to stimulate more than a sense in the learners, from this point came this research.

In addition to what the researcher noticed during his field visits that teachers' totally depend on the traditional methods in teaching Geography, the weakness in using technology in teaching Geography subject, the students' low achievement in Geography, in addition to the difficulty in applying the geographic knowledge to different educational situations.

Based on what has been mentioned previously, the researcher believes in the importance of using a modern method of teaching that is interested in the concepts and their acquisition by the students where the educational literature of teaching the concepts showed scarcity in the scientific researches and studies that paid attention to study the impact of using Web Quest Strategy on the geographic concepts' acquisition in Jordan. So based on this, this study came to identify the Effectiveness of Web Quest Strategy in the geographic concepts' acquisition among the basic eighth grade students in Jordan. Therefore, the study problem has been identified by testing following hypothesis:

- There are no differences with statistical significance at the significance level (α=0.05) in the eighth basic grade students' acquisition of the geographic concepts attribute to the method of teaching (Web Quest Strategy and the Traditional Method) and the gender variables and the interaction between them.

OBJECTIVES OF THE STUDY

This study aims at the following

- Identifying the web quest strategy as a new teaching strategy that helps in acquiring the geographic concepts to the students.
- The contribution to the improvement of learning the geographic concepts in response to what the educational studies called for.
- Investigating the effectiveness of web quest strategy in acquiring the geographic concepts among the eighth grade students in Jordan compared to the traditional method.
- To show the effect of the differences between the males and the females in terms of benefiting from the web quest strategy and acquiring the Geographic concepts.

SIGNIFICANCE OF THE STUDY

- This study is compatible with the modern trends in teaching process in terms of its concentration on the concept of qualitative teaching which is characterized by being technological learning at the time the world started to increase the interaction between the teacher and the student on one hand and between the students themselves on the other hand. And the Web Quest Strategy considers an aspect of this global trend.
- The significance of this study lies in its harmony with the modern developmental thinking of Ministry of Education in Jordan, which is represented by the project of knowledge economy that focuses on using technology and helping the student constructing the concepts by himself.
- Attention of the specialists in the curricula of Geography as curricula designers and educational supervisors towards exploring a method that may motivate the students towards learning to improve their results and to employ Web Quest Strategy in geographic concepts' acquisition.
- Making the teachers of Geography aware of the Web Quest Strategy to improve the methods of teaching which have been already used and to develop them continuously at schools.
- Benefiting from the theoretical literature of the Web Quest Strategy in clarifying its educational applications.
- It encourages the researchers to do more researches and experimenting in the teaching strategies of the geography subject.

PROCEDURAL DEFINITIONS

Web Quest Strategy

Purposeful planned educational activities depend on the technology usage in teaching to help the students construct knowledge by themselves. These activities are represented by the research and enquiry processes in Internet in addition to journal and (CDs) in order to reach the information with less effort and time.

Traditional Method

A set of strategies in the teachers' guide book used by the teachers in teaching Geography subject of the eighth basic grade. It is a teaching method that relies on memorization and discussion strategies, in delivering the information to the students depending on text book using the same procedures with all students (Ministry of Education, 2013).

Geographical Concepts

All the meanings which the students have in the field of the concepts mentioned in the unit of Natural Resources Such as (natural resources, water resources, mineral resources, energy resources and maintaining and protecting the natural resources) which were all mentioned in the eighth grade book of Geography in Jordan for the academic year 2013-2014.

Geography Subject

The school curricula of the 8th basic grade which is taught in the schools of Ministry of Education for the year 2013-2014 including studying units distributed to two semesters, And this curricula includes the Unit Natural Resources.

THE STUDY'S LIMITS AND DETERMINANTS

Generalizing the study's results in the light of the following:

- The study is limited to a sample representing the eighth basic grade students (119) students of AL- Zarqa the Second Directorate of Education who enrolled in the public schools for the year 2013-2014.
- The study is limited to teaching the concepts mentioned in the Natural Recourses unit of the eighth grade book of Geography in Jordan.
- The study is limited to the teaching plans according to the web quest strategy and testing the acquisition of the Geographic concepts prepared by the researcher for the purposes of this current study.

METHODOLOGY

The researcher depended on the semi - experimental method of two groups to identify the effectiveness of using Web Quest Strategy in acquiring the geographical concepts by the eighth basic grade students in Jordan for the academic year 2013-2014.

Study Individuals

Study individuals consisted of (119) male and female eighth basic grade students who enrolled in the public schools of Al-Zarqa the second Directorate of Education, in the academic year 2013/2014. Table (1) shows the details about the two groups.

Table 1: *Distribution of Study Individuals According To the Strategy of Teaching and Gender Variables*

Gender	Strategy of teaching		Total
	Experimental	Control	
Male	27	29	56
Female	31	32	63
Total	58	61	119

Moreover, four branches were selected randomly from two schools and distributed into two groups; the first group was the experimental group consisting of (58) male and female students who studied using Web Quest Strategy and the other group was the control one consisting of (61) male and female students who were taught using the traditional Method.

Study Instruments

The researcher used the following instruments to achieve the study objectives:
First: Preparing the Lessons Plans According To Web Quest Strategy.
The first Unit (Natural Resources) was selected from the eighth basic grade's Geography book to know the Effectiveness of Web Quest Strategy. To achieve this objective, the researcher prepared a guide to the teacher including thirteen plans of Web Quest Strategy. And to test its validity, it was presented to ten arbitrators representing academic staff's members at Balqa Applied University and the University of Jordan, in addition to supervisors and teachers of Geography who worked at Ministry of Education. The teacher's guide was adjusted according to the arbitrators' notes.
Stages of Preparing the Teacher's Guide:

- Analyzing the content of Natural Resources Unit. The unit consisted of six lessons (natural resources, water resources, mineral resources, energy resources and maintaining and protecting the natural resources) where the educational outputs and the main and sub concepts of each lesson were identified in addition to identifying the relation between them.
- Identifying the general steps of the strategy and preparing the daily planning of every class including the basic steps of every class and write the cognitive content according to these steps including the selected activities. And this stage was implemented according to the steps of Web Quest Strategy (Joma`&Ahmad,2012;Salih,2012);
    - Introduction: Clarifying the idea of each lesson in the unit of Natural Resources by firstly presenting the educational outputs and the whole idea of the student's task starting by identifying the idea and the method of the research, the required evaluation and the way of presenting the research, in addition to a basic question aims at stimulating the learners' motivation and attracting their attention to the subject.
    - Tasks: Include the organized and the pre- prepared major and sub task, the accurate and clear description of the final results of the activity. Some of the tasks to be achieved that will enable the students to acquire the geographical concepts, warding the subject in the students language, the students' retelling the content using their words and verification, reporter's missions, creative production, conversation, negotiation, practical and analytical tasks and making the judgment.
    - Operations: The sequenced steps of carrying out the activity were mentioned, the websites on Internet were identified, so as to be accessed by the students and each

group which was formed by the teacher to search in resources which were provided by the teacher in addition to provide some guidance concerning ways of organizing and displaying the information as : PowerPoint presentations ,worksheets ,conceptual map, summaries tables, teaching path plan… and others.

- Resources: A list of related resources to the unit of Natural Resources was identified to help the students complete the tasks (electronic –websites, scientific encyclopedias, journals and periodicals, the researches, articles, PowerPoint presentations… and others.).
- Evaluation: A set of standards that help in evaluating the students was prepared, and the teacher has to clarify the standards used in the evaluation process as the students' cooperation at work, using resources and the references, exchanging of information between the groups and students' communication skills. Other evaluation tools were used as Rating Scales, Check Lists and scoring guide.
- Conclusion: it is a summary of the basic idea which the Web Quest Strategy searched for and summarizing the activities or the lessons results, and some questions or activities or other related links, which meet the students' desires in the expansion in the issue, were introduced.

Validity of the teaching plans according to the web quest strategy.

To check the teaching plans according to the web quest strategy, they were presented to (10) arbitrators from the teaching staff members at the University of Jordan, al-Balqa Applied University, the educational supervisors and teachers who teach the Geography subject in the ministry of education, they were asked to present their opinions regarding the teaching plans according to web quest strategy in terms of the linguistic wording of the specific educational outputs, their clarity appropriateness, and the scientific accuracy in formulating the lessons' activities, clarity and adequacy in the evaluation, and ease of application to the eighth basic grade's students.

The arbitrators suggestions and opinions were taken in to account, the proposed modifications were made on the teaching plans that received (80%) of the arbitrators agreements.

Second: Testing the Acquisition of the Geographical Concepts.

A test was prepared to measure the acquisition of the study Individuals of the geographic concepts in the unit of Natural Resources in the eighth grade book of Geography which the students studied in the first semester for the academic year 2013/2014. The test in its initial from consisted of (34) items of Multiple-Choice Questions with four alternatives for each item with one correct answer.

To check the test's validity, it was presented to ten arbitrators representing academic staff's members at Balqa Applied University and the University of Jordan, in addition to supervisors and teachers of Geography who worked at Ministry of Education. They were all asked to present their suggestions of deleting , adjusting items or adding some items. In the light of arbitrators' views and notes, the researcher made the appropriate adjustments which (80%) of the arbitrators agreed upon and so the test in its final form consists of (30) items of Multiple-Choice question and the grades range from the 30 (highest grade) to Zero (lowest grade).

The researcher also tested the reliability through applying the test to a sample, the study sample consists of (31) male and female students. The reliability was calculated according to Kuder Richardson (KR-20) and its value reached (0.91). Acceptable for the purposes of the study. The coefficients of difficulty and discrimination were calculated; the coefficients of items' difficulty ranged from (0.39 to 0.88) while the coefficients of discrimination of the items of the geographic concepts' acquisition test ranged from (0.26 to 0.79) and these values indicate that the value of coefficients of difficulty and discrimination are within the acceptable limits in the tests.

Procedures of the study

The following procedures were followed to conduct this study:

- Identifying the geographical concepts that should be taught by analyzing the unit of Natural Resources in the Geography Book of the eighth grade.
- Preparing the plans of the lessons of the Natural Resources' Unit in the eighth grade's book of Geography according to Web Quest Strategy which includes the educational outputs of the unit, electronic websites regarding to the short and long term cognitive journeys, tools and the educational means used in implementing the activities and identifying the steps of carrying out the lesson according to the Web Quest Strategy followed by evaluative questions to measure the students' degree of acquisition at every level.
- Preparing a test of the geographical concepts' acquisition and affirming its validity and reliability.
- Selecting the study Individuals from the eighth basic grade students studying at AL- Zarqa the second Directorate of Education, for the academic year 2013-2014.
- Interviews with the eighth basic grade students (the study's individuals) were conducted to clarify the objective of the study, to make them aware of the web quest strategy and its importance in teaching. They were asked about some concepts related to geography, but the researcher found that they had wrong concepts and unclear understanding of them. The steps of the web quest strategy and practical exercises and activities were provided before starting the experiment.
- Applying the pre-test to the Study groups to test their equivalence. And the results revealed the groups' equivalence at the pre -test of acquiring the geographical concepts.
- Implementing the experiment that lasted for two months with a class weekly teaching geographical concepts of the Natural Resources Unit in the book of Geography while the experimental group was taught using Web Quest Strategy.
- The control group was taught the Natural Resources Unit using the traditional Method and this group was taught for two months.
- Applying the post-test geographical concepts' acquisition to the study Individuals directly after finishing the experiment.
- Collecting data and analyzing it and carrying out the necessary statistical treatments.
- Concluding the results, discussing them and presenting a set of recommendations.
- After finishing the experiment application and analyzing the results, the results were introduced to the study's individuals and the Geography teachers to show the improvement in eighth basic grade students of acquiring the geographic concepts at the public schools in al-Zarqa the Second Directorate of Education, confirming the importance of the web quest strategy in acquiring the Geographic concepts by the study's individuals.

Study Variables

First: Independent Variables

- Teaching Strategy and it has two levels (Web Quest Strategy, Traditional method).
- Gender: (male, female).

Second: Dependent Variables

The degree of the students' achievement at the test of acquiring the geographic concepts.

Statistical Treatment

Data was analyzed using the Statistical Package for Social Sciences (SPSS). The means and the standard deviations were calculated and the Two Way ANCOVA was used to control the impact of the differences' on the pre-test.

RESULTS & DISCUSSION

This study has attempted to test the following hypothesis:

- There are no differences with statistical significance at the significance level (α=0.05) in the basic eighth grade students' acquisition of the geographic concepts attribute to the method of teaching (Web Quest Strategy and the Traditional Method) and the gender variables and the interaction between them.

To test the hypothesis, the researcher applied the test of acquisition of the geographic concepts to the study Individuals according to the method of teaching and the gender variables. Means and standard deviations of the students' scores were calculated, and table (2) illustrates this.

Table 2*: Means and standard deviations of the students' scores on the pre and post test of the student's acquisition of geographical acquisition according the method of teaching and gender variables.*

Group	Gender	No	Pre-test		Post-test	
			Mean*	Std. Div.	Mean*	Std. Div.
Control Group	Male	29	8.19	2.37	19.67	3.89
	Female	32	8.22	2.34	20.14	3.53
Experimental Group	Male	27	8.24	2.24	27.81	2.52
	Female	31	8.16	2.38	28.09	2.36

Mean* - maximum degree of 30

Table (2) showed apparent variance between the means of the eighth grade students' scores at the test of the geographic concept's acquisition in the pre and post tests according to the method of teaching and to gender. Figure (1) shows that.

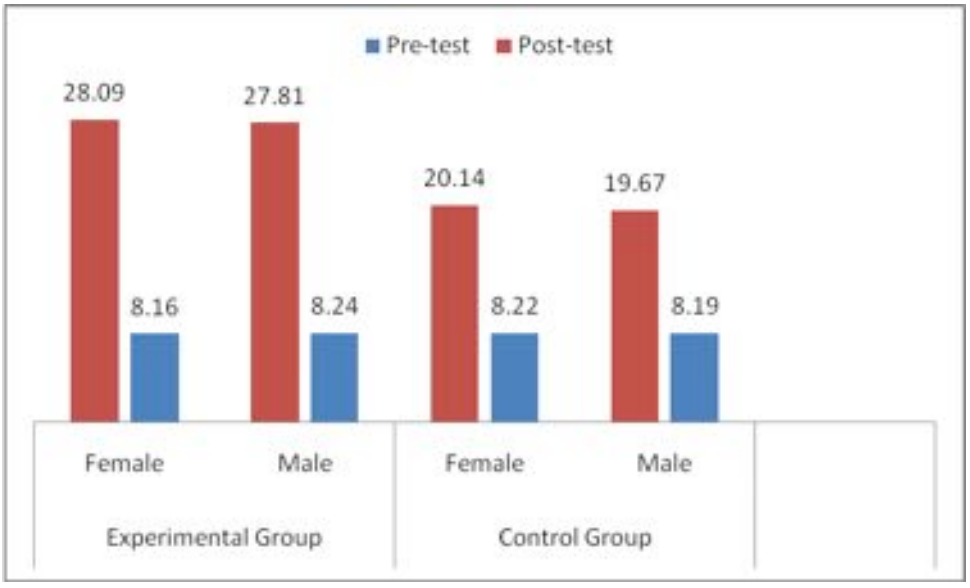

Figure (1): *Means of the students' scores on the pre and post test of the student's acquisition of geographical acquisition according the method of teaching and gender variables.*

Figure (1) shows the means of the females and males in experimental and control groups as follows:

- The pre-mean of the meals performance in the control group was (8.19). While for the females in the same group was (8.22).The post mean of the males performance in the control group was (19.67) and for the females in the same group was (20.14).
- The pre-mean of the performance of the meals in the experimental group was (8.24) and for the females in the same group was (8.16).While the post-mean of the performance of the males in the experimental group reached (27.81) and (28.09) for the females in the same group.

And to know the significance of the statistical differences between the means, Two Way ANCOVA was used, and Table (3) illustrates this.

Table (3) shows that there are differences with statistical significance at the significance level (α =0.05) between the means of the eighth grade students' scores on the test of geographic concepts' acquisition attribute to the method of teaching variable, F-value reached (6.408) referring to these means in table (2).

We notice that the differences were in favor of the individuals performance in the experimental group. The researcher attributes these differences in acquiring the geographic concepts to the social cooperative atmosphere inside the classroom. Considering the student as the axis of the educational process and exchanging ideas and opinions among the groups during teaching created an effective educational atmosphere. The researcher also noticed during the application of Web Quest Strategy the students' participation to reach solutions to the given activities as their degree of harmony has increased with their groups to get a turn in answering which reflected on their understanding and the acquisition of the geographic concepts included in the course.

***Table 3**: results of Two Way ANCOVA for the differences between the means of the eighth grade students' scores on the pre and post test of the geographic concepts' acquisition according to the method of teaching and the gender variables.*

Source of Variances	Sum of Squares	DF	Mean of Squares	F-Value	Sig.
Pre-test	25.824	1	25.824	5.636	0.001*
Method	29.361	1	29.361	6.408	0.001*
Gender	5.027	1	5.027	1.097	0.492
Method*Gender	4.294	1	4.294	0.937	0.525
Error	522.348	114	4.582		
Total	586.854	118			

Sig* - ($\propto$ = 0.05)

The Web Quest Strategy encourages self-learning, takes into account the individual differences between the students and creates more effective learning environment than the traditional method. Additionally, it leaves a space for thinking, searching and enquiring which made the learner the center of the learning process instead of the teacher as it is in the traditional method. Therefore, this made the differences in acquiring the geographic concepts between the members of the experimental and control groups. And this result is compatible with the results of the studies by (Brunton,2005;Michelle & Eula 2005).

Also, Table (3) shows:

- There are no differences with statistical significance at the significance level (α =0.05) between the means of the eighth grade students' test scores on acquiring the geographic concepts attributed to the gender variable. F- Value reached (1.097) at significance level (0.492).
- There are no differences with statistical significance at the significance level (α =0.05) between the means of the eighth grade students' test scores on acquiring the geographic concepts attribute to the interaction between the method of teaching and gender. F- Value reached (0.937) at significance level (0.525).

The researcher attributes this result to the similarity of the circumstances of the educational environment which the male and female students were exposed to, the similarity of the available technological capabilities regardless of the type of the school, whether a males or a females school, or this result may be attributes to the nature of Web Quest Strategy that provided the students with a space to search and enquiry about geographical issues according to a cognitive plan provided to them with specific electronic websites regardless the teacher's gender. Additionally, Web Quest Strategy agrees with the students' interests in using the modern technology especially Internet. Since the students spend very long time using Internet for different purposes, as enjoyment, entertainment, and play regardless of their gender male or female.

RECOMMENDATIONS

The study results showed the effectiveness of the Web Quest Strategy, so the researcher recommends the following:

- Using the Web Quest Strategy in teaching the Natural Resources Unit in Geography subject and not only depending on the Traditional Method to enable the eighth grade students acquire the geographic concepts and to improve their level of achievement.
- Drawing the attention of the Jordanian Ministry of Education to the importance of training the Geography teachers in Jordan on employing the web quest strategy in teaching the Geography topics.
- Directing the attention of the curricula designers to the web quest strategy in acquiring the Geography concepts to benefit from in the field planning and building the curricula.
- Establishing a special unit in the Ministry of Education in Jordan that takes care of the production of the studying units in the Geography subject according to web quest strategy.
- Using the technology in teaching geography subject with the focus on teaching strategies that tackles students' activities and provide self-learning experiences in the geography subject.
-

SUGGESTIONS FOR THE FUTURE RESEARCH

Based on the results that have been reached, the researcher recommending the following:

- Conducting more studies relating to the web quest strategy with new variables, such as the critical and creative thinking skills and motivation.
- Conducting a study that includes larger sample for applying the web quest strategy from the different geographic regions in Jordan.
- Conducting more studies relating to the web quest strategy at different studying stages such as the secondary and the lower basic stage.
- Applying the web quest strategy to the other humanities and social sciences branches, such as history and national education.

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The effect of computer based instructional technique for the learning of elementary level mathematics among high, average and low achievers

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ABSTRACT

The major objective of the study was to elicit the effect of three instructional methods for teaching of mathematics on low, average and high achiever elementary school students. Three methods: traditional instructional method, computer assisted instruction (CAI) and teacher facilitated mathematics learning software were employed for the teaching of three chapters of six class mathematics textbook (Integers, Algebra and Geometry). Interactive software was developed, using the contents of these three chapters. Two urban and two rural schools were selected containing a male and a female school. Seventy eight students from each of the four randomly selected schools were randomly selected and assigned in to three groups. On the basis of pre-test the students were identified as low, average and high achievers. After the treatment a post test was conducted. The score of the students were analyzed that revealed teacher facilitated mathematics instructional method produced better score when compared with CAI and traditional instructional methods of teaching mathematics for low and average achievers, but no significant difference was observed between instructional techniques for high achievers. It raises the questions; why instructional techniques not affected the high achievers scores? What kind of provisions may be added in the next version of the instructional software?

Keywords*: Pakistan, Punjab province, Mathematics Education, Teaching Technologies, High and Low Achievers, Teacher facilitated Software Technique and Computer Based Teaching*

INTRODUCTION

According to the National Education Assessment System (NEAS, 2007) report, students of 4th and 8th grades remained underachievers in the subject of mathematics when measured by the National Achievement Tests administered in 2006 and 2007. Similar findings were reported by the Punjab Education Assessment System (PEAS) in the same years. This consistency in the results over the years confirmed the under achievements throughout the country both across four provinces and federally administrated areas. The problem identified by NEAS and PEAS need some specific measures to overcome. They also identified that students are weak in contents of geometry, sets and algebra.

In order to overcome these shortcomings, there is a dire need for a comprehensive set of strategies to be followed. National and provincial assessment reports revealed that major components of the underachievement in mathematics are contents of algebra and geometry. The

instructional techniques and strategies and their effectiveness may also be an important factor contributing towards the underachievement of the students in mathematics.

Many research attempts (Mahmood 2004, Tabassum 2004, Vergnaud 1997 and Seeger and Steinbring 1994) addressed the similar problems across the globe but no comprehensive solution is available. In order to address this issue there is a need to understand the nature of mathematics and different ways of teaching mathematics. Teachers are using same techniques for students of different achievement levels and background. It highlighted the need to use different techniques for the different ability groups. In this study the researchers tried to answer the question “which instructional technique works well” by formulating the following three null hypotheses.

1. There is no significant difference between the scores of the three groups of low achievers students taught using traditional method, mathematics software method and teacher facilitated mathematics software method.
2. There is no significant difference between the scores of the three groups of average achievers students taught using traditional method, mathematics software method and teacher facilitated mathematics software method.
3. There is no significant difference between the scores of the three groups of high achievers students taught using traditional method, mathematics software method and teacher facilitated mathematics software method.

NATURE OF MATHEMATICS

According to Vergnaud (1997) many questions have been raised by the teachers and researchers about the nature of mathematical knowledge, but no simple answer is available. Many mathematics educators think mathematics activity as a timely discovering of the truth and totally independent of the culture and disciplines. They are pointing towards the numeration or learning of the basic arithmetic skills (+, -, ×, ÷). Ernest (1994) has also reported the same fact about discovery learning saying that discovery learning assumes that mathematical knowledge is pre-existing.

Researchers of the present era (Bokhove and Drijvers 2012, Ferguson 2014 and Festus 2013) are more focused towards the use of constructivism, especially in teaching of science and mathematics. The basic assumption behind this philosophy is that "the evolving organism must adapt to the environment in order to survive". Reflecting that mathematics learning is active, the discipline of mathematics has witnessed changes with the environment and the new trend towards technology needs some more basic changes in order to make mathematics more compatible with our societal context. The mathematics learner should be allowed to construct knowledge in their own cultural and social context. The software used for this particular study was designed on the philosophy of active involvement of the students. The purpose of active involvement was achieved by incorporating hinting and feedback strategies emerging from the local teachers and educators.

TEACHING OF MATHEMATICS

The diverse nature of the mathematical knowledge demands different strategies from the teachers in the classroom. Many studies (Afzal and Gondal 2010, Mahmood 2004 and Tabassum 2004) have highlighted that in Pakistan the teachers are following a traditional teaching method that is Chalk and Board method. This method is appropriate while teaching the basic operations and facts. But according to Seeger and Steinbring (1994) it reflects only one side of the coin, the

traditional teaching process in mathematics classroom tend to beginning of the universal epistemological basis.

The frequent use of computers for teaching of mathematics demands development of new software that may be embedded in the local context. Therefore there is a need to provide enough knowledge and skills to the teachers that consequently help to develop a more positive attitude towards the use of technology for teaching (Afzal, et.al. 2011). Technology has already changed the way educators teach. Shelly, Cashman, et.al. (2002) have identified that most of the teachers are using multimedia during instruction. Many researchers (Black and McClintock 1995, Richards 1998, Brush and Saye 2000 and Katmada, Mavridis, and Tsiatsos 2014) have studied the impact of constructivism on classroom practices for the purpose of integration of technology in teaching learning process, due to potential of technological embedded pedagogical techniques. Dwyer, Ringstaff, and Sandholtz (1990) as cited in Imel (1992) and Robinson (2012) were of the view that providing immediate access to technology mean free hand to construct their own knowledge in the classroom substantially changes the teaching learning process. Multiple studies (Black and McClintock 1995, Richards 1998, Brush and Saye 2000 and Katmada, Mavridis, and Tsiatsos 2014) pointed to the benefit of using technology to enhance student learning elementary school language, arts, science, and mathematics; middle school language, arts, science, mathematics, and social studies; and high school mathematics, science, and writing.

According to Owens and Waxman (1994) the students got higher scores in the computer assisted instruction (CAI) group in Geometry but no differences in Algebra. The study of Afzal and Gondal (2010) had also highlighted similar kind of facts, where teacher facilitated mathematics software group outperformed the students taught through traditional method and CAI for both male and female groups. In the present scenario (Ahmad and Latih 2010, Boon 2009, Casey, 2012 and Clark-Wilson, Robutti, and Sinclair 2014) many companies and research groups are trying to develop the software and to see their effect on learning achievement (Kaput 1992, Brown 2001, Chen 2005, Chang 2002, McKethan, Everhart & Stubblefield 2000 and Yildirim, Ozden, & Aksu 2001).

CONTEXT OF THE STUDY

Very few efforts of teaching with computers in Pakistani context had been witnessed, and its effectiveness for the different achievement groups (High, Average and Low). Therefore there was need to conduct a study in mathematics that provided evidence of its effectiveness for high, average and low achievers in Pakistani teaching learning context. The researchers investigated the role of mathematics software, used for improving students learning achievements in mathematics at elementary level across different achievement levels. The study also explored the effect of different instructional techniques for high, average and low achievers.

METHODOLOGY

The investigation of the effect of different teaching strategies on teaching of mathematics at elementary level is a contribution towards identification of improvement in educational instructional methods. It was an experimental study to examine the effect of independent variables; traditional instructional method, mathematics software instruction and teacher facilitated mathematics software instruction on the achievements of high average and low achievers measured by mathematics test prepared by the researchers. The researchers formulated three hypotheses as already stated and developed software the details are discussed in the following section.

DEVELOPMENT OF SOFTWARE

The new paradigm of teaching-learning process need interactivity that demands more efforts from the teachers, assuming that mathematical knowledge can be socially constructed and teacher is capable to provide the learning environment where students can actively participate. Therefore, after presentation of the concept the examples were provided to the students. These examples provided basis for the exercises that were the part of each lesson, students were involved in assessment and feedback was provided for the assessment component whereas hints were given for exercises. This was the basic structure on which the software was designed.

Developing teaching software is a complex process, as it requires the basic philosophy, content selection, appropriate delivery, programming and the user-interface that is user friendly. For this purpose three teaching units for 6th grade mathematics were selected and modified. Minor changes were made to have units compatible with the software requirements in consultation with the programmers and subject experts. The modified units were validated by opinion of subject experts and teacher teaching mathematics at grade six, and were used to develop the software for imparting instruction to the experimental-1 and experimental-2 groups. Three teachers, currently teaching mathematics at elementary level, a programmer, quality assurance personnel and user interface designer were employed for the formative evaluation of the software. Software evaluation rubric recommended by Shelly, Cashman, Gunter and Gunter, (2003) was used for this purpose. The teachers contributed towards the content, ease of use and the component of assessment, as well as provided comprehensive list of suggestions which helped to enhance the instructional quality of the software. A programmer (other than developers) went through the coding of the software and suggested changes which were discussed with the developers in a meeting and incorporated accordingly. The quality assurance personnel added valuable suggestions towards the animation, graphics and feedback prompts where a user interface designer helped in adjusting the area of main frame and the mini frames of the program. Piloting of the first version was done with forty students of 6th grade, researchers and mathematics teacher of the school remained present during the piloting process and noted the points highlighted by the students. This effort consequently produced software for teaching of mathematics at 6th grade level and was used for this study. The main frame of the software is given in Figure 1.

The far right area (No. 1) of the screen presented the three major content areas. Users were allowed to enter the lessons after selecting the major content area first. Then clicking the lesson number allowed the users to navigate through the lesson. The area of the screen to the left of the University monogram (No. 3) presented the learning outcomes desired to be mastered during the lesson. The instructional manual and the installation instructions are presented in the software manual.

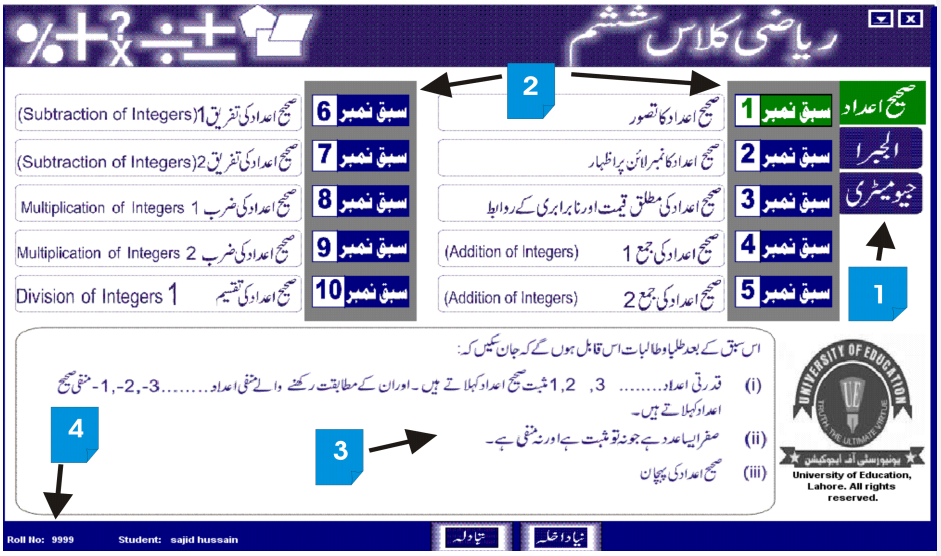

Figure 1: *Main Frame of the Mathematics Software*

The researchers randomly selected four schools from Punjab province to conduct the experiment. One school from each stratum (Urban, Rural, Male and Female) was sampled. Seventy eight students of class six from each school were randomly assigned to three groups. First group was taught using traditional teaching method, where teacher used chalk and board and students noted the questions in their note books and reproduced the same in their homework copy in the next day, this group was named as control group. The second group was taught in the computer lab in this group the students studied on their own pace and they were free to move through the lesson, teacher and the lab assistant were present to guide them for the use of computer and software, lab assistant helped to resolve the hardware problems. Computer assisted instruction was the teaching technique used for experimental group 1. The third group was taught in the computer lab; teacher facilitated learning in this group by helping the students to grasp the concepts, answered students' questions and gave explanations using chalk and board where necessary. Students were free to ask questions and seek help from the teacher. The lab assistant remained with this group during instruction to help students in using software and solving hardware problems that saved much of the students' time. The intervention prolonged for ten weeks.

Pre-test post-test control group experimental design was employed to explore the information regarding the effectiveness of the different teaching strategies for high, average and low achievers used for the experiment.

Before the start of the experiment a pre-test was conducted. Scores obtained by the students on the pre-test were used to label the students as high, average and low achievers. The students scoring 60% or above were considered as high achievers, the scores of the average achievers were from 40% to 59%, whereas the students scoring below 40% percent were labelled as low achievers for the purpose of the data analysis. The labels were not disclosed to students and the

teachers' involved in the experiment. After the intervention of ten weeks a post test was conducted and the data were analysed using inferential statistics.

DATA ANALYSIS AND INTERPRETATION

The data were analyzed by using ANOVA statistics to test the significant differences caused by the different instructional methods on low achievers, average achievers and high achievers. According to Gay (1996) ANOVA compares the amount of between-groups variance in individuals' scores with the amount of within groups' variance whereas Post hoc testing applied later provided differentiation among variables by creating the homogeneous groups.

The first hypothesis stated no significant difference between the different instructional techniques on low achievers when measured by the post-test. In order to obtain answer to the question the researchers employed ANOVA on the score obtained through post-test. The summary of ANOVA statistics is presented in Table 1.

Table 1: *ANOVA Statistics for Overall Comparison of Instructional Methods on Post-test Scores of low Achievers*

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1848.574	2	924.287	8.676	.000
Within Groups	6711.244	63	106.528		
Total	8559.818	65			

Level of Confidence α=0.05

The ANOVA results F(2,63)=8.676 are significant at α=0.05 level of confidence to reject the null hypothesis that there is no significant difference between the mean scores of the three groups as measured by the achievement test. It indicated that there is at least one group which performed different from the others. Therefore there was a need to identify the group that is different from the others; for this purpose the descriptive statistics was employed and the summary is given in table 2 below.

Table 2: *Descriptive Statistics of Instructional Groups on the Scores of Post-test of Low achievers*

Instructional Groups	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Control	21	46.90	9.648	2.105	42.51	51.30
Experimental I	21	52.10	11.086	2.419	47.05	57.14
Experimental II	24	59.62	10.197	2.082	55.32	63.93
Total	66	53.18	11.476	1.413	50.36	56.00

The mean scores indicated that all the three groups were different. The control group mean score (M=46.90) was the minimum whereas the mean score (M=59.62) of the Experimental II group was maximum. The mean score of the Experimental I group remained in between the mean scores of the two treatment groups.

In order to further investigate the difference between the groups when the ANOVA results are significant to reject the null hypothesis the post-hoc test helped to identify the difference between the groups. The Scheffe, post hoc test were applied to determine which group was different. The summary of the Scheffe test is given in Table 3.

Table 3: *Summary of Scheffe Statistics on Post-test Scores of Low Achievers for Multiple Comparisons*

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Control	Experimental I	-5.190	3.185	.272
	Experimental II	-12.720*	3.084	.001
Experimental I	Control	5.190	3.185	.272
	Experimental II	-7.530	3.084	.058
Experimental II	Control	12.720*	3.084	.001
	Experimental I	7.530	3.084	.058

* The mean difference is significant at the .05 level.

The Scheffe test indicated statistically significant difference between the groups at α=0.05 level of confidence between control and Experimental group-2. There was a difference between the mean scores of the control and experimental-1 groups of low achievers students, but not statistically significant. Similarly no significant difference was found between experimental group-1 and Experimental group-2. Scheffe statistics divided these groups in to homogeneous subsets, and the results are reported in Table 4.

Table 4: *Homogenous Grouping on Post-test Scores of Low Achievers*

Group	N	Subset for alpha = .05	
		1	2
Control	21	46.90	
Experimental I	21	52.10	52.10
Experimental II	24		59.62
Sig.		.258	.062

Means for groups in homogeneous subsets are displayed.

Only two groups were generated, showing that there was no difference between the mean scores control and experimental-1 groups of the low achievers. And also no difference was found between the mean scores experimental-1 and experimental-2 groups of the low achievers.

The second hypothesis of the study stated the no significant difference caused by the different instructional techniques on average achievers when measured by the post test. In order to test this hypothesis the researchers again used ANOVA on the score obtained through post-test. The ANOVA statistics compared the groups for the justification of the effect of instructional methods used for the treatment of different groups. The summary of ANOVA statistics is presented in Table 5.

Table 5: *ANOVA Statistics for Overall Comparison of Instructional Methods on Post-test Scores of Average Achievers*

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4439.880	2	2219.94	42.214	.000
Within Groups	10464.852	199	52.587		
Total	14904.733	201			

Level of Confidence α=0.05

The ANOVA results F(2,199)=42.21 are significant at α=0.05 level of confidence to reject the null hypothesis that there is no significant difference between the mean scores of the three groups of average achievers as measured by the achievement test. It indicated that there was at least one group which performed different from the others. Therefore there was a need to identify the group that was different from the others; for this purpose the descriptive statistics was employed the summary is given in Table 6 below.

Table 6: *Descriptive Statistics of Instructional Groups on the Scores of Post-test of Average Achievers*

Instructional Groups	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Control	68	52.50	6.370	.773	50.96	54.04
Experimental I	68	57.46	6.838	.829	55.80	59.11
Experimental II	66	63.98	8.424	1.037	61.91	66.06
Total	202	57.92	8.611	.606	56.73	59.12

The mean scores indicated that all the three groups were different. The control group mean score for average achievers (M=52.50) was the minimum whereas the mean score (M=63.98) of the Experimental-2 group was maximum. The mean score (M=57.46) of the Experimental I group remained in between the mean scores of the two treatment groups.

Many researchers (Gay, 1996 and Kahn & Best, 2006) recommended post-hoc statistics for the identification of odd group, where ANOVA provided evidence for the rejection of the null hypothesis. The Scheffe, post hoc test were applied to determine which group was different. The summary of the Scheffe test is given in Table 7.

Table 7: *Summary of Scheffe Statistics on Post-test Scores of Average Achievers for Multiple Comparisons*

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Control	Experimental I	-4.956*	1.244	.000
	Experimental II	-11.485*	1.253	.000
Experimental I	Control	4.956*	1.244	.000
	Experimental II	-6.529*	1.253	.000
Experimental II	Control	11.485*	1.253	.000
	Experimental I	6.529*	1.253	.000

* The mean difference is significant at the .05 level.

The Scheffe test indicated statistically significant difference between the groups at α=0.05 level of confidence between control, Experimental I and Experimental II groups. Scheffe statistics further categorized these groups in to homogeneous subsets, the results are reported in Table 8.

Table 8: *Homogenous Grouping on Post-test Scores of Average Achievers*

Group	N	Subset for alpha = .05		
		1	2	
Control	68	52.50		
Experimental I	68		57.46	
Experimental II	66			63.98
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

The table highlighted that all the three groups were placed in three categories, indicating that none of the group is homogeneous with others.

The third hypothesis of the study stated no significant difference between the different instructional techniques on high achievers when measured by the post test. In order to test this hypothesis the researchers employed ANOVA on the score obtained through post-test. The ANOVA statistics provided the statistical evidences for the effectiveness of instructional methods used for the treatment of different groups. The summary of ANOVA statistics is presented in Table 9.

Table 9: *ANOVA Statistics for Overall Comparison of Instructional Methods on Post-test Scores of High Achievers*

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	157.870	2	78.935	2.002	.148
Within Groups	1616.857	41	39.436		
Total	1774.727	43			

Level of Confidence α=0.05

The ANOVA results F(2,41)=2.002 were not significant at α=0.05 level of confidence to reject the null hypothesis that there is no significant difference between the mean scores of the three groups of high achievers as measured by the achievement test. Therefore the null hypothesis was accepted. There may be the difference between the mean scores of the three groups but not statistically significant.

CONCLUSIONS AND RECOMMENDATIONS

Afzal and Gondal (2010) highlighted that teacher facilitated software instruction method may be better as compared to the mathematics software and traditional instructional methods for teaching of mathematics at 6th grade. There was need to justify whether the software facilitated teaching of mathematics worked equally well for different groups of students based on their achievement levels. The three achievement groups were formulated named as low, average and high achievers. The data revealed that the teacher facilitated software instruction method worked better as compared to the mathematics software and traditional instructional methods for the average and low achievers groups. The results were consistent with the studies conducted by Owens and Waxman (1994), Imel (1992), Mahmood (2004) and Tabassum (2004) so it provided evidence to conclude that Teacher facilitated mathematics software method worked better for the both average and low achievers. The technology and activity based methods are being proved to be more effective than the traditional methods (Katmada, Mavridis, and Tsiatsos 2014, Ahmad and Latih 2010, Boon 2009, Casey, 2012 and Clark-Wilson, Robutti, and Sinclair 2014) the similar results were found in this study, major conclusions discussed below.

The students instructed through the teacher facilitated software method outperformed their counterparts, whereas mathematics software instructional method provided better results as compared to the traditional method of teaching mathematics to average achievers of 6th grade. These results might be due to the active involvement of the students in learning of mathematics. The researchers recommend that further research may be conducted to generalize the results of the study to the entire contents of the mathematics. Both horizontal (content areas) and the vertical (different grades) need to be researched before the large scale implementation of the software for teaching of mathematics. For the group of low achievers there was significant difference between the scores of students instructed by the traditional method and the teacher facilitated software method of teaching mathematics, whereas the mathematics software method was equally effective as traditional method and was also not different from the teacher facilitated software method, therefore there is enough evidences to use the software for low achievers. For high achievers the researchers doing work in mathematics education have to locate other methods or develop more interactive software. Although the software facilitated mathematics teaching provided better results for the low achievers, there is still a need to conduct research with the improved version of the software for teaching of mathematics. Therefore researchers

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recommend that more detailed hinting and feedback strategies may be incorporated in the software to facilitate the low achievers in learning of mathematics.

There was no difference between the scores of the high achievers for the different instructional methods. There may be number of reasons for similar effect of three teaching methods used for high achievers. Firstly, there may be the low number of students in each group, and this was a limitation of this particular study. Secondly, there may be the different philosophy of teaching mathematics to high achievers, different techniques may be used, and more comprehensive feedback, hinting strategies, examples, and exercises may be incorporated in the software for teaching of mathematics to high achievers.

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Evaluation of a pilot project on information and communication technology for rural education development: A Cofimvaba case study on the educational use of tablets

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ABSTRACT

In an endeavour to find solutions to the country's improving but ailing education system the South African government through some of its departments is attempting to find out if the introduction of technology in the class room has the potential to improve teaching and learning. The paper is based on a pilot study currently underway in Cofimvaba in Eastern Cape Province where tablets were introduced to teachers in eleven schools. The paper used the Cofimvaba ICT4RED initiative as a case study to ascertain how teachers accepted the introduction of tablets at their schools for teaching and learning. The main research methodology is qualitative multiple case study research with interpretivism as paradigm. Data were gathered though the use of questionnaires administered to teachers. The results showed that most teachers embraced tablets and were using them in the classroom, for their own professional development and personal use. Therefore, within the South African education system the introduction of tablets in learning and teaching is an important step towards improvement of education particularly in poorly resourced schools.

Keywords: *Information and Communication Technology, ICT for development, rural development, technology acceptance model, Education, Learning, interpretivism*

INTRODUCTION

The origin of the term e-learning is up for debate as different scholars place it at different places and points of time. What makes this difficult is the fact that, "in the history of e-learning, it is important to note that there is no single evolutionary tree and no single agreed definition of e-learning" (Nicholson, 2007). Nicholson indicates that e-learning evolved in different ways depending on the area of human endeavour involved. The term has been around from the late 1950s but its evolution became faster with the advent of the Internet from around 1995 "when it was all called "Internet based Training"(IBT), then "Web-based Training"(WBT) then "Online Learning" and finally e-learning, adopting the in vogue use of "e" during the dot com boom" (Fatma, 2013).

Today the focus is not only on online environments but also embraces "a full range of computer-based learning platforms and delivery methods, genres, formats and media such as multimedia, educational programming, simulations, games and the use of new media on fixed mobile platforms across all discipline areas" (Nicholson, 2007). Nicholson goes on to state that the key to accommodating e-learning is increased adoption of constructivist paradigm "and the uptake of constructivist pedagogies". This led to increased collaborative online learning environments.

In an endeavour to find solutions to the country's improving but ailing education the South African government through some of its departments is attempting to find out if the introduction of technology in the classroom has the promised potential to improve teaching and learning. The recent pilot study currently underway is in Cofimvaba in the Nciba district in Eastern Cape Province where tablets have been introduced in a number of schools to teachers and learners, excluded for this paper, for teaching and learning. Respondents were from the following junior secondary schools: Bangilizwe, Gando, Gudwana, Mcqawezulu, Mtimbini, Mvuzo, Ntsingeni, Siyabalala, St Marks and Zamuxolo, and two others were Khwaza Senior Secondary and Mthimbini Primary school. Therefore, this paper looks at the pilot study to ascertain how the project is continuing by looking at analysing the teacher's survey on their impressions on different uses of their tablets. This will be achieved by first providing the background to the study. Secondly, literature on elearning will be unpacked. Thirdly, a short discussion on the conceptual framework underpinning the paper will follow. These will be followed by short sections on the problem statement and methods and tools. The subsequent sections will concentrate on results, analysis and conclusion.

BACKGROUND

The Cofimvaba School District Technology Project is a joint initiative between the Department of Science and Technology, the national Department of Basic Education and the Eastern Cape Department of Education, and is aimed at contributing to the improvement of education in the rural area through technological innovation (Hanekom 2012). The project is intended to enhance education of mainly rural people. Hanekom further states that the Information and Communication Technology for Rural Education Development (ICT4RED) project is meant to improve the quality of teaching and learning and to ensure that the learning environment is conducive to allow ease of learning and teaching and technology implementation. Because environmental factors influence teaching and learning the project is anticipated to go further and provide technology interventions in among others ICTs, water and sanitation, health, nutrition and energy (Ford & Miril 2013).

The overall objective of the ICT4RED project is to document a model for e-textbook rollout in schools which can be replicated all over the country. This will assist the project to contribute towards improving the learner results and teacher skills by integrating technology in everyday learning, teaching and administration at schools (Williams, Marais, & Rampa, 2013). The ICT4RED project is implemented in three phases whereby phase 1 was piloted in one school (2012-2013), phase 2 expanded pilot to 11 additional schools (2013 – 2014), and phase 3 included an additional 14 schools (2014 – 2015).

The CSIR's Meraka Institute (Meraka) was commissioned by DST to roll out the project in Cofimvaba in the Eastern Cape. Meraka has installed a wireless mesh network in the area to open up access to broadband and teachers in 11 schools in the districts have received tablets and training on how to incorporate this in the classrooms (Hanekom 2012). The pilot is currently under way in the Nciba district in which technological interventions are tested to determine how technology strengthens the teaching and learning of Maths, Science and Technology in schools (Ford & Miril, 2013).

Now for this paper it was important for this project to have some kind of monitoring and evaluation process in order to assess and measure whether the aims and objectives are reached and to inform decisions and processes as the project goes along. This paper shares some of these lessons.

LITERATURE ON E-LEARNING TRENDS

Definition:

It is important to begin this by differentiating between e-education and e-learning. According to Campbell, (2001) "e-education involves e-teaching and e-learning along with the various administrative and strategic measures needed to support teaching and learning in an Internet environment. It will incorporate a local, regional, national and international view of education." South African Department of Education, (2003) states that within "the South African context, the concept of e-Education revolves around the use of ICT to accelerate the achievement of national education goals. E-education is about connecting learners to other learners, teachers to professional support services and providing platforms for learning. E-Education will connect learners and teachers to better information, ideas and one another via effective combinations of pedagogy and technology." The Department of Education considers ICT as a: (i) Tool for management and administration; (ii) Resource for curriculum integration; (iii) Communication tool; (iv) Collaborative tool for teachers and learners; and (v) Learning environment that advances creativity, communication, collaboration and engagement.

By looking at the two definitions "of education above" one sees that the distinctions are quite thin and difficult to see. However, Campbell's definition gives a little clarity as it indicates that e-learning is a subset of e-education. Therefore, what is e-learning?

Many scholars have found the e-learning concept to be broad and hard to define as it encompasses teaching, learning and technology. E-learning is sometimes substituted by other concepts such as computer-based learning, technology-based training and computer-based training (Friesen, 2009). For example, Manville (2003) includes in the definition (i) content and learning objects, (ii) learning environments, (iii) simulations and document repositories, (iv) learning support systems, and (v) tools for management of learning.

Campbell (2001) says, "E-learning is learning which takes place as a result of experiences and interaction in an Internet environment. It is not restricted to a regular school day and can take place in a variety of locations, including home, school and community locations e.g. libraries, cafes etc." Another definition is by AADM Enterprises Inc. (2009), "The use of any electronic technology to aid in the acquisition and development of knowledge and understanding in order to demonstrably and positively influence behaviours. E-learning focuses on four general categories identified as: (i) technology-driven, (ii) delivery-system-oriented, (iii) communication-oriented, and (iv) educational-paradigm-oriented (Sangrà, Vlachopoulos & Cabrera 2012).

The challenge is to come up with one all-inclusive definition for e-learning, particularly for this study, without getting into the area of e-education. Since different scholars look at e-learning concept from different positions we intend to come up with a definition which is all inclusive, that is, one which talks to learners, teachers, management, content and technology. Therefore, on the basis of all these definitions our understanding of e-learning incorporates educational philosophy, technology as the medium of instruction, subject content and how it is packaged, support and management (of enrolment, teaching and learning) which are all centred around technological enablement of learning and teaching.

Scope:

For this paper the scope of e-learning is restricted to: Content: where it is delivered through ICT technologies such as Internet, intranet, audio or video tape, satellite TV, and CD-ROM, desktop, laptop or notepad, palmtop or hand held computers. It can be self-paced or instructor-led. Flexibility: learning from anywhere and everywhere is crucial to e-learning. The connection to the

internet and the explosion of social media have allowed this flexibility in the personal learning environment. Collaboration: whereby learners are able to connect with other learners and teachers.

Context:

The study of e-learning particularly in Africa is done within the context of the following challenges: infrastructural constraints, lack of skills, high costs of implementation, differing cultural attitudes, lack of digital content, etc. The value we try to derive from e-learning is determined by the digital content, ICT technologies, social collaboration and flexibility of learning as described in the scope section above. This helps us in how: (i) information is displayed, (ii) the environment for interaction is designed, and (iii) instructional elements are set up.

Challenges to e-learning:

In another study carried out in 34 countries in Africa and among 147 e-learning practitioners the following challenges were identified: Infrastructural constraints, lack of training, excessive costs, logistical challenges, cultural attitudes, limited awareness and ineffective leadership, etc. (Hollow and ICWE, 2009). These were all classified into three categories of (i) resources, (ii) infrastructure, and (iii) understanding.

Almost four years later ITU (2013) identified the following challenges in low income countries: affordability, capacity, inclusion, content, and quality assurance. The ITU further elucidates that the challenge of slow adoption of e-learning is a result from the "constantly evolving technologies into present teaching models and methods".

Fatma (2013) raises the issue of most awareness of e-learning as a major challenge to the majority of rural people. Fatma goes on to say, "Lack of infrastructure in terms of connectivity, availability of Internet, etc. is another issue."

e-Learning trends

The eLearning landscape is one that is fluid and continuously changing. In simple terms e-learning trends are divided into two categories: (i) trends in approaches and (ii) trends in technologies. The African continent has seen three major technology trends converge with the power to contribute to learning. Abell and Long (2010) indicate "The technology trends in hardware and power are very compelling in enabling Africa to transform education using eLearning". They talk about three major trends in e-learning as (i) the low-cost computing devices, (ii) low powered computing devices and (iii) low-cost energy.

Abell and Long state: (i) the trend toward low-cost computing devices is exemplified by MIT's One Laptop Per Child (OLPC) Program to develop $100 laptops for education. (ii) The trend to lowered power consumption of computing devices is as important. (iii) Innovation driven by the market for netbooks, tablets, and eReaders has led to low power processors, screens, and other components. The third trend is the availability of low-cost off-grid energy and technologies like photovoltaic solar panels and wind turbines are significantly cheaper and more feasible today than just a few years ago. Many schools in Africa have either no electricity or have very unreliable power grids. This has represented an extreme limitation to the use of eLearning. Once these three are adopted Africa will be able to "leapfrog developed world education solutions by using e-content, low-cost devices, cloud computing, and renewable energy sources" (Abell & Long 2010. Looking at the Western countries one sees different trends in e-learning which include the following: (i) Gaming (Gamification): increased role of games in learning is seen in many courses

and learning management systems. (ii) Interactivity: more interactivity rather than just power point presentation. (iii) HTML5: Long term interactivity and m-learning. This provides better performance, multimedia, and connectivity. (iv) TinCan API replacing SCORM; (v) Responsive Web Design: A web design approach aimed at crafting sites to provide an optimal viewing experience across a wide range of devices. And (vi) Open Source e-learning platforms are gaining momentum in higher education.

E-learning is taking a strong foothold in other sectors such as ICT, business services, financial and pharmaceutical sectors, national health services, defence and public and local government institutions. According to Campus Technology (2012) the following trends are also prevalent: (i) Digital texts: The move to reduce the costs of education, including both the costs of books and of running school bookshops has ensured that the latest editions of digital textbooks are available. (ii) Distance learning programs: Again many universities are offering distance education programs with robust tools. (iii) The online learning environment becomes more personalized because of advancements in interactive technologies. And (iv) Mobile technology and apps.

Tablets, laptops, and mobile phones are each playing their respective roles in the mobile revolution that's taking place on today's college campus. Athey (2012) also talks about social-collaboration as one of the trends where “The rise of social provides an open environment with opportunities for communication and collaboration.”

Benefits of eLearning:

The following benefits to instant access to ICT means for education are identified by ITU (2013) as: (i) expanding the reach and equity of education; (ii) facilitating personalised learning; (iii) powering anywhere, anytime learning; (iv) providing immediate feedback and assessment; (v) Ensuring the productive use of time spent in classrooms; (vi) building new communities of learners; (vii) Supporting situated learning; (viii) Enhancing seamless learning; (ix) Bridging formal and informal learning; (x) Minimising education disruption in conflict and disaster areas; (xi) Assisting learners with disabilities; (xii) Improving communication and administration; (xiii) Maximising cost efficiency.

Iowa State University’s elearner (undated) identified the following advantages of e-learning: Class work can be scheduled around work and family; reduces travel time and travel costs for off-campus students; students may have the option to select learning materials that meet their level of knowledge and interest; students can study anywhere they have access to a computer and Internet connection; self-paced learning modules allow students to work at their own pace; flexibility to join discussions in the bulletin board threaded discussion areas at any hour, or visit with classmates and instructors remotely in chat rooms; and elearning can accommodate different learning styles and facilitate learning through a variety of activities.

Disadvantages of online or computer-based learning Iowa State University’s elearner (undated): Learners with low motivation or bad study habits may fall behind; without the routine structures of a traditional class, students may get lost or confused about course activities and deadlines; instructor may not always be available when students are studying or need help; slow Internet connections or older computers may make accessing course materials frustrating; managing computer files and online learning software can sometimes seem complex for students with beginner-level computer skills; and hands-on or lab work is difficult to simulate in a virtual classroom.

It was discovered that in 2013 laptops, mobile phones and social networking are the most popular technologies supporting education. This is indicated in Table 1 which show data extracted from

The eLearning Africa Report of 2013 and representing data collected from 42 African countries and 413 elearning practitioners.

Table 1: *Popularity of technologies supporting education*

Technologies	**% of respondents**
Laptops	83%
Mobile Phones	71%
Social Networking	60%
Desktops	67%
TVs	34%
Radios	31%
Tablets	20%

CONCEPTUAL FRAMEWORK

Grounded Theory (GT) is the research methodology from which a conceptual framework is generated. Grounded theory is regarded as a general research method which is not owned by any one school or discipline (Scott 2009). According to Scott GT normally provides guidance data collection methods be it quantitative or qualitative and "details strict procedures that are utilised for data analysis". Grounded Theory may be defined as "the discovery of theory from data systematically obtained from social research" (Glaser & Strauss 1967). In order to accomplish this, researchers are required to keep an open mind at the start of the research, "coloured as little as possible by expectations based on existing theories" (Taber 2000).

Scott (2009) suggests that GT is fundamentally a research method and by strictly utilising it one gets involved in a research process which will lead to theory 'grounded' in data. Therefore, both the research method and research output have the same name. Scott provides the following methodological stages: (i) Identify your substantive area – this refers to the area of interest; (ii) Collect data – relates to the use of qualitative or quantitative data or a mixture of the two; (iii) Open code – relates to the open coding and data collection as integrated activities (iv) Write memos throughout the entire process. The development of your theory is captured in your memos; (v) Conduct selective coding and theoretical sampling – stop when the core category and main concern are recognised; (vi) Sort your memos and find the Theoretical Code(s) which best organises the substantive codes; and (vii) Reading of the literature and integrate with your theory through selective coding.

We are using GT in this study because of the flexibility it provides to researchers. Therefore, open mindedness is of utmost importance when using GT.

PROBLEM STATEMENT

In an endeavour to find solutions to the country's improving but ailing education, in particular the school leaving certificate (Matric), the South African government through some of its departments is attempting to introduce technology with the intention to improve teaching and learning. The recent pilot study currently underway is in Cofimvaba in the Nciba district in Eastern Cape Province where tablets were introduced in a number of schools to teachers and learners for

teaching and learning. A number of modules were taught and these included those dealing: with teaching, use of social media, peer support and strategies, etc. Now our challenge is to find out if teachers after attending a number of modules accepted and used effectively tablets allocated to them for teaching, learning and personal development.

METHODS AND TOOLS

The main research methodology will be qualitative multiple case study research with interpretivism as philosophy. “Interpretive methods start from the position that our knowledge of reality, including the domain of human action, is a social construction of human actors” (Walsham 2006). It accepts the notion that individuals create meaning within a specific environment (Hanson 2008).

These methods support our research paradigm because of their flexible use, particularly with technology, while allowing future developments. The research employed interpretive methodologies which included the use of case study and questionnaire for data collection. The case study research method can be defined as an empirical study that uses multiple sources to investigate a contemporary phenomenon in a real-world context (Yin 1984 & Thomas 2011) and emphasise detailed contextual analysis of a limited number of events or conditions and their relationships (Soy 1997). The weaknesses of case study methods, according to Mikkelson (1995), are that sometimes they serve as a foundation for generalisations, which might be erroneous. In this study, a number of TCs will be studied as part of our case studies.

Rich data were collected using questionnaires whereby the objective was to find out how respondents used their tablets, for what and to determine the levels of confidence in their use. Questionnaires are one of the most frequently used methods of collecting effectiveness data and they can be composed of items that address information and attitudes (Reeves and Hedberg, 2003). The aim of the questionnaires was to ascertain the real impact of how teachers are using tablets in their teaching.

ICT4RED: COFIMVABA CASE STUDY

The Information and Communication Technology for Rural Education Development (ICT4RED) project started in 2012 and will run until 2015. The project team held a workshop titled “What it looks like when it’s fixed” with the aim of getting buy-in from the schools. This workshop was attended by representatives of headmasters, School Management Teams, School Governing Bodies of each of the 26 Nciba Circuit schools and Cofimvaba district officials in December 2011. In August 2012 the first phase (Phase 0) of the project started at Arthur Mfebe School with handing out of tablets and training the teachers on how to use the tablets and introducing the learners to cell phone-based supported for maths and science i.e. Dr Math, QuizMax and other MXit-supported educational applications. The success of these endeavours led to a broader pilot which included more schools. The Minister of Science and Technology, Deputy Minister of Basic Education and the provincial minister of Eastern Cape Department of Education launched the Cofimvaba Technology for Rural Education Development (TECH4RED) project on December 3, 2012. At this launch learners were provided with two MobiKits each containing 20 learner tablets. This marked the first tablet provision to learners in Cofimvaba.

The ICT4RED project was launched on 1 April 2013 with 11 schools (Bangilizwe, Gando, Gudwana, Khwaza, Mcqawezulu, Mtimbini, Mvuzo, Ntsingeni, Siyabalala, St Marks and Zamuxolo) making Phase 1 of the project. This launch included a workshop attended by headmasters of these schools. At this launch learners from Arthur Mfebe made presentations on

the use of tablets in supporting learning. In May 2013 the first training session on the use of tablets was held and 16 district officials were provided with tablets.

A number of courses were offered to teachers of participating schools under the stewardship of CSIR Meraka Institute. At the end of each professional development training module teachers were given tasks to perform in class or as homework at their schools. For these teachers to earn a personal tablet they needed to attend and complete all training modules. At the end of each module each teacher received a badge. The first school to earn a projector through all its teachers completing their modules was Zamuxolo Junior Secondary School, one of the poorest schools in the project. The badges teachers earned during training contributed towards the school receiving a number of technology gadgets like printers and projectors.

In July 2013 the first professional development session for the 144 new teachers from the 11 schools took place at Queens College, Queenstown with 100% attendance. At this event teachers were each given their tablet and this was followed by a tablet orientation course which was followed by modules 1 and 2.

RESULTS

The results of this teacher survey show the functions respondents performed with their tablets. Here we are presenting some of the results of the questionnaire which was administered to participants of the Cofimvaba ICT4RED project.

Teaching Purpose:

The Bar Chart in Figure1 shows that fifty seven percent (57%) of participants use tablets frequently for finding information for class, 63% develop teaching resources, 60% develop digital content and 53% use them in the classroom for showing digital content. On the other hand 17% of the teachers did not use tables to develop teaching resources, 8% did not develop content and another 8% did not use tablets in class for digital content development.

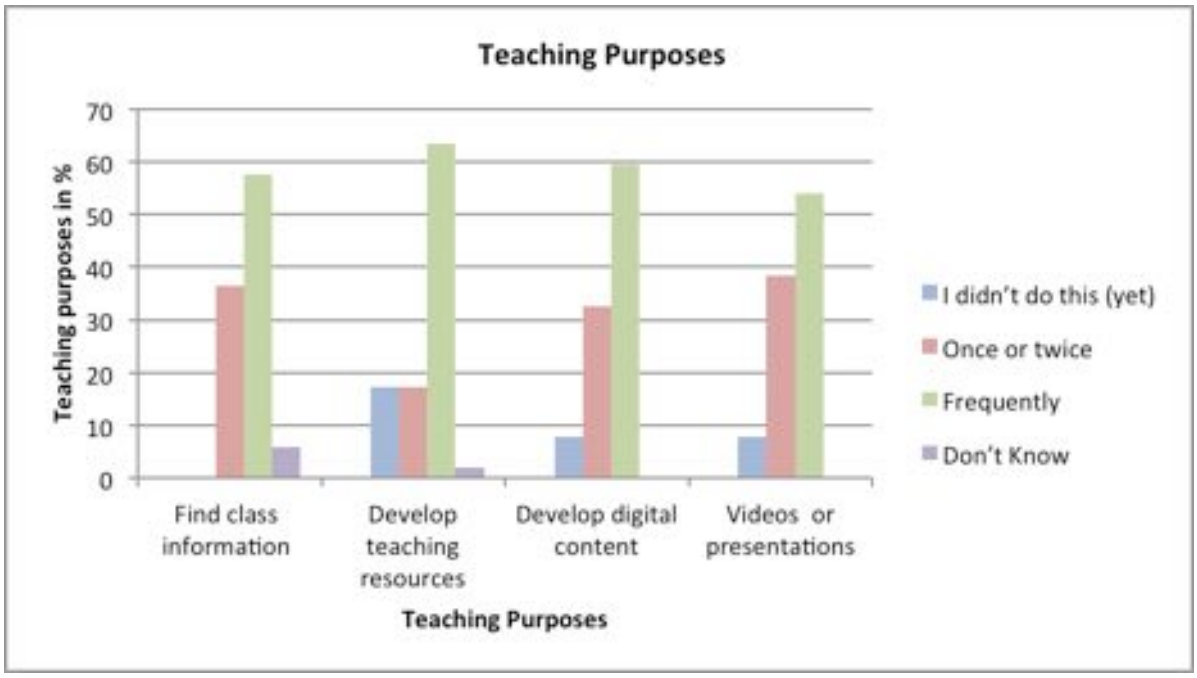

Figure1: *Bar chart indicating purposes teachers used their tablets for*

Some participants have used tablets fewer than twice where 36% used them to find information for class, 17% for developing teaching resources, 32.69% for developing digital content, and 38.46% for using tablets in class. About 6% of teachers have indicated that they did not know whether they used tablets for finding information for class and 2% indicated that they did not develop teaching resources on tablets.

Social Media

Over the past three months many respondents had started to engage frequently (35.85%) in social networking, instant messaging (39.62%), 41.5% accessed emails, 11.32% internet banking (see Fig.2 below). Most people use tablets to take pictures 90.57%, 79.25% to access Apps, 58.49% to record sound clips, 71% for recording videos and 41.51% for research.
Again, there were those respondents who used their tablets less than twice to perform all the above activities: social networking (22.64%), 24.5% in instant messaging, 41.5% emails, 15% internet banking, 9.43% to take pictures, 15.9% to access Apps, 28.3% to record sound clips, 22.64% for recording videos and 28.3% for research.

There were a large number of respondents who have never used their tablets to do some of the above mentioned activities. For example, 37.74% never used social networking tools, 33.96% instant messaging applications, 52% internet banking, 11% and 15% never used emails and research respectively. Those who never recorded videos were counted at 1.89%, 3.77% never recorded sound clips and only 1.89 never access Apps.

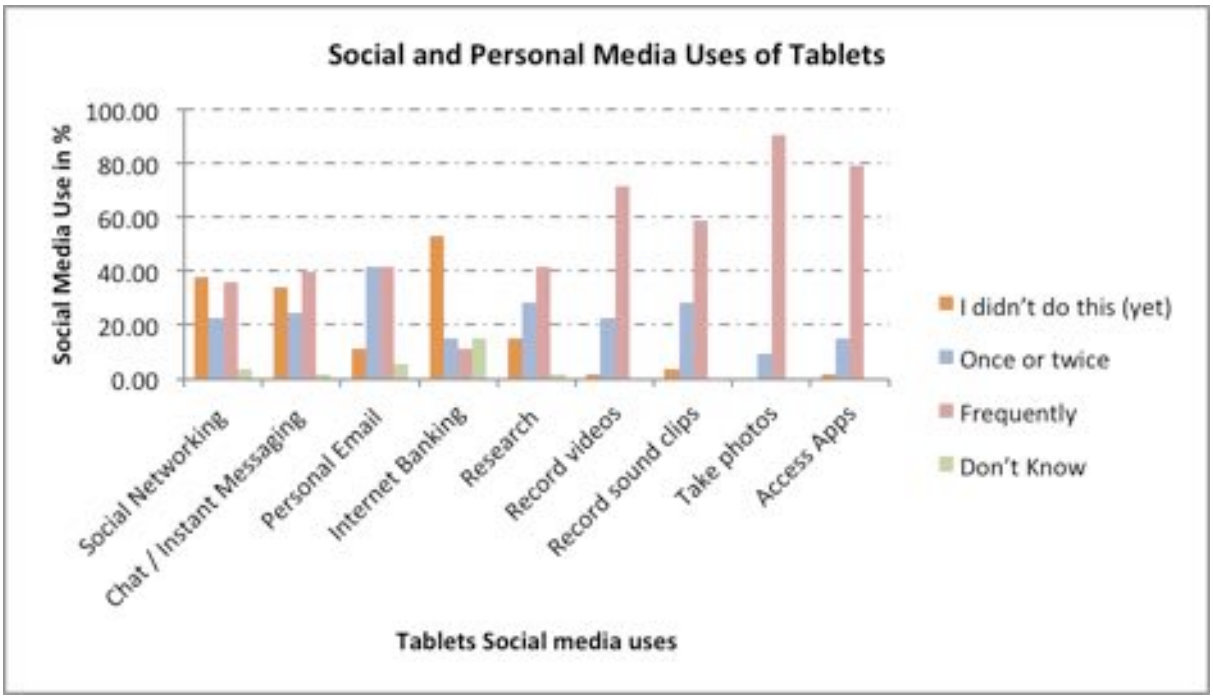

Figure 2: *Bar chart indicating teachers' social media uses*

Peer support

The participants (94%) agreed that they got support from the peer groups based at the school while 4% indicated that the peers at school were not giving them enough support and 2% did not know whether the peers at school supported them or not (see Figure 3).

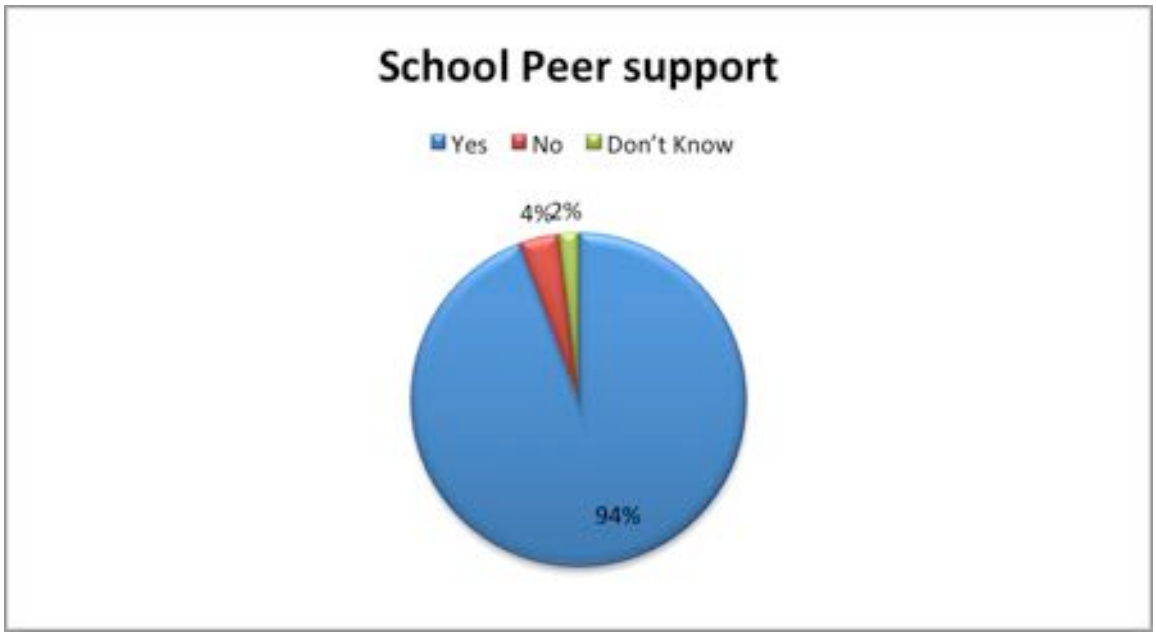

Figure 3: *Pie chart showing peer support of respondent.*

Software and Hardware Experience

The majority of participants (Fig.4 below) did not experience any problems with hardware and software: tablets (75%), apps loaded on tablet (85%), tablet battery (64%), tablet charger (100%), sound quality (51%), photo/video quality (81%), Wi-Fi connections (66%), internet connection (47%), USB port (57%) and the ability to access removable storage (60%).

Some educators indicated that they did not know whether they experienced problems with the hardware or software of their tablets with regard to Wi-Fi connections (6%), internet connection (6%), USB port (21%) and tablets' ability to access removable storage (19%).

There was a small percentage of teachers who experienced various problems with both the hardware and software: tablets (25%), apps loaded on tablet (15%), tablet battery (35%), sound quality (49%), photo/video quality (18%), Wi-Fi connections (26%), internet connection (47%), USB port (19%) and the ability to access removable storage (19%). None of the teachers experienced problems with their tablet chargers.

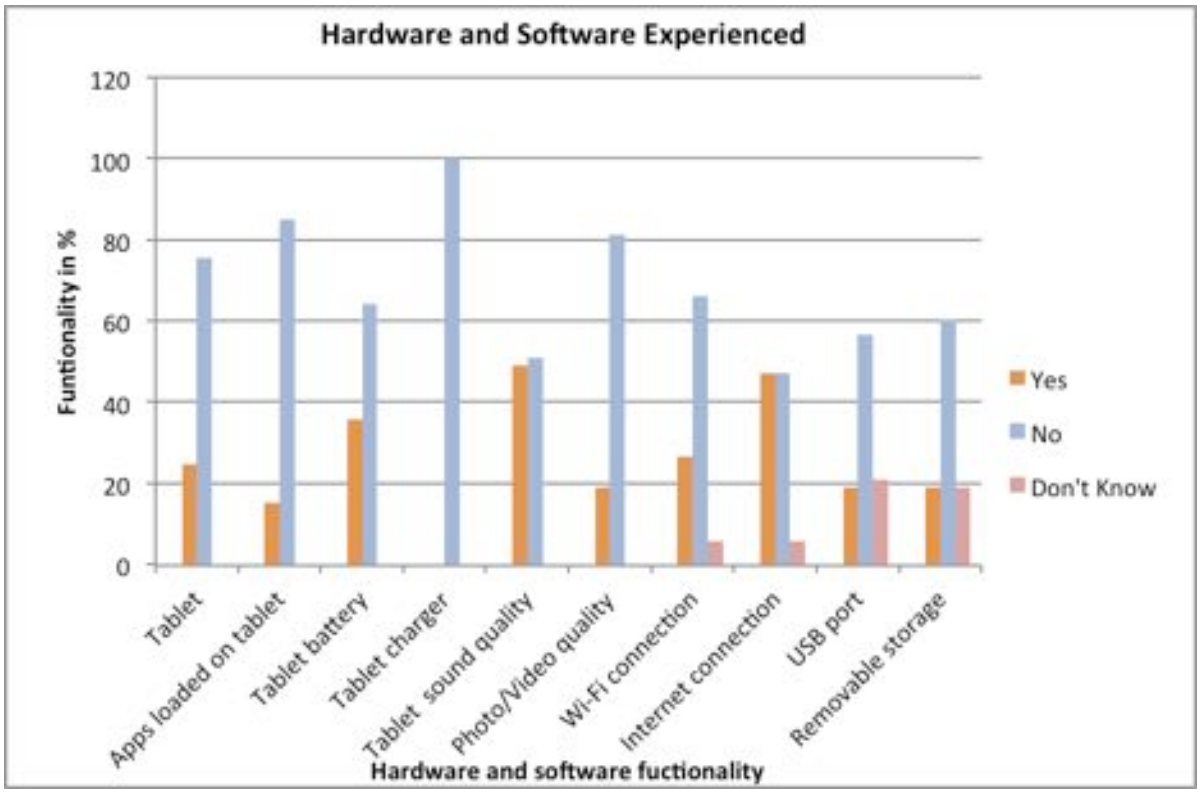

Figure 4: *Bar chart indicating teachers' experiences with hardware and Software*

Personal Development

A large number of educators used tablets for their own professional development (Figure 5) where 79.25% like reading frequently, 71.7% watched professional development videos, 66% listened to professional development content and 69.81% made contact with people who helped them learn.

There were teachers who have used tablets once or twice for reading content for their own professional development (20%). 19% have watched professional development videos while 28% have listened to professional development content and 24% have made contact with people who have helped them learn.

Again few respondents never used tablets for their professional development with 9.43% having never watched professional development videos, 3.77% never listened to professional development content and also never made contact with people who could help them to learn.

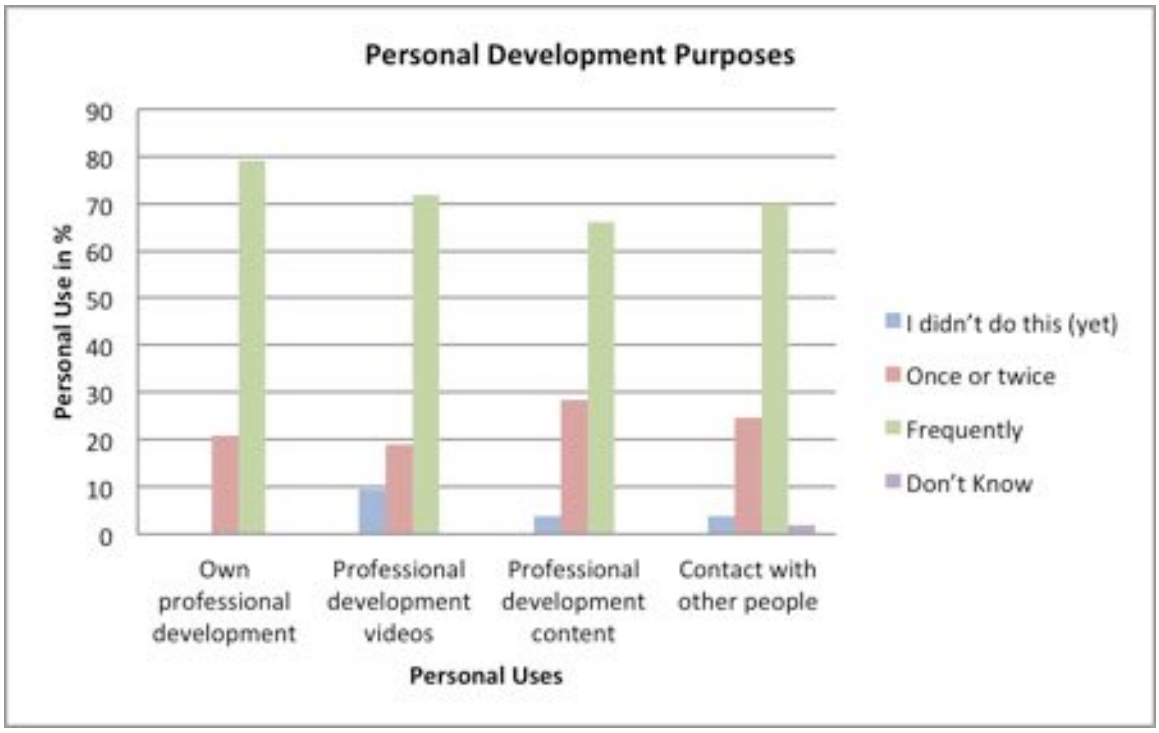

Figure 5: *Bar chart indicating teachers' development purpose*

ICT Committee Support

The ICT committee is giving full support to the teachers with 94% agreeing. Only 2% of participants did not receive sufficient support and 4% do not know if ICT committee gives sufficient support.

Strategies used

A large percentage of teachers frequently used strategies that were taught in different courses (Figure 6). Jigsaw puzzle and story telling each had 71% of usage each while 78% of respondents had done role play, 50% utilised learning stations and 76% used mind mapping. Of those who used their tablets once or twice about 25% of teachers had used jigsaw, 26% storytelling, 19% role-playing, 35% learning stations and mind-mapping with 23%. However, a few respondents did not use these teaching strategies with jigsaw at 3.85%, 1.9% role-playing, 15.38% learning stations and mind-mapping with 1.9%.

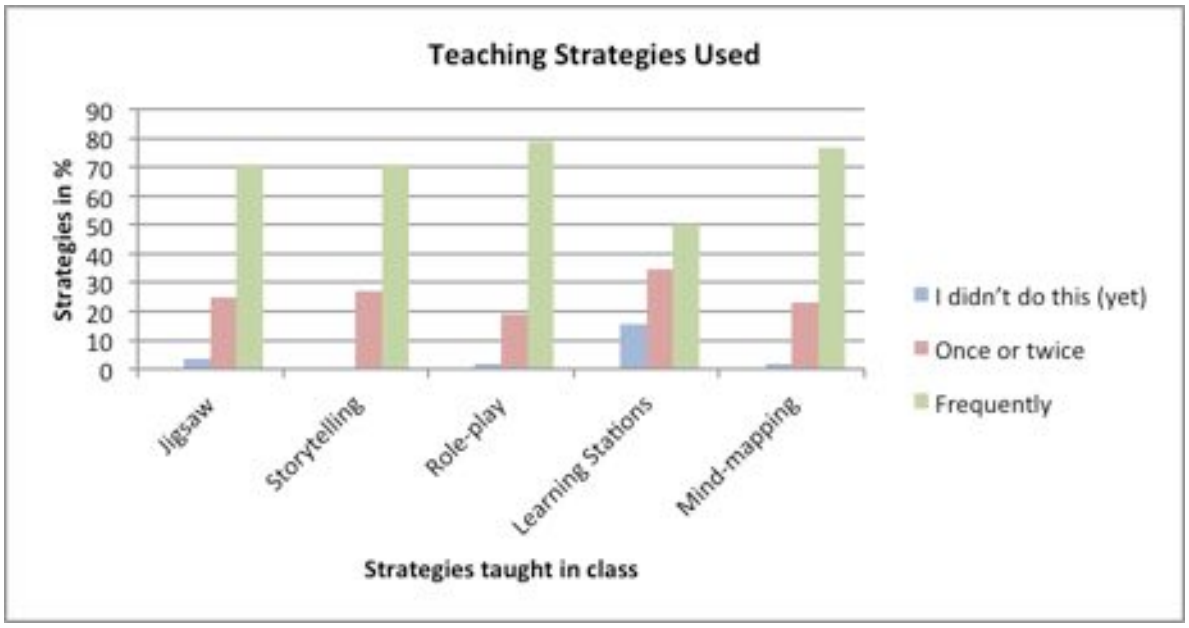

Figure 6: *Bar chart indicating teachers' teaching strategies used*

Relevant Apps

Participants (Figure 7) strongly agreed that they found relevant applications for their purposes (28%), relevant subject specific digital content (20%), relevant grade specific digital content (22%) and variety of content available to help in teaching (13%). Many participants agreed that they found relevant applications (60%), relevant subject specific digital content (60%), relevant grade specific digital content (72%) and know there was a variety of content available to help with teaching (66%). Few teachers indicated that they did not find relevant applications (4%), relevant subject specific digital content (2%), relevant grade specific digital content (6%) and not much variety of content available to help teach in class (15%). Some participant strongly disagreed that they found relevant applications for their purposes (2%) and that there was a variety of content available to help teach in class.

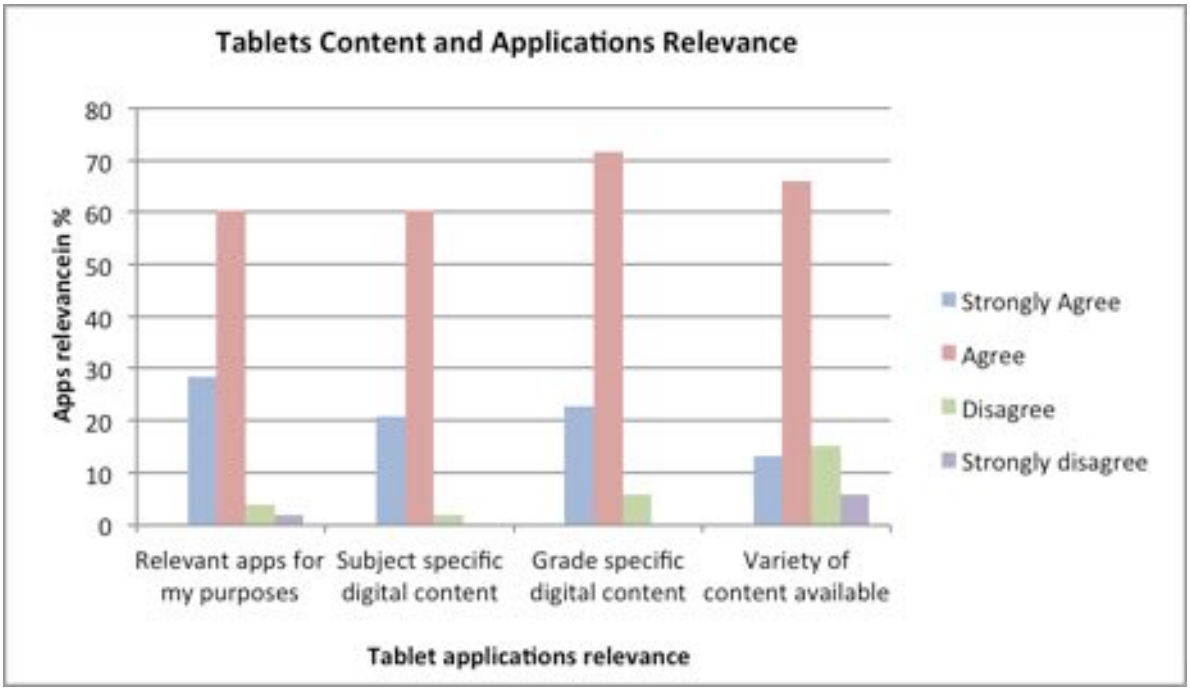

Figure 7: *Bar chart indicating tablets content and applications relevance*

Administrative purposes

Most people had not started using their tablets for administrative work (Figure 8) with 45% never using their tablets for typing exams papers (45%), recording marks (45%), administrative tasks (49%), and even email communication (43%). However there were other teachers who used tablets frequently for typing examination papers (30%), recording marks (32%), school administration purposes (30%) and school email communication (18%). There were a small percentage of teachers who used tablets fewer thna twice for typing examination papers (24%), recording marks (22%), school administration purposes (9%) and school email communication (30%).

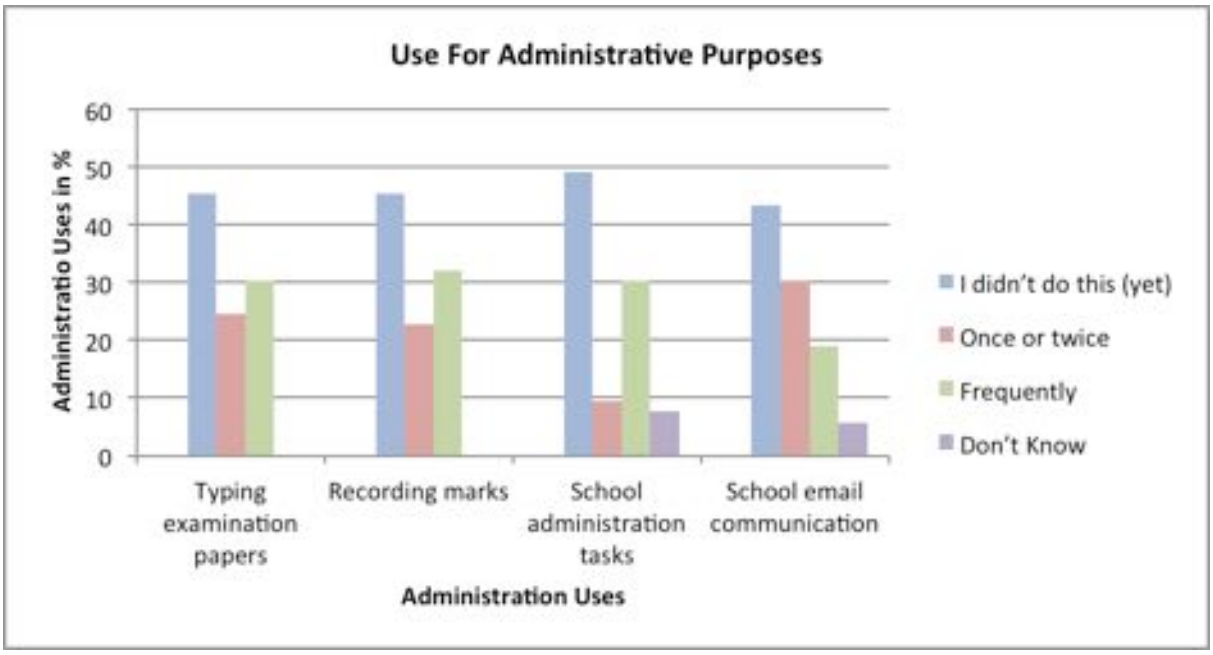

Figure 8: *Bar chart indicating tablets' use for administrative purposes*

ANALYSIS

The Cofimvaba School District Technology pilot project on the whole achieved its objectives. After introducing tablets to the teachers and attending a number of modules, the study shows that most teachers embraced tablets and started using them in the classroom and for their own personal and professional development. These teachers began to believe in their own strength to change the way they have been teaching. This is supported again by Park (2009) who elucidates "both e-learning self-efficacy and subjective norm play an important role in affecting attitude towards e-learning and behavioural intention to use e-learning." This belief in one's own strength to achieve their development goals (self-efficacy) is important in teaching, particularly where teachers have learned new skills. Parks goes on to state that e-learning self-efficacy may be considered an intrinsic motivational factor. on e-learning." The study also found that teachers learn best through active learning and reflective practice (Duncombe et al., 2004).

Within a short time most participants were already using their tablets in their teaching. This is in line with a statement by Mock (2004) who states that tablets can be used as an effective tool for grading, preparing lectures, and delivering classroom presentations. Tablets provide a simple way to integrate content live while teaching, whereas handwritten material with slides and figures can be prepared in advance. It can be seen that the majority of these teachers accepted this technology and used it well to find information, develop teaching aids and digital content and to adapt videos for classroom use, while a few respondents showed that they never use their tablets to look for information to use in their teaching duties.

Again, it was found that most respondents used their tablets for personal use by downloading Apps, taking photos, recording sounds and videos among others. This is similar to views raised by students who extensively used electronic tools (e-tools) such as mobile phones, emails, MSN, digital cameras, game consoles and social networking sides. The students reported that they would use any form of technology available to them if it would help them to learn (Trinder et al.

2008). This shows that both learners and teachers by learning and teaching with new tools they are developing new teaching strategies which will enhance education.

However, a few respondents were slow to adopt such things as social networking, instant messaging and emails, and internet banking, i.e. most things which requires one to register or use a password. Participants often lacked the incentive to login into the internet to take advantage of the broad learning community and in many instances this is because of the high costs needed to have access to these benefits (Ally 2009).

These tablets had been well received by both groups and there was a lot of support that teachers received from school and peers. Continuous professional development worked well in ICT if it is preceded by training from external ICT specialists (Cordingley, et al. 2007). The support structures put in place to assist teachers once trained seem to be working well with almost all teachers indicating that they are receiving sufficient support from their ICT committees. There has been little or no proof at all that teacher professional development makes any difference (Schrum 1999). Hence, it is important to note that the paper was not attempting to ascertain whether tablets work or not in practice but to discover their acceptance.

CONCLUSION

The Cofimvaba School District Technology pilot project on the whole achieved its aims. The respondents have accepted the tablet technology and are using it in their professional and personal circumstances. This can only assist them in their teaching duties and therefore this is another important step towards the improvement of education in poorly resourced schools and for the poor majority of South Africans.

We believe the way forward is for the pilot test to be broadened to include more schools in the area. On the evidence of this pilot we can see that teachers in the rural areas will happily use information and communication technologies if they are available. This can only help them but most importantly help learners by bringing new innovations to the classroom.

Finally, in places where there has been poor distribution of textbooks teachers are now empowered to look for the relevant information and to distribute it to their learners on time. It is important to note that e-learning is going to be very important going forward for a country like South Africa.

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Synchronous e-learning: Reflections and design considerations

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ABSTRACT

This paper is a personal reflection on the design, development, and delivery of online synchronous conferencing as a pedagogical tool complementing traditional, face-to-face content delivery and learning. The purpose of the paper is to demonstrate how instructors can combine collaborative and virtual learning principles in course design. In particular, the paper asserts that instructors should take into account relative advantage, compatibility, complexity, and risk attributes of new technologies before incorporating them to their courses. Further, it is important to evaluate organizational support availability such as financial resources and managerial support. In realizing team work for course projects that require group interactions, synchronous online conferencing can be very valuable, and even preferable, for students since it overcomes limitations of space, time, and distance. Future research should explore benefits, challenges, and outcomes of synchronous online discussions. Comparisons to implementation and design considerations of "asynchronous" virtual learning environments such as discussion board forums could be beneficial as asynchronous virtual discussions seem to be more commonly used in supplementing traditional course designs.

Keywords: *Collaboration, Synchronous, Online Learning, Teaching Practice, Technology*

INTRODUCTION

Technological changes in the methods used to deliver course content are becoming widespread in higher education. Computer-supported collaborative learning environments are allowing students to experience new ideas and different perspectives, and easily share their thoughts with other students (Dillon, 2008; Golden, 2006; Sullivan et al., 2011; Tabak & Nguyen, 2013). Yet, courses that involve an online learning component or those that are fully online or blended put different demands on the professor, many times changing his or her role to one of a tutor-facilitator (McFadzean & McKenzie, 2001; Ross & Rosenbloom, 2011) and posing challenges regarding the design, initiation, and implementation of online course components (Milwood & Terrell, 2005).

Although computer assisted teaching and learning or Internet based education is gaining acceptance as a supplement or an alternative to teaching and learning in traditional classroom settings, more research is clearly needed on its effectiveness in enhancing and supporting student learning (Lai, 2011; Nicholas & Wan, 2009; Ross & Rosenbloom, 2011). Most of the existing research is exploratory and in early stages of assessing the contributions of an online course component to the learning process (e.g., Arbaugh, 2000; Sullivan et al., 2011) as this is a relatively new method of delivering knowledge and creating an interactive learning environment. Yet, together with advances in technology, more opportunities are emerging for electronic collaboration, and in addition, there is research evidence that collaborative activities and learning

lead to better retention of content as well as to higher quality critical thinking and knowledge transfer (Pronovost, 2011; Sharon, 1990). Research further supports use of virtual classrooms for collaborative learning (Leidner & Jarvenpaa, 1995; Zhu, 2012). Use of advanced technological features encourages more student involvement and interaction in both synchronous and asynchronous contexts. Since computer assisted education overcomes limitations of time, space, and distance that may constrain collaborative activities within the physical classroom, virtual learning leads to enhanced collaboration and experiential learning (Erlandson, Nelson, & Savenye, 2010; McFadzean & McKenzie, 2001).

This paper discusses the design, development and implementation of online synchronous conferencing as a pedagogical tool. The purpose of the paper is to reflect on how instructors can integrate e-learning technology with collaborative learning principles to deliver content and enrich traditional course design. The framework of design considerations was based on initiation and implementation of collaborative Web-based technologies as guided by Rogers' (2004) innovation diffusion model and research.

REDESIGNING TWO MANAGEMENT COURSES

Course Objectives and Connections to Synchronous Conferencing

The courses that were central to this research were "Organizational Leadership" and "Management of Organizational Behavior" offered as part of a Management concentration under a B.S. in Business Administration degree. Both courses were under-graduate and senior level. The courses were also required (as opposed to being elective) for a Management concentration. An online synchronous conferencing activity was introduced to students enrolled in three sections.

"Organizational Leadership" course objectives focused on developing leadership skills, managerial leadership concepts and theories, research findings, and practical applications. It entailed group exercises and cases to illustrate practical applications. Course topics included participative leadership, leadership in decision making groups, and charismatic and strategic leadership in organizations. The course also covered points of convergence and divergence among different leadership perspectives, practitioner-oriented approaches for improving leadership effectiveness, and current issues in leadership. Course objectives also included students' developing and practicing skills required for effective managerial leadership at all organizational levels, and enhancing creative, critical and integrative thinking abilities.

By applying various leadership theories and concepts to real-life situations, the course focused on developing practical excellence skills. It further aimed at developing written, spoken, and electronic communication skills through Leadership-in-Action papers, team case presentations, and group and individual experiential exercises. One of the objectives of the course was to improve technology skills. Real-time (synchronous) discussions were added to the course site on Blackboard course management system to supplement this particular objective as well as to facilitate content learning.

"Management of Organizational Behavior" course was organized around the main topic areas of individual, group, and social processes and behavior, interpersonal processes and behavior, and organizational processes and structure. This was an experiential course, and so learning outcomes were achieved through several personal awareness and growth exercises, group exercises, and case studies. Course objectives included studying individual behavior in organizational settings through job design, decision making, quality management, motivation, and

performance management, interpersonal behavior through communication, conflict management, power/politics, and empowerment, as well as group behavior through intra-group and inter-group dynamics, and teams and teamwork. Another objective of the course was to enhance written and oral communication skills, ethical reasoning skills, creative, critical, and integrative thinking skills, and diversity management skills. The new e-learning course component was aimed at strengthening the collaboration skills of participants as well as enhancing their technology awareness and facilitating content mastery.

Design Considerations

Applying the teaching-for-learning model of Conrad, Johnson, and Gupta (2007), synchronous online conferencing was integrated into both courses. Teaching-for-learning model focuses on design of learning experiences that are responsive to learning outcomes. Accordingly, the teacher implements a teaching practice and collects feedback to re-align the teaching practice as appropriate. In both of the courses discussed above, enhancing teamwork skills and improving technology skills were two of the learning outcomes that needed to be addressed in course design. A teaching practice such as synchronous online conferencing involving both the use of online technology and student collaboration skills directly responded to the stated learning outcomes.

The choice of this specific teaching practice was further guided by research on technology diffusion (Rogers, 2004). Specifically, Rogers asserted that attributes of relative advantage, compatibility, complexity, divisibility (later revised as trialability), and communicability (later revised as observability) consistently influenced the adoption and diffusion of ideas, or practices new to the adopter. Extant literature on Rogers' typology focused on perceived innovation attribute effects on decision makers' adoption behaviors (Makse & Volden, 2011). Rogers (2004) in his review of past research in this area concluded that strongest support exists for attributes of relative advantage, compatibility, and complexity, "with somewhat weaker support for the existence of trialability and observability" (Rogers, 1983: 212). Meta-analytic summaries can be found in Tornatzky and Klein (1982) and in Rogers (2004) across a wide range of disciplines.

Perceptions of the contributions of an idea to future performance refer to relative advantage (Makse & Volden, 2011; Rogers, 2004). The question is whether the adopters of the idea and/or practice perceive that there is an advantage to adopting the idea/practice. Relative advantage concept was evident in students' comments in both courses in their written assessment reports. Students clearly indicated that they prefer being involved in live chats over traditional teaching/learning methods such as writing term papers or making presentations of their research to class. One of the commonly expressed comments was that they felt they could express their opinions more freely in a virtual real-chat environment than in a face-to-face context.

High compatibility refers to perceptions of consistency with the values, experiences, and needs of the organization (Makse & Volden, 2011; Rogers, 2004). The new course component (teaching practice) of real-time conferencing was highly compatible with the current course structure and the structures of other business courses. Students had used Blackboard in other courses before and over 80 percent of all students indicated that they were familiar with the software. Many other tools of Blackboard were also in use such as the group Wikis, blogs, group asynchronous discussion boards, file exchange, and external links. Hence, since this technology was a tool available within Blackboard, perceptions of compatibility increased for the students. Also, the fact that they did not have to learn how to use a new software package contributed to perceptions of ease of use (Tabak & Nguyen, 2013).

Complexity is the degree to which an idea is perceived as relatively difficult to understand and use. When complicated ideas are introduced such that there are high levels of interaction with

various structural systems, adopters may perceive them to be less manageable (Rogers, 2004: 242). For example, it is relatively easier (and so less intimidating) to learn how to use a calculator than to learn how to use a tablet or iPad. Low complexity means the technology is better defined and poses high perceived control, low risk, and high predictability to the user. When online real-time chats were introduced in these course, the professor encouraged and reminded the students several times to enter the chat room and do trouble shooting before their scheduled chat times. A list of items to check for was handed to students and emailed as well. The objective was to enhance perceptions of control and lower perceptions of complexity.

Perceived risk was also considered as an attribute influencing successful new adoptions of technology. Research shows that if the innovation is perceived as less risky by adopters, probability of success improves (Tabak & Barr, 1998). Marketing research further provides support that perceived risk influences how consumers behave (Holak, 1985; Pi & Sangruang, 2011). When risk is assessed, it is important to evaluate how radical the change is in comparison to an existing system (Carlo, Lyytinen, & Rose, 2012). Routine changes, for example, are new, yet similar, to prior experiences (Tabak & Barr, 1999), involving less risk, while radical changes can involve higher risk as well as originality. In this case, the new pedagogical tool indicated a routine and incremental change. If the whole course had been put online and all face-to-face interaction had been eliminated, this would have been a radical change. Hence, perceived risk for adopters was relatively low.

Methods

Cross-sectional synchronous student discussion groups were randomly formed from the students registered for the two sections of the Organizational Leadership course and one section of the Management of Organizational Behavior course. Two (and sometimes three) students were chosen randomly from each one of the three course sections and these students were assigned to a team. Each team had six (and sometimes seven) students. Student teams met online at pre-scheduled times in a chat room. Students chose their own meeting time and date. Teams engaged in "live" real-time classroom discussions. The professor attended every session. The role of the professor was that of a facilitator in that she stayed silent most of the time and let the discussions evolve at their own paces. Discussions focused on pre-specified course topics that bridged or overlapped across the two fields of study (organizational behavior and leadership). Students had access to the discussion questions before the virtual classroom session both as a handout (hard copy) and online in Blackboard course sites. Discussion questions were put online in the Whiteboard area of Virtual Classroom in Blackboard before the meetings. There were two sets of discussion questions used in two separate sessions in the virtual classroom during the semester. Table 1 includes both sets of questions.

During the first set of virtual live discussions, team sizes were kept at six or seven students maximum. Teams consisted of five students each maximum in the second set of discussions. This resulted in 13 student teams (2 teams with 7 members; 11 teams 6 members) in the first set, each team meeting for at least 30 minutes. In the second set, 16 student teams, each with five members, participated in virtual live chats and sessions lasted at least 45 minutes. Students were teamed up with different students in each set. Meetings occurred outside of regular class meeting times typically during the weekends or evenings so that student work and school schedules could be accommodated.

Table 1. *Synchronous Online Conferencing Discussion and Assignment Questions*

Q #	**Synchronous Online Conferencing Discussion and Assignment Questions Part I**
1	Why should the average manager or any leader be well versed in the various motivation theories?
2	How have hygiene factors and motivators affected your job satisfaction and performance?
3	Do you know anyone who would not respond positively to an enriched job (that is a job enriched with more responsibility and decision making authority)?
4	Do you believe that job satisfaction is partly a function of both personal traits and genetic factors? Explain.
5	Do you believe job satisfaction leads directly to better job performance?
6	How would you respond to a manager who said, "Work-life balance is a personal problem that does not belong in the workplace. If you want to get ahead, be prepared to work a lot of hours and don't complain."
7	What are the main advantages and drawbacks of the trend toward increased delegation at the workplace?
8	In your opinion, how much empowerment is "too much" in today's workplace?
9	Will empowerment turn out to be just another management fad? Explain your rationale.
10	How would you respond to a manager who said "Employees cannot be motivated with money"?
11	How would you respond to the following statement: "Whenever possible, managers should hire people with an external locus of control"?
12	Is everyone cut out to be a leader? Explain.
13	Has your college education helped you develop any of the traits that characterize leaders such as assertiveness, communication and cognitive skills, internal locus of control, self-confidence, initiative, ambition?
	Synchronous Online Conferencing Discussion and Assignment Questions Part II
1	What role do emotions play in decision making?
2	Given the intuitive appeal of participative management, why do you think it fails as often as it succeeds? Explain.
3	Do you think you are creative? Why or why not?
4	What advice would you offer a manager who was attempting to improve the creativity of his or her employees? Explain.
5	Considering your current lifestyle, how many different roles are you playing? What sorts of role conflict and role ambiguity are you experiencing?
6	Have you observed any social loafing recently? What were the circumstances and what could be done to correct the problem?
7	Why is delegation so important to building organizational trust?
8	Would you like to work on a self-managed team? Explain.
9	How would you respond to a manager who said: "Why should I teach my people to manage themselves and work myself out of a job?"
10	What bases of power do you rely on in your daily affairs? Do you handle power effectively and responsibly?

In both sets of sessions, the total number of students participating in the research was 80 students. Hence, in the first set of sessions, 13 student groups participated at 13 different times

during a two week time span. The discussion questions were selected randomly from the list of 13 questions displayed in Table 1. In the second set of sessions, 16 student groups met at 16 different times during a two week span, and again, the discussion questions were randomly selected from the list of 10 questions listed in Table 1. After each one of the session sets, students individually completed a report answering each one of the 11 questions displayed in Table 2 for session 1 and the 6 questions displayed in Table 2 for session 2.

Attendance in the virtual chat twice and turning in the reports that provided answers to all questions by the deadline was worth 20 points for each session. Thus, a total of 40 points (10%) of the course grade came from attendance in the chat sessions and the quality of the assessment reports turned in by students. All assessment reports were graded.

Organizational Support

Implementation of the new teaching practice emphasized framing and environment (Johnson, 2000). Framing strongly implies effectively managing the perception, understanding, and interpretation of messages. Good framing results in a high level of communication quality. As for synchronous online conferencing (or live real-time chats) and framing it for relevant stake-holders, the new pedagogical tool was posed as a method that will potentially contribute to students' multi-faceted experience in the courses. Main target consisted of two different stakeholders. One was the peer group involved in teaching similar business administration courses. A faculty development and research committee comprised of one faculty representative from each of the five departments in the College approved the new pedagogical tool and awarded a summer teaching grant that enabled the implementation of the innovation in the upcoming fall semester.

The second stakeholder group consisted of students who were going to participate in the use of the new pedagogical tool. The professor was highly engaged in communicating the benefits of the tool for the students and clarifying points of confusion. The course syllabus, Blackboard announcements, multiple emails as well as verbal short meetings were widely utilized to explain how the new tool was going to be implemented and how student performance was going to be assessed.

The environment must also be supportive and encouraging for successful initiation and implementation of interventions. Climate for change, managerial support, and financial resource availability are influential factors in how successful change would be (Klein & Knight, 2005). In this particular case, by making financial funds available for the technology enhancement awards, the Dean's office was showing full support and encouragement for such online initiatives. The College climate was such that faculty on the cutting edge of technology use in classroom and in research were being rewarded in various ways. Teaching technology grants was one of the channels through which this support was shown.

EFFECTIVENESS OF IMPLEMENTATION

Student performance on assignment reports was the main measure of implementation effectiveness. Both reports required students to use the virtual live chat/discussion content and structure. In the first report, completed after the first set of sessions, students gave feedback on what they would change structurally in the way the new pedagogical tool was utilized to make it more user-friendly and easier to use. They also discussed what they thought about such online learning tools and whether they should be more fully integrated into course design. Students also commented on whether such online tools should replace face-to-face classroom discussions.

Students further elaborated on what they thought about interacting with other students who were not in their class. After the second set of chat sessions were completed, the assessment questions asked students whether their thoughts have changed after exposure to others' views on these topics. In the assignment, students wrote what they thought about at least four of the content (discussion) questions before and after the chat room experience. Table 2 includes both sets of assessment questions.

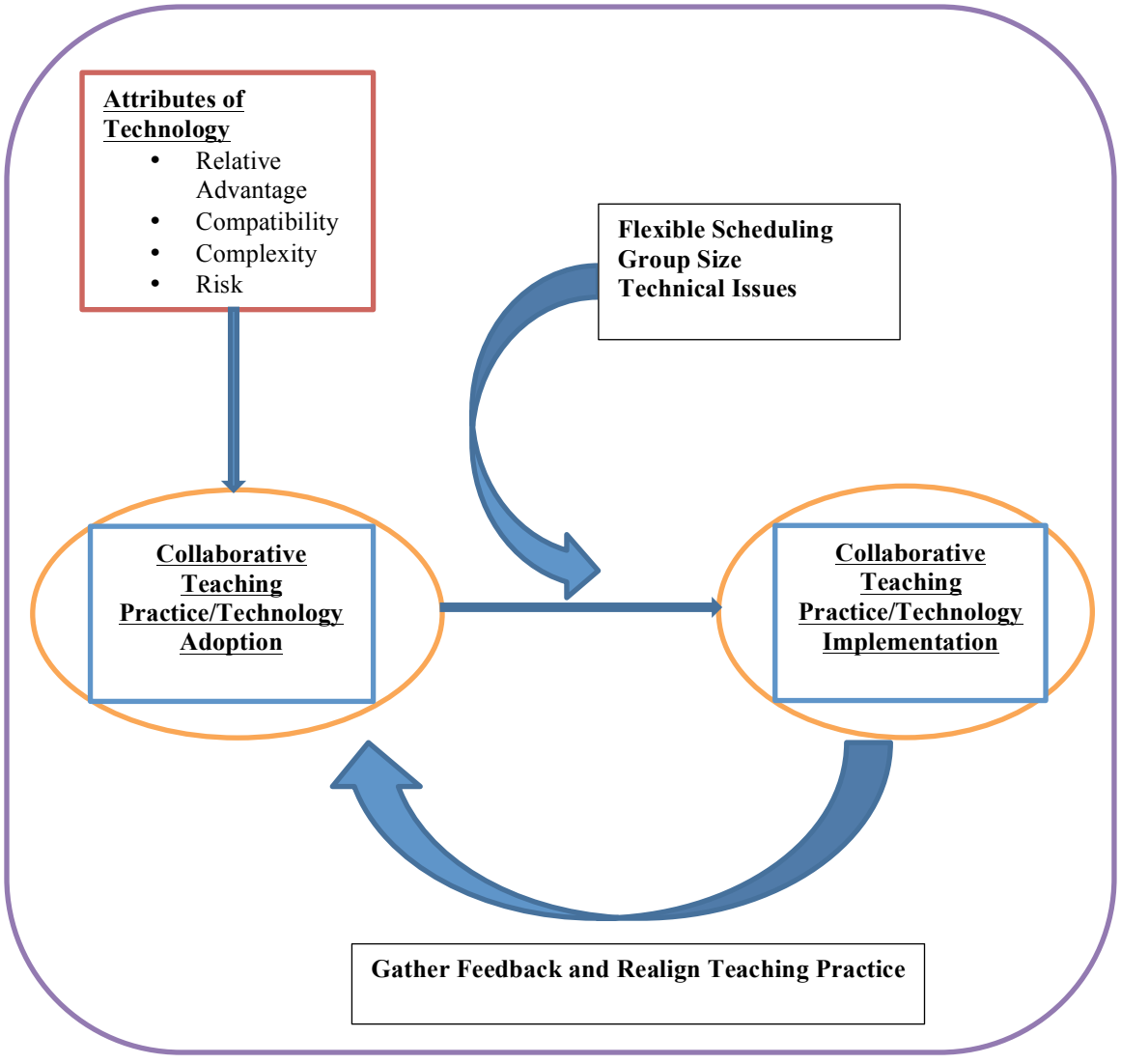
Table 2. *Synchronous Online Conferencing Assessment Questions*

Q #	**Synchronous Online Conferencing Assessment Questions - Part I**
1	Which session did you attend? Write the date and time.
2	Did you find the chat room interaction useful? Why/why not?
3	What was the topic of discussion? Explain completely what was discussed.
4	How did the discussion go? Did you get a chance to speak your mind?
5	What would you change structurally for your second virtual meeting? Explain specifically. For example, did it work to split up to two groups and allow only 6 students maximum to talk simultaneously?
6	What would you change content-wise for your second virtual meeting? Explain specifically. For example, would you add Web pages to initiate discussion? What areas in Leadership or Organizational Behavior most interest you?
7	Do you think that online learning tools like this can be more fully integrated into traditional course designs? How?
8	Do you believe that virtual interaction can or should one day replace face-to-face interactions in a traditional classroom context? Why/not?
9	Do you have any ideas on how to make the scheduling task more efficient for the next meeting?
10	Did you find it useful to interact with other students who are not in your class? Why/not?
11	Please add any other thoughts that you think would be relevant and useful for improving the outcomes of this new teaching practice.
	Synchronous Online Conferencing Assessment Questions - Part II
1	Refer to the Virtual Chat Discussion Questions Part II. Respond in detail to four of the questions that were discussed in your virtual classroom session II.
2	In answering these questions, first type the question out and then put your response to it underneath. In your answers, first explain what your initial thoughts were about this question.
3	Then, explain how and /or whether your thoughts changed or expanded after exposure to the views of others in the chat room.
4	Finally, explain what you now think about the issue raised in the question after incorporating others' perspectives.
5	Repeat steps 3, 4, and 5 for each one of the four questions.
6	Finally, add a feedback paragraph to the end of your report assessing the effectiveness of Virtual Classroom and how it could be improved to be an integral of any organizational behavior or leadership course.

Feedback was very positive and constructive in general, and most suggestions were implemented in the second set of sessions. As a result, the meeting times were extended to 45 minutes from 30 minutes and the group sizes were limited to 5 members maximum. Also, the professor started scheduling the sessions at least 2 weeks before to accommodate scheduling difficulties and allow more time to plan. Further, only one chat session per day was scheduled due to technical challenges experienced by students from having too much material on the buffer when several chats take place on the same day.

As a result, this project further identified variables that would influence the effectiveness of online synchronous conferencing as a course component. These are group size, flexible scheduling, and technical difficulties. Figure 1 exhibits these variables as moderators of the relationship between adoption and implementation. Also shown in Figure 1 is the feedback loop from implementation to adoption. The feedback loop represents how information was integrated back into the course and how changes were made in the second set of virtual conferences.

Figure 1. *Collaborative Teaching Technology Adoption Process*



Just as there is an ideal group size in face-to-face group experiential exercises, there seems to be an ideal group size in online group work as well. During this exercise, when the group size increased to six or seven in the first set of chats, discussions in the chat room became quite chaotic; that is, it was difficult to follow who said what, and private conversations emerged. On the other hand, in cases when there were three or two members only in the chat room, discussions

and conversations quickly ended and the richness of exchange that would normally be present in larger groups was not attained. This exercise indicated a group size of four or five as optimum for high quality exchange of ideas and improved learning outcomes. This finding is consistent with prior research which indicates that as the number of members in a group increases, communication as well as the process of reaching a consensus becomes more difficult, and cliques may tend to form (Hill 1982; Shull, Delbecq, & Cummings, 1970). Hence, teams must be small enough for effective participation and bonding among their members (Trent, 2004).

Scheduling the meetings around busy schedules of students was another big challenge since the chats were conducted outside regular class time. Several options including weekends and evenings were offered. Still, it was difficult to coordinate so that four or five students sign up for any particular session. Also, when two or more sessions were scheduled for one day, the later meetings did not move swiftly as there was too much material kept in the buffer. This slowed the appearance of comments on the screens. It also made the screen blink every time a new comment was added to the common public chat area. This may be due to the limitations of the version of the software used. In summary, flexibility in scheduling was a factor in student satisfaction with the overall implementation of the new practice. This is consistent with research on flexible work scheduling in terms of its impact on work outcomes. For example, a meta-analysis found that flexible work arrangements positively impacted employee performance, job satisfaction, and absenteeism (Baltes, Briggs, Huff, Wright, & Neuman, 1999).

Several students had technical difficulties in logging into the chat room at their designated times. These either had to do with problems in their computers, or in their connections to the Internet. Make-up opportunities were provided for these students. These are technological issues to take into consideration when attempting to incorporate any online learning component to course design.

All students indicated that they found the chat room interaction very useful and that they each had a chance to express opinions and discuss the issues presented. In each chat session, the professor was present and was able to observe the high level of interaction and great interest from students as a silent observer. All students reported that online learning tools like this one can be more fully integrated into traditional course designs, but a majority expressed that virtual interaction should not one day completely replace face-to-face interactions in a traditional classroom context because the richness of interaction, such as the nonverbal cues (facial expressions, tone of voice, body language, and so forth) would most likely be lost.

DISCUSSION

This paper described the initiation and implementation steps involved in the use of synchronous online conferencing as a course component and delineated the design elements and principles that instructors should consider before implementation. The paper further identified variables that may have a potential impact on the implementation and use of this technology application in course design. Implementation of synchronous chatting was new for both of these courses and the students. Based on this premise, this paper focused on design considerations for implementing technology based new teaching practices. Since the development of design considerations is theory-driven based on research in innovation diffusion literature and partly on research in group dynamics and work scheduling literatures, same considerations should be applicable to new teaching and learning practices in other academic contexts.

The objective was to identify design factors that would enhance learning in a collaborative learning environment and to have students experience “live” classroom discussions on course topics. A virtual learning environment was expected to enhance creativity in critical thinking by

providing an online opportunity for exchange of different views on course topics. The student was to further experience synchronous online conferencing.

Numerous innovations and new practices fail due to little consideration of a variety of success factors contributing to initiation and design stages of development. New practices may either be perceived as too complicated and risky or they may not be seen as having any significant advantage over, or compatibility with, the existing systems. Sometimes, it may just be that they are viewed as difficult to manage. Instructors should take into account relative advantage, compatibility, complexity, and risk associated with designing, initiating, and implementing new teaching practices.

The new teaching practice fulfilled the course goals of learning, developing, and practicing technology and electronic communication skills required for effective managerial leadership, enhancing creative, critical and integrative thinking abilities through collaborative analysis of effective and ineffective managerial behaviors, and applying leadership and organizational behavior concepts to real-life situations, and developing practical excellence skills by use of discussions and learning in teams. Students, in their assessment reports, clearly stated that they learned from other students' comments and were pleased to have the opportunity to exchange views on various course topics freely. Students seemed to relate the course topics on subjects such as stress, motivation, leadership, and personality during their chats to organizational examples and examples from their real-life work experiences. They were able to simulate how the discussion would have been in a face to face classroom context.

Most students stated that despite all the benefits they perceived they would prefer the new tool to remain as just a small part of the course rather than switch to an all online structure. Many students also indicated that synchronous chats allowed them to freely express their ideas without feeling the anxiety of public speaking in front of a whole class. Several comments emphasized that the environment was more relaxed than in a traditional classroom. In fact, there is evidence suggesting that the anonymous nature of an online classroom environment may be more accommodating for some students (Sullivan, 2002) and that it changes the social psychological dynamics of the learning environment in powerful ways (Kiesler, Siegel, & McGuire, 1984).

CONCLUSIONS AND FUTURE RESEARCH

In general, face-to-face discussions may be preferable and more easily carried out than online synchronous discussions; however, there are a few instances where designing synchronous discussion contexts and incorporating them into courses may be important. First, they can be an integral part of a completely online course where students do not meet face-to-face at all or meet rarely as in hybrid courses. Especially in order to realize team work for course projects that require group interactions, synchronous online conferencing can be very valuable. Second, many times in the management discipline, classes require group work outside of regular class meeting times. Students may find it preferable to get together online even if it is for a brief period of time to coordinate and organize their group efforts. Hence, it overcomes limitations of space, time, and distance for collaborative activities. Third, rather than replacing face-to-face class or group discussions, online synchronous conferencing can be used as a supplement to traditional classroom teaching and learning techniques. To that end, open distance and e-learning platforms can benefit from incorporating our design suggestions into course development targeting online learners.

One limitation of this exercise was that the feedback assignments about the new practice effectiveness were not anonymous and they were graded. Although this would have led some

students to provide positive feedback even if they thought otherwise, the questions were designed to elicit responses on improvement of the practice rather than asking for a straight positive or negative assessment. Many times during the semester, the professor also emphasized that students who provide constructive and thoughtful comments in their assignments about the new teaching practice would be rewarded. Future research should assess effectiveness and student reactions by use of a questionnaire before and after implementation.

Obviously, there are significant benefits, challenges, and outcomes of synchronous online discussions. Future research should compare and contrast implementation and design considerations of synchronous online learning with asynchronous online learning environments such as discussion board postings, as very commonly used in supplementing traditional course designs. A fruitful avenue of future research can be to investigate the advantages and disadvantages of using both synchronous and asynchronous learning through experimental design.

One other factor to consider as a moderator in the design of any new teaching practice and its implementation is awareness. For example, in this project, some students indicated that they were familiar with chat rooms and virtual classrooms while most have not used them before. This may have influenced their perceptions of the new practice. Hence, awareness can be measured as a control variable or a moderating variable of the relationships between adoption and implementation during the pre-test phase of future studies.

Future research should also conduct experiments that compare effectiveness of and student reactions to online versus face-to-face discussions on course topics. Stronger evaluations may result from comparisons of outcomes of two or more groups that are assigned to the synchronous, asynchronous, face-to-face discussion groups.

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Students' experiences of learning in a virtual classroom

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ABSTRACT

Online learning environments can offer learners opportunities for flexibility, interaction and collaboration distinctly different from face-to-face learning environments. However, the integration of educational technologies also presents challenges and concerns in relation to students' learning. This article attempts to develop a better understanding of students' experiences of learning with the specific online learning technology of Adobe Connect virtual classroom. The study was conducted in a university in New Zealand using a case study method. With Activity Theory as its research framework, the research methods of this study include individual interviews, online observation and analysis of other relevant documents. This article includes some of the findings of the research and a discussion on how the synchronous technology—Adobe Connect virtual classroom, used in an online learning environment affected students' active participation in e-learning activities. The article also offers some suggestions that can be of use to instructors who teach online courses.

Keywords: *E-learning; virtual classroom; synchronous; Activity Theory; learner engagement, ICT, tool mediation, synchronous, affordances.*

INTRODUCTION

E-learning can be defined as the use of educational technologies to design, deliver, and manage both formal and informal learning and knowledge sharing at any time, any pace and any place. In educational contexts, some e-learning courses are offered fully online without any face-to-face interactions while in some contexts, courses are offered with a blended mode that is the use of both face-to-face and online interactions that are facilitated by educational technologies. Online learning environments can offer learners opportunities for flexibility, interaction and collaboration (Gedera, Williams & Wright, 2013). Also, with the significant growth of e-learning, teachers and students explore new ways of constructing knowledge and enhancing teaching and learning experiences outside the four walls of the classroom. According to New Horizons (2012), "4,600,00 college students in the United States are currently taking at least one of their classes online and by 2014 this number will increase to 18,650,000" (para. 10).

In spite of the significant growth and interest in e-learning (Bell & Federman, 2013; Nagel, 2010; Rivera & Rice, 2002), positive outcomes are not ensured in all contexts (Alexander, 2001). In view of this, some researchers have shown uncertainties about technology transforming teaching and learning (Lee, 2006; Romeo, 2006; University of Washington, 2013) and the pedagogic values of online learning OECD, 2005). In addition, the integration of educational technologies presents challenges and concerns in relation to students' learning.

In relation to challenges and uncertainties about technology, the e-learning Advisory Group (2004) accentuate that technology does not offer a complete solution for a transformative education; rather the practitioners should concentrate on the potentials and uses educational technologies offer individuals to enhance their performance and also the limitations of these technologies that hinder their performance. These potentials and limitations are known as affordances and constraints of technologies in education and they should be thoroughly considered for a

successful implementation of e-learning. Focusing on affordances and constraints, this article attempts to develop a better understanding of students' experiences of learning with the specific online learning technology of Adobe Connect virtual classroom.

RESEARCH CONTEXT AND RESEARCH QUESTIONS

This course on which this article is based was one of the case studies observed under a larger research project that was carried out in a university in New Zealand. The case study focused on a fully online course that was offered in the first semester of the 2012 academic year. Six students and their lecturer participated in this study.

The research question that guided the data analysis of this research was:

> What are students' views on their experiences of learning with the synchronous Adobe Connect virtual classroom in a fully online university course?

ACTIVITY THEORY AS A THEORETICAL FRAMEWORK FOR ANALYSIS

Activity Theory is derived from socio-cultural and socio-historical theories and draws heavily on Vygotsky's concept of mediation. Vygotsky's (1978) triangular model includes *tool, subject* and *object* and shows the relationships between these elements. However, this model tended to focus more on individuals. Therefore, sociocultural theorists used Vygotsky's basic mediated triangle as a framework to develop Activity Theory which is accountable for both individual aspects as well as the social nature of activity. Engeström considered activity systems as object-oriented, mediated and collective in nature. Through activity systems analysis researchers are able to observe the interactions that take place among individuals and the environment and how each affects the other (Yamagata-Lynch 2010). An activity is comprised of elements which together form activity systems, and these systems are meaningful units through which to understand human activity (Kuutti, 1996, p. 25). An activity comprises a variety of mediators such as tools, rules and community and division of labour. These elements in an activity system act as mediators and the relationships between these elements are constantly mediated. For instance, a tool (computer) mediates between the subject (participant) and object (writing an essay), and rules (communication etiquette) mediate between subject (participant) and community (peers).

This article attempts to develop an understanding of students' experiences of learning with synchronous educational technology in a fully online university course. In capturing participants' experiences and views on how the use of this educational technology affected their learning, the tool mediation principle (shown in top triangle) of Activity Theory will be used in the analysis of this article. The following figure is the basic structure of Activity Theory framework that shows the interrelated elements of an activity system.

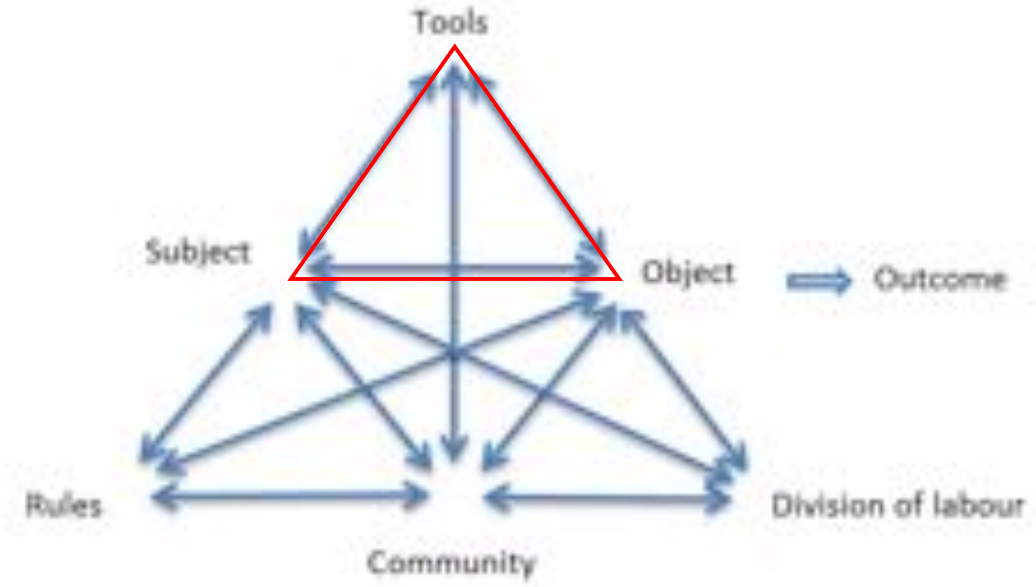

Figure 1: *Basic structure of Activity Theory (adapted from Engeström 1987)*

RESEARCH METHODS AND DATA ANALYSIS

This study used a qualitative case study approach and data were gathered over a period of one semester mainly through interviews, observation of online activities (Adobe virtual classroom) and analysis of other documents (course outline, marking criteria and activity descriptions). The online learning activity was the focus of data gathering in this research. The interviews took place at the beginning and at the end of the semester when the participants were asked semi- structured questions that were related to their experiences of learning with the virtual classroom.

In coding the data, relevant meaningful units from transcribed interview texts and observational notes were identified and categorized according to the elements of Activity theory as a method of typology. In this process, Nvivo was used as a data management tool. Based on the research question, with particular attention to the types of *tools* used in this course, this article draws on the *Tool mediation* principle of Activity Theory- that is the notion that human activity is mediated by several tools (Kaptelinin 1996). These *tools* can be: physical—a computer or a book, conceptual– a mental model, a plan or a strategy, psychological— a language, virtual— functions of a website.

Mediation of tools plays an important role in shaping how human beings act and interact with the world (Kaptelinin, Nardi & Macaulay 1999). Focusing on the *tool mediation* tenet of Activity Theory, the sub-themes that emerged under the element *Tool*s were mainly considered for the analysis. In the case of this article, the *tool mediation* refers to the use of Adobe Connect virtual classroom in achieving the students' (subject) objective (object) in this case.

Adobe virtual classroom is an online platform where participants can communicate, interact and share presentations and learning resources in real time. These synchronous virtual classrooms can be accessed from multiple locations using a PC or a mobile device. The features of Adobe virtual classroom include video/audio, text chats, file sharing and polling features. Figure 2 shows the synchronous virtual classroom activity system that is overlaid in the Activity Theory framework.

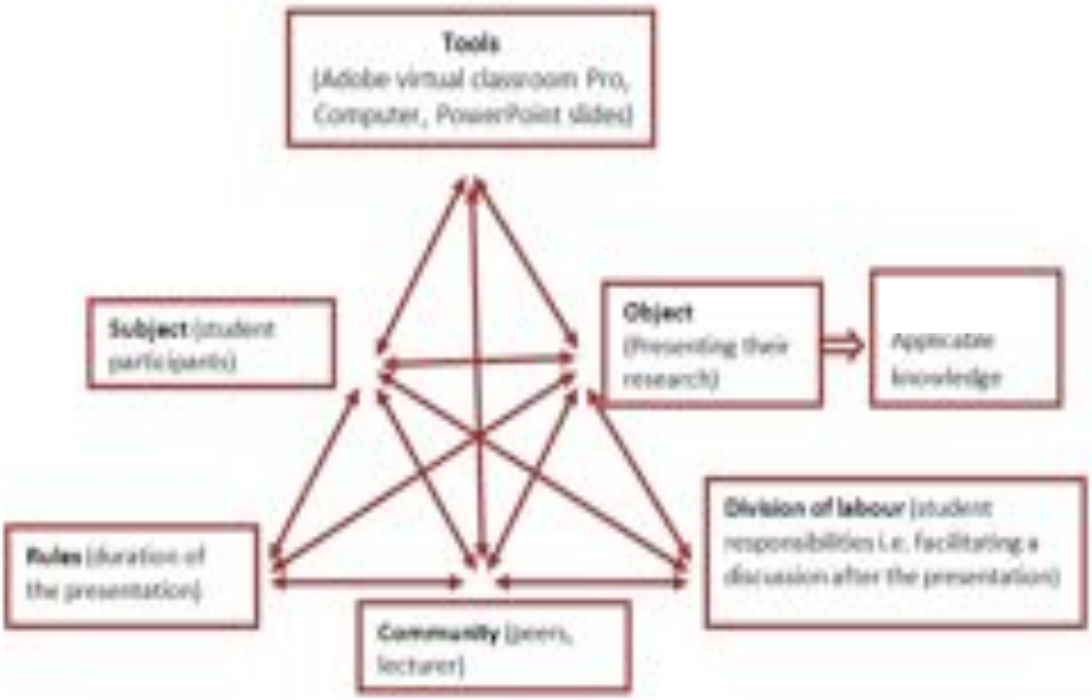

Figure 2: *Virtual classroom activity system*

In this activity system, the *subject* represents the student(s) who are the focus of the study. The *object* is the purpose of an activity. In this case, the students' purpose was to present their research to the other members of the class. The *tools* that were used in this activity in order to achieve students' object include physical tools (computers), mental tools (learning strategies), models and virtual tools (functions that were available in Adobe virtual Classroom). The *rules* for this activity were the duration of the presentation (10 minutes), relevant literature and references (following APA format) and a written script or notes (1500 words). The *community* of this activity includes the lecturer of this course and the members of the class. *Division of labour* defined the students' responsibilities. As part of their responsibilities, one peer had to review the allocated student's presentation and the notes before the actual activity and also the peer was to propose three questions to be discussed after the presentation. Figure 3 shows the layout of a typical virtual classroom

***Figure* 3:** *Virtual classroom*

FINDINGS

The findings suggested that the students' experiences of learning with the virtual classroom were associated with the affordances and limitations of this educational technology. This synchronous activity was carried out as an individual assignment and represented 30% of the student assessments. In this activity the students were to present their research using PowerPoint or equivalent to the other members of the class. The dates of presentations and the schedule were pre-determined and posted on the Moodle site beforehand.

As pointed out by the participants, the affordances of the Adobe virtual class allowed them to see and hear each other in real time when they were presenting their research to their peers. These video and audio features facilitated two way communications among the students and thereby created a sense of belonging to a learning community. As a student commented, *"I like seeing people when I'm talking to them … I like that backwards and forwards that can happen"* (Alex, student interview 2).

Another feature of virtual classroom that supported students' active participation was the ability to have an oral discussion in real time right after each presentation. As part of students' responsibilities, each student was nominated by the lecturer to ask three questions from another student in the form of a discussion. Having a discussion after each presentation allowed the students to clarify issues related to the topic immediately, as well as provide some peer feedback. When Alex was asked what he thought about the reviewing of notes and facilitating a discussion after each presentation, he stated that "*I think it caused us slightly deeper interaction with what the others have done. I thought that was quite useful"* (Alex, student interview 2). As a group, they

were also supporting each other by giving words of encouragement after their presentations. The words exchanged included *"very interesting", "Well-done"* and *"excellent presentation".*

With Adobe virtual class the students could also able to have a text-based chat during this activity. This was particularly useful when they had questions to ask from a particular person in private or in public as well as to have a chat before the facilitator (lecturer) joined the group. An example of a text-based chat is shown below.

> *Alex: Hi I hope you're not too nervous :)*
> *Debbie: Hi hope technology is on our side tonight*
> *Fiona: no I am not*
> *Alex: That's good.*
> *Debbie: I'm nervous*
> *Alex: The lecturer will come on at some stage and enable all that business and then you click the camera button that will appear at the bottom of the "Camera and Voice" thingy at the top left :-)*
>
> (7th May virtual classroom observation)

The above conversation took place while students were waiting for their lecturer to join the virtual classroom. The students were trying to understand how to set up their cameras and see each other and also exchanging ideas about how they feel right before their presentations.

On the other hand, students' perspectives indicated that there were limitations with the virtual classroom. One of the main reasons why students were attracted to this course was for its flexibility, as it was fully online and it enabled them to have flexibility in terms of time, place and pace. However, on that particular day and at that particular time if the internet connection was not stable, or any technical difficulties occurred students would not able to participate in the activity. This was also echoed in students' views:

> *It gave that flexibility to choose the night that suited you the best whereas if we had more synchronous opportunities, probably it won't suit unless you have the dates right at the beginning of the course. Then things can go wrong like thunder and lightning, storm and you struggle with your equipment and you miss out because you can't get on it that time* (Christine, student interview 2).

As pointed out by the lecturer, another limitation of virtual classroom is that when number of students is high, it gets harder to allocate time slots. Also, having limited capacity for only one speaker to talk at a time, discussions take a longer time and also the participants may have to repeat their utterances many times if two people talk at the same time. The findings also indicated that there were some technical issues that affected students' engagement with the virtual classroom activity and this caused frustration.

> *The virtual classroom was a little frustrating. I had a fast enough speed and internet, but somehow the audio…one time sounded twice and there was an echo. Someone was giving the presentation and I missed the whole bunch of it. I had technical problems on that* (Eddy, student interview 2)

Students' perceptions also demonstrated that they found this activity challenging and thus, they were not relaxed when they were presenting their research thinking that they may not be able to get onto the virtual classroom. This was evident in the case of a student who participated from a Middle Eastern country. Due to slow speed internet connection that was caused by an unstable political situation in the country, the student could not hear what the others were saying and also she could not do her presentation or facilitate and join discussions. Although the lecturer gave her

a one-to-one session to present her research via Skype the next day, it was a disappointing and frustrating experience for her. The lecturer said:

> *I had her notes and I had her PowerPoint slides and I also had a Skype conversation with it. The issue was there, the bombs are going outside the window and probably it had something to do with it, but from her point of view, it was frustrating because she had prepared and she did a good job* (Richard, lecturer interview 2)

In addition, one concern raised by the students was that as an assessed task that weighed 30%, they preferred to have more practice before the actual virtual classroom activity. Some of the students found it to be stressful going into the virtual classroom and using it having no experience apart from the quick introductions they did at the beginning of the session. Although the lecturer facilitated a practice session for this synchronous activity, some of the students had trouble setting their cameras and also some of them could not hear properly, so this practice session did not seem to be as beneficial as it could be for the students. As one student suggested, it would have been easier if they collaborated in this activity with a peer.

DISCUSSION AND IMPLICATIONS

In the virtual classroom activity system, with the affordances of the Adobe virtual tool the participants could see each other in real time, and the participants saw this as a benefit, as they could get to know each other better. The findings also suggested that having audio and video features, the virtual classroom facilitated reciprocal communication among participants where they could clarify issues and provide instant feedback as they were engaging in the activity. In synchronous learning, instant feedback and the interactions with peers and the facilitator seem to increase motivation and student learning (Schullo, Hilbelink, Venable & Barron 2007). In addition, as highlighted by Alex, having an opportunity to review each other's work and have a discussion after each presentation caused *"slightly deeper interaction"* among students (student interview 2). Students acknowledged the value of being able to have a lot of physical cues, thus there were more human interactions in the virtual classroom compared with asynchronous interactions. Some of the findings of my research were consistent with Falloon's study (2011) on students' experiences of synchronous virtual classroom in which he explored the areas where educators should pay attention to gain maximum advantage from its use. In both studies the students indicated that they preferred to have virtual classroom experience earlier on to get to know people better rather than towards the end of the course.

On the other hand, the constraints of the virtual classroom tool seemed to affect students' participation this this context. Like other synchronous tools, the virtual classroom requires people to come online in real time despite different time zones. As Richard, the lecturer pointed out, arranging the schedules to participate at specific times can be troublesome (Schullo, Hilbelink, Venable & Barron 2007). If students are attracted to online courses it is mainly due to their flexibility, and if students have to participate at a given time, they may not find it flexible enough. Moreover, as the students and the lecturer pointed out, when the student number is higher, the harder it is to schedule sessions, as these sessions took place from 7.30 – 9 pm at night during week days. Having limited capacity for only one speaker to talk at a time, discussions took a longer time and also students had to wait until their turn came to talk. The unexpected technical difficulties also caused some students to feel frustrated in the virtual classroom activity. In Eddy's case he lost the opportunity to listen to a peer's presentation due to technical difficulties, because of an echo. The person who was affected most due to technical difficulties was Gail. Although the technical difficulties were due to an unstable political situation in the country, for Gail it was a frustrating experience and it affected her full participation.

Participating in synchronous virtual classroom activities can also be challenging for some students if they lack knowledge of the virtual classroom's functions. Most students were not relaxed but challenged while participating in this virtual classroom activity, perhaps because of its unfamiliarity. Most participants claimed they needed more practice before undertaking the presentation assessment. The single practice session that was available for them was clearly insufficient and students even felt stressed knowing the risk of going into the virtual classroom to gain 30 marks having little experience of using it. This clearly affected students' active participation. Having little experience of using the virtual classroom, students lacked knowledge to use it to its full potential. Data from my research supported the perspective introduced by Falloon (2011) that students in virtual classrooms need *multiple knowledges* (italics in original) to get the best from virtual classrooms. Students generally struggled to transfer communication practices and their skills from face-to-face environments to virtual settings. The multiple knowledges Falloon introduces constitute *technical*—how to set up devices like camera, log in and find the way in virtual classroom, *procedural*—the conventions and etiquette they were to follow when interacting with peers and *operational*—how to make best use of the tools that are available for communication in virtual classroom (2011, p.443). The students' lack of knowledge and familiarity of the tool influenced the way students participated in the activity denoting how tools shape humans' action and vice versa.

However in spite of the constraints of virtual classroom, most of the students still preferred to have more virtual classroom activities because of the presence of physical cues and more 'human' interactions. It may be useful to have synchronous tools early on to both facilitate a sense of community and prepare students for later tasks assessed via such technologies. However, time zones may be an issue in this regard and if the learners are from different time zones, planning synchronous activities at a time that is suitable to all the participants can be a challenge. All in all, regarding their experiences of learning with this educational technology, students indicated their overall satisfaction. Considering the limited research conducted on synchronous tools compared with asynchronous learning tools, Adobe Connect virtual classroom requires further research that focuses on every day practices and uses of this virtual tool to determine its best use.

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Measurement invariance of the UTAUT constructs in the Caribbean

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ABSTRACT

This article employs confirmatory factor analysis to evaluate the factorial validity and the cross-national comparability of the UTAUT constructs with respect to mobile learning in higher education in four Caribbean countries. Except for the measurement of one factor, the UTAUT constructs exhibit adequate reliability and validity. Though full metric invariance is not achieved, cross-national comparisons of the regression relationships among the factors are still possible. In addition, non-invariant item intercepts also affect the comparisons of the factor means. Partial scalar invariance is required.

Keywords: *UTAUT, measurement invariance, Caribbean, mobile learning, technology adoption, higher education*

INTRODUCTION

The increasing use of technology in higher education leads to the increasing importance of educational technology acceptance. This is relevant to the Caribbean region where the use of e-learning systems is accompanied by numerous challenges (Waldron 2009). It is important to identify the variables that influence user acceptance as this can help in ensuring successful delivery of education. In this regard, the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) identifies some important factors. The UTAUT model is based on the Theory of Reasoned Action (TRA) (Fishbein & Ajzen 1975), and it incorporates components of several other models inclusive of the Technology Acceptance Model (TAM) (Davis 1989) and the

modified Technology Acceptance Model (TAM2) (Venkatesh & Davis 2000). The UTAUT model has become popular in technology acceptance studies, but such studies focus overwhelmingly on Western (Schepers & Wetzels 2007; Traxler 2007) and Asian countries. The appropriateness of the measurements in these contexts does not guaranteed their validity in the Caribbean region. Furthermore, the Caribbean may themselves differ in their experience with mobile technology and such differences can affect measurement comparability (Li & Kishore 2006). Both the validity and cross-national comparability of the measurements therefore need to be demonstrated rather than assumed.

This paper investigates the validity and comparability of the UTAUT constructs across four Caribbean territories. The constructs are evaluated in the context of mobile learning in higher education. Many definitions of mobile learning are currently in use. However, mobile learning is essentially learning with the aid of mobile technologies. This can occur at anytime and anywhere via mobile devices (El-Hussein & Cronje 2010). This ubiquitous element of mobile learning sets it apart from e-learning in general. Mobile devices are distinct from more traditional technologies such as a computer which requires either a fixed position (desktop) from which access to the internet can be obtained or which facilitates access only at hotspots or other specific areas (laptop) (Jeng et al. 2010). Mobile devices include for example mobile phone, tablets and others which facilitate internet access from anywhere and therefore facilitates more flexibility (El-Hussein & Cronje 2010; Hlodan 2010). In addition to providing new evidence which can guide the use of the UTAUT model in mobile learning adoption in the region, this paper provides results that are relevant to the study of technology adoption in general. They aid determination of the generalizability of the UTAUT measurements outside of the frequently studied contexts and add to the evidence about the cross-national comparability of the measures.

THE UTAUT MODEL

The UTAUT factors are Performance Expectancy (PE), Effort Expectancy (EE), Social Factors (SF), Facilitating Conditions (FC), Behavioural Intention (BI) and Use Behaviour (UB) (Venkatesh et al. 2003). PE is the extent to which the individuals believe that the technologies improve their performance. EE is the perceived ease of use. SF is the degree to which the respondents believe that significant persons in their lives think that they should use the technologies. FC is the respondents' beliefs about the extent to which organisational and technical infrastructure to support the use of the technologies exist. BI is the behavioural intention to use the technologies. UB measures the intensity of use. Given the engagement in mobile learning in the Caribbean is voluntary, measuring UB in relation to mobile learning is difficult. As such, UB is not evaluated in this paper.

The items included in the UTAUT instrument are usually adapted for the specific research domain; for example, acceptance of information systems, virtual learning environment, mobile learning in higher education acceptance and use of IT (Al-Gahtani et al. 2007; Bandyopadhyay & Fraccastoro 2007; Cheon et al. 2012; Jairak et al. 2009; Nassuora 2012; Teo 2011; Van Raaij & Schepers 2008; Wang & Shih 2009; Tibenderana et al. 2010; Attuquayefio & Addo 2014). Modifications of the items are made in this study to ensure that the content is applicable to mobile learning (see Table 1).

Table 1: *Measurement of the UTAUT Constructs*

Construct	Code	Item
PE	PE1	Mobile Technologies are useful in education in general.
	PE2	Using mobile technologies enable students to accomplish tasks more quickly.
	PE3	Mobile technologies would improve students' performance.
	PE4	Mobile technologies would increase students' productivity.
EE	EE1	Mobile technologies are easy to use.
	EE2	Finding or using features in mobile technologies is easy.
	EE3	Learning to operate mobile technologies is easy.
SF	SF1	People who influence my behaviour think that I should use mobile technologies.
	SF2	People who are important to me think that I should use mobile technologies for learning.
	SF3	University teachers are supportive of the use of mobile technologies.
FC	FC1	In general, my University campus has support for mobile learning.
	FC2	I have the resources necessary to use m-Learning.
	FC3	I have the knowledge necessary to use m-Learning.
	FC4	Support from an individual or service is available when problems are encountered with m-Learning technologies.
BI	BI1	I intend to use m-Learning technologies in the next semester.
	BI2	I predict I will use m-Learning technologies in my courses in the next semester.
	BI3	I have a plan to use m-Learning technologies in the near future.

- Scale labels: 1 – Strongly disagree , 2 – Disagree, 3 – Neither Agree nor Disagree, 4 – Agree, 5 – Strongly Agree.
- In the items, m-Learning refers to mobile learning.
- Mobile learning, mobile technologies and the other terms used in the items were defined for the participants at the beginning of the survey and the definitions were repeated at intervals throughout the questionnaire. M-Learning means mobile learning.

In the UTAUT model, PE, EE and SF along with their interactions (in some cases) with age, gender, experience and voluntariness of use explain BI, while BI and SF explain UB (see Figure 1) (Venkatesh et al. 2003). Venkatesh et al. (2003) indicates that the model explains approximately 70% of the variance in BI. However, such a high proportion of explained variance is not usually found in other studies. Some studies have reported explained variances as low as 35% to 45% (Thomas et al. 2013; Teo 2011), but others have reported larger explained variances in the range 50% to 65% (Tibenderana et al. 2010; Al-Gahtani et al. 2007). Nevertheless, the validity and reliability of the UTAUT measurements and the utility of the model in explaining BI are widely acknowledged.

The literature on the UTAUT model includes investigations of measurement comparability. In some cases, the cross-national/cross-cultural comparability is considered (Im et al. 2011; Kang et al. 2011; Oshlyansky et al. 2007) whereas in others, measurement comparability between other groups is investigated (Li & Kishore 2006). Oshlyansky et al. (2007) show that the UTAUT items measure the same factors in several Western and non-Western countries; however, the level of comparability demonstrated (configural invariance: discussed subsequently) is not enough to permit direct comparisons of regression relationships or factor means. Kang et al. (2011) and Im et al. (2011) investigate the comparability of the UTAUT measures in greater detail between the United States and Korea and find instances of a lack of measurement comparability leading to biased regression relationships. Li and Kishore (2006) focus on groups defined in various ways; for example, gender and experience and they also find instances of measurement incomparability.

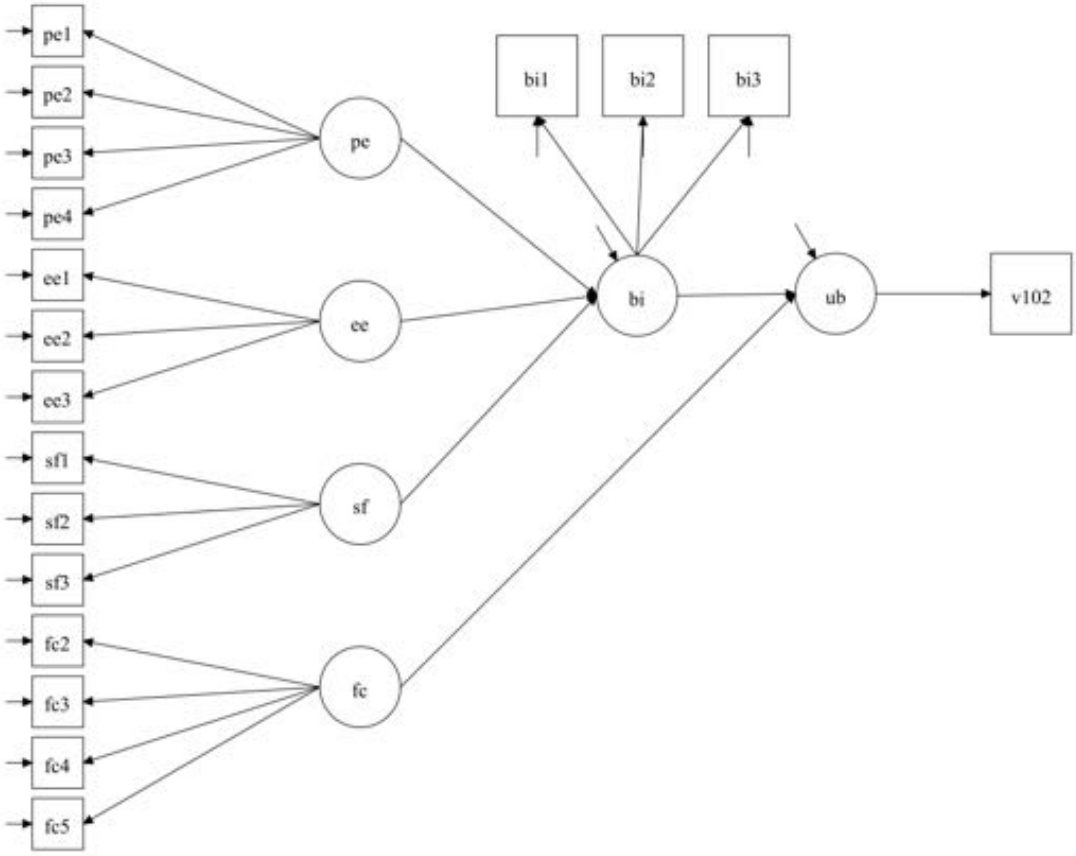

Figure 1: *Conceptual UTAUT Model*

Cross-national comparisons are often regarded as cross-cultural comparisons especially when countries which are known to differ culturally are included. This can be said of the comparisons between the United Stated and Korea (Im et al. 2011). Culture is known to affect measurements differentially and it is therefore not surprising that there are violations of comparability between such groups (Van de Vijver & Poortinga 1997). Even when the groups are not defined by culture, comparability of the UTAUT measures is not guaranteed (Li & Kishore 2006). This underscores the need for demonstrations of the absence of such measurement violations before substantive measures such as regression relationships and factor means are compared.

In this paper, the validity and cross-national comparability of the UTAUT constructs are evaluated with respect to mobile learning in the Caribbean region. In the region, mobile learning has not yet been formally adopted by universities. As such, the use of mobile technologies for education is a voluntary undertaking by both the students and the teachers. In spite of this, there is evidence to suggest that mobile learning is in use. Research on e-learning, technology and mobile learning adoption in the Caribbean region is ongoing and researchers have documented such evidence in various territories; for example, in Barbados (Gay et al. 2006), Guyana (Gaffar et al. 2011; Thomas et al. 2013), Jamaica (Reid & Levi 2008) and Trinidad and Tobago (Kalloo & Mohan 2011; Sultan & Mohan 2009). In addition, Figaro-Henry et al. (2011) note that facilitators and students are willing to embrace the use of mobile technologies for learning in the region. However, we know of only one study that provides an evaluation of the UTAUT factors. This evaluation is done with

data from Guyana and the measurements appear to be valid (Thomas et al. 2013). However, this is one territory and in spite of the fact that the UTAUT model is based on several technology adoption theories and that it has been evaluated in many countries, it is still important to establish the validity of the measurements before the model is applied in a new context. Given the almost absence of evaluations of the model, the Caribbean region qualifies as a new context. Furthermore, given the evidence of violations of measurement comparability elsewhere, an evaluation of comparability in the Caribbean region where studies on technology adoption are emerging, is also an important contribution.

CROSS-NATIONAL COMPARISONS

Cross-national and group comparisons in general, assume the absence of bias and hence, the preservation of the psychometric properties or scales across the groups (Chen 2008; Meredith 1993; Schmitt & Kuljanin 2008; Vandenberg & Lance 2000; Van de Vijver & Poortinga 1997). There are three main types of bias – construct, method and item bias – that affect group comparisons (Van de Vijver & Leung 1997). This article focuses mainly on construct and item bias which result from the survey items used (Van de Vijver & Tanzer 2004) and which affects measurement comparability.

Construct bias means that the constructs measured by the items are not the same in all the groups. This is caused by several issues among which are differential appropriateness of the content of the items and incomplete overlap in the definitions of the constructs across the groups (Van de Vijver & Leung 1997). Item bias refers to measurement artefacts at the item level (Van de Vijver & Leung 1997). Item bias alos has several sources and they include incidental differences in the content of the items, poor translation and poor item formulation (Van de Vijver & Tanzer 2004). Construct and item bias may occur even when the same items are used with the same wordings due to differences in the frame of reference of the groups. These two types of bias can be detected to a large extent by evaluations of measurement invariance (MI).

MEASUREMENT INVARIANCE

MI implies independence of the observed item scores from group membership (Meredith 1993; Millsap 1995). Hence, with MI achieved, individuals with the same true standing on a construct have the same observed scores (Schmitt & Kuljanin 2008). If this does not hold, group and cross-national (group) comparisons are invalidated (Byrne & Watkins 2003; Van de Vijver & Tanzer 2004). The demonstration of MI is therefore necessitous to cross-national (and group) comparisons (Cheung & Rensvold 1999).

MI tests form a hierarchy in which the lower levels are less restrictive and are prerequisite to the higher levels. The first recommended MI test is an omnibus test of equality of the between-group variance-covariance matrix (Joreskog 1971). If this test lacks significance, the data from the different groups may immediately be pooled since there will be no group differences (Joreskog 1971; Schmitt & Kuljanin 2008; Vandenberg & Lance 2000). However, most researchers begin with the test for configural invariance instead of the very stringent omnibus test. In fact, the three levels of MI that are most often useful in group comparisons are configural, metric and scalar invariance (Van de Vijver & Leung 1997). These three level of MI are investigated in this paper.

Configural invariance is the lowest level of MI and it focuses on the basic form of the model. It asserts that an equal number of factors is formed in each group (Horn & McCardle 1992; Joreskog 1971) and that there is a fixed pattern of salient and non-salient factor loadings (Steenkamp & Baumgartner 1998). Although it is required for the other levels of MI, configural invariance is

insufficient for group comparisons of factor means, regression and other structural relationships which are often the focus of research. Configural invariance is affected by construct bias (Van de Vijver & Leung 1997).

The next level MI is metric invariance which indicates that the measurement units (or interpretation of the items) are preserved across the groups. This is evaluated by imposing between-group equality constraints on the respective factor loadings (Dimitrov 2010). Metric invariance permits group comparisons of the structural relationships (factor variances, covariances and regression effects) among the factors, but not of the factor intercepts (means) (Dimitrov 2010). Metric invariance is affected by method and construct bias (Van de Vijver & Leung 1997). Comparisons of factor intercepts require scalar invariance which in turn requires between-group equality of the item intercepts in addition to metric invariance (Schmitt & Kuljanin 2008; Vandenberg & Lance 2000). Scalar invariance indicates that the basic item levels are equal across the groups and it is affected by construct, method and item bias (Van de Vijver & Leung 1997).

The described MI procedure implies full invariance at each step, but this does not always happen in practice. One or more items may show non-invariance and the restrictions on such items may be relaxed leading to partial invariance. For partial invariance, at least two items must be invariant – the reference indicator and one other item (Cheung & Rensvold 1999). Under partial invariance, the freed items do not contribute to the group comparisons (Byrne et al. 1989). When the bias is severe and when several items are biased, partial invariance can result in substantial changes in the meaning of the construct (Millsap & Kwok 2004). As such, it should be applied with caution and the modifications to the measurement of the constructs should be taken into consideration when the results are interpreted.

THE CARIBBEAN CONTEXT

The Caribbean region consists of developing countries that differ with respect to several variables including human development and tertiary level education (See Table 2, for information about the four territories under study.). The most recent United Nations Human Development Report identifies Latin America and the Caribbean as the most unequal region in human development globally (United Nations Development Programme 2013). For example, whereas Barbados, Jamaica, and Trinidad and Tobago have achieved the CARICOM's target 15% participation rate for tertiary education that was set in 2002, most other countries, including Guyana, have not (Tewarie 2009). The ICT rankings of the territories are also markedly different (Table 1) and there are large variations in their ICT development index[1]. Barbados and Trinidad and Tobago tend to outperform Jamaica and Guyana with Barbados being among the highest ranked countries in the world whereas Guyana is ranked quite low (International Telecommunication Union 2013). There are also large between-territory differences in the percentage of individuals that use the Internet. Apart from the need for evaluations of the UTAUT measures due to the relative novelty of the model in the Caribbean, the heterogeneity of the territories may affect the measurements.

Differences in tertiary education levels can indicate differences in ICT adoption and development (Lee 2001). Combined with the disparities in the ICT development and rankings, these realities support the view that the local conditions may create differences in experience with technology

[1] The ITU, ICT development index is a summary measure of 10 indicators which evaluate ICT access, usage and skills within a country. The scale of the index ranges from 1 to 10 and the values may be used to compare countries. The ITU, ICT rankings give the rank position compared to the other countries based on the development index (International Telecommunication Union 2013).

across the Caribbean territories. Differences in experience can in turn lead to a lack of comparability of the UTAUT constructs. In particular, experience is shown to limit the comparability of the UTAUT effort expectancy and facilitating conditions measures (Li & Kishore 2006). Experience with mobile technology can affect the frame of reference of the population leading to both construct and item bias. As a consequence, the meaning of some of the items and their average levels can vary even though the same items are administered with the same wording. We do not anticipate, that construct bias will play a major role, but we expect that item bias affects the measurements. As such, it is more likely that violations of scalar invariance will occur than violations of metric invariance.

Table 2: *Country Variables*

Country	Population Size#	Gross Enrolment Ratio (Tertiary, 2011)+	UNDP Human Development Index Rank+	Percentage of Individuals Using the Internet^	ICT Development Index*	ICT Development Rank*
Barbados	283,221	65.90	38	73.33	6.65	36
Guyana	795,369	11.90	118	34.31	3.08	105
Jamaica	2,712,100	29.00	85	46.50	3.68	93
Trinidad and Tobago	1,337,439	11.50	67	59.52	4.73	66

*ICT information is for the year 2013 and is obtained from ITU (International Telecommunication Union 2013). ^ Obtained from the ITU Indicators Database 2012 (International Telecommunication Union 2012). + Human Development Report 2013, UNDP (United Nations Development Programme 2013). # The World Bank (The World Bank 2013).

Our expectations in relation to measurement invariance, is based on the belief that the UTAUT factors will be measured adequately by the items. The UTAUT model has been evaluated widely and even though, a lack of measurement invariance is found in some cases, the model appears to be quite robust. The evidence from Guyana also indicates that with some limitations, especially in relation to the FC, the factors are adequately measured (Thomas et al. 2013). However, these results do not guarantee the validity of the measurements in the Caribbean region in general. As such, validity also needs to be demonstrated.

DATA AND METHODS

Data

This study is done with data collected from students at several university campuses within the Caribbean region. The data were collected via a web survey (See Table 1 for the UTAUT items) administered in: Barbados at the UWI Cave Hill, Guyana at the University of Guyana, Jamaica at the University of Technology and UWI Mona, Trinidad and Tobago at the UWI St. Augustine and at the UWI Open Campus, between October 2012 and February 2013. The students were contacted by email and invited to participate on a voluntary basis without any incentives. The email contacts were made through the university which ensured that the entire university student population was contacted in each case. In total, 1726 respondents completed the questionnaires: 649 (Barbados), 243 (Guyana), 262 (Jamaica: 112 (University of Technology), 150 (UWI Mona), 333 (Trinidad and Tobago), and 239 (UWI Open Campus). Because the Open Campus pulls students primarily from several territories within the Caribbean region, it is excluded from the analysis. Consequently, the

effective sample consists of 1487 students. These groups are regarded as coming from the various university-territory combinations, hence, the data from the campuses in Jamaica are merged.

Table 3: *Sample Distributions*

Gender	Territory			
	Barbados	Guyana	Jamaica	Trinidad & Tobago
Male	175 (0.72)	151 (0.62)	181 (0.75)	189 (0.78)
Female	68 (0.28)	92 (0.38)	62 (0.26)	54 (0.22)

The approximate sample proportions are enclosed in brackets.

The large differences in sample sizes, would result in large power differences in the measurement models across the groups. Power will be comparatively high especially for Barbados. To address this, the sample sizes are scaled to that of the smallest group (Guyana) by making simple random selections from the data. The gender distributions of the initial data are preserved in the selections (see Table 3). However, we note that these distributions are not necessarily representative of the population distributions. For example, we know generally that there are more females than males at the University of Guyana, but the sample consists of more responses from males. In the absence of the population distributions, we are unable to apply weights (for example through iterative proportional fitting) to adjust for nonresponse due to self-selection. This is a limitation of this study. In spite of this, the results are still expected to be indicative of what can be expected of the measurements within the various country-campus contexts since the same self-selection issues affect each sample.

Given the focus on MI, it is necessary to discuss the inclusion of UWI campuses in three of the four territories (Barbados, Trinidad and Tobago, and part of Jamaica). Although three of the campuses come under the UWI brand, they exist in different territories which are at different stages in their ICT and economic development (see Table 2). The country conditions such as physical resources and experience with and access to ICT resources are expected to influenced the conditions at the campuses. This is expected to create sufficiently different local conditions despite the common university name. However, that the possibility of influences of the UWI brand is not eliminated is a limitation of the current study since this can result in measurement invariance. This is particularly relevant to Barbados and Trinidad and Tobago where students from only UWI campuses are included in the samples.

Methods

Several methods for evaluating MI are available, but Multi-Group Confirmatory Factor Analysis is both the most powerful and the most popular method (Meuleman et al. 2009). In the analysis, the respondents' ratings are regarded as continuous and the models are computed with robust maximum likelihood estimation using Mplus 7.11. In the models, the covariances among the UTAUT factors are freed (see Figure 2).

Configural invariance is judged from the basic form of the measurement models when they are estimated separately in each group. Only the factor loadings and the residual variances implied by the UTAUT constructs are initially estimated (see Figure 2). If modifications are required, they are discussed. Once the adequately fitting models are established in each group, they separate models are combined and estimated simultaneously to provide the baseline, configural invariance

model. For metric invariance, the respective factor loadings are equated with each other across the groups. Modifications to the equality constraints on the factor loadings are allowed if warranted, but this is done in a stepwise manner. To evaluate scalar invariance, equality constraints are imposed on the respective item intercepts across the groups in addition to the equality constraints on the factor loadings. Only the intercepts of items whose loadings are invariant are included in the evaluation of scalar invariance.

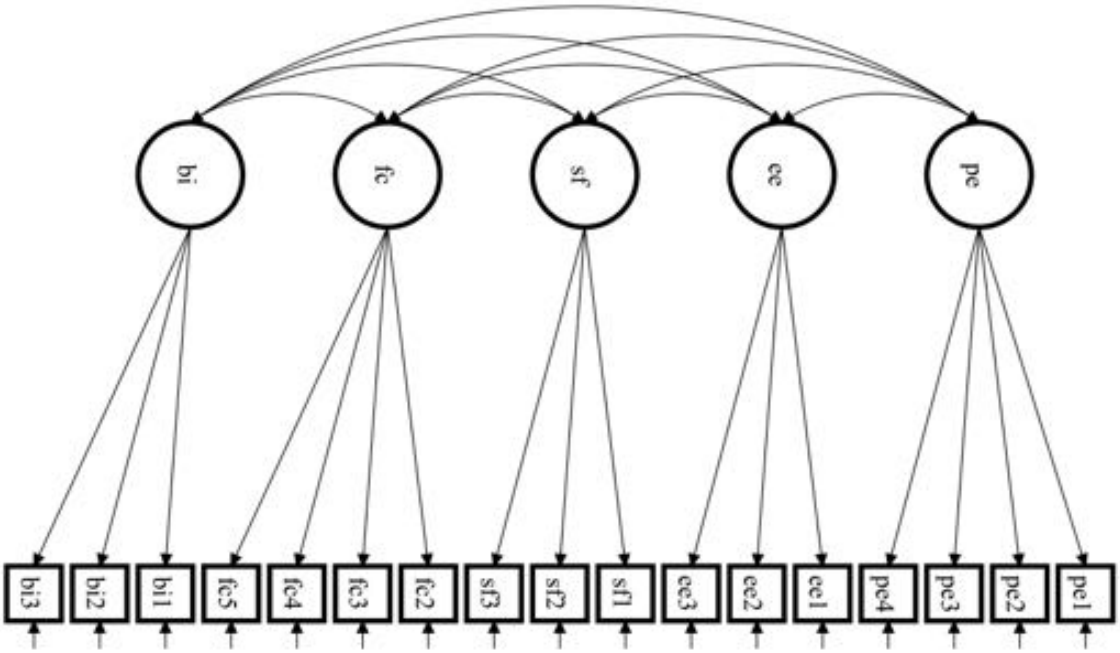

Figure 2: *The UTAUT Measurement Model*

The simultaneous model estimations are done in three stages. In the first stage, all the two-group combinations are evaluated. This results in the evaluation of six models consisting of two groups each. In the second stage, the three-group combinations are evaluated; four models in total. Finally, in the third stage, a four-group model consisting of all the territories (Barbados, Guyana, Jamaica and Trinidad & Tobago) is evaluated.

Before MI is assessed, the reliability and factorial validity of the UTAUT constructs in each group are evaluated. Cronbach's alpha greater than or equal to 0.70 is taken as indicative of adequate reliability (Hair et al. 2006). The results of the model estimations also enable evaluation of the practical significance of the factor loadings; standardised loadings greater than or equal to 0.70 are regarded as ideal. Factor convergent validity is achieved if the average variance extracted (AVE) is greater than or equal to 0.50, and discriminant validity is achieved if the square root of the AVE is greater that the factor correlations (Fornell & Larcker 1981). These are discussed for the model in each territory separately before joint estimation.

The fit of the models is evaluated based on alternative fit indices since the chi-square statistic is too sensitive for large sample sizes. In particular, the Root Mean Square Error of Approximation (RMSEA) less than or equal to 0.06, Comparative Fit Index (CFI) greater than or equal to 0.95, and the Standardised Root Mean Square Residual (SRMR) less than or equal to 0.05 are regarded as indicative of adequate global fit (Byrne 2012; Hu & Bentler 1999). To determine the

level of MI achieved, the relative fit of the nested models are judged based on the change (Δ) in the fit indices. In particular, $\Delta RMSEA \geq 0.01$ and $\Delta CFI \geq 0.005$ indicate significantly poorer fit for metric, scalar and strict invariance whereas $\Delta SRMR \geq 0.025$ indicates lack of metric invariance and $\Delta SRMR \geq 0.005$ indicates poorer fit for scalar (sample sizes less than 300) (Chen 2007). These criteria are used in combination and the decisions are based on a majority of the indices (Sass 2011). In spite of a strong research tradition of using global fit indices to evaluate factor models, misspecifications may still occur when these indices indicate adequate fit (Saris et al. 2009; Van der Veld 2008). Such misspecifications can be detected with the use of the program Jrule for Mplus 0.91 (Oberski 2008). Jrule (judgment rule) for Mplus, is a program that takes the Mplus output as its input and it uses a combination of the expected parameter change, modification index and power (all obtained or calculated automatically from the Mplus output) to detect parameter misspecifications (Saris et al. 2009; Van der Veld 2008). In this study, high power is set at 0.80 and Type I error at 0.05. The misspecification is set to 0.10 for error covariances and at 0.40 for factor loadings.

RESULTS

Construct Validity

For each group, the initial model with the five UTAUT factors fits adequately with respect to the RMSEA and the CFI. The fit is a bit poorer with respect to the SRMR but not poor enough to cause great concerns (see Table 4). The models are therefore accepted as fitting adequately in general, however, reliability and validity of the factors are examined furtherqw.

Table 4: *Within-Country Models*

Country/ Group	χ^2	Degrees of freedom	RMSEA	CFI	SRMR
Barbados	211.14	109	0.06	0.95	0.06
Guyana	220.14	109	0.06	0.95	0.06
Jamaica	200.57	109	0.05	0.97	0.06
Trinidad & Tobago	207.66	109	0.05	0.96	0.06

Except for SF and FC in Guyana, the reliability (Cronbach's alpha) of each of the scales for each construct in each group is above 0.70 (Table 4). The reliabilities of SF and FC in Guyana (0.65 and 0.66 respectively) are only marginally lower. Hence, the reliability of each scale in each group is adequate.

Turning attention to the size of the factor loadings (Table 5), we observe that many of them exceed 0.70, but that some are lower. These loadings in combination with the factor level convergent validity (AVE: Table 5) and the discriminant validity (Table 6) lead to a few remarks about the factors. Firstly, the respective indicators are all valid measures of PE, EE and BI and both the convergent and discriminant validity of these factors are confirmed since the average variance extracted (AVE) exceed 0.50 and their correlations with the other factors are lower than the square root of the average variance extracted. Secondly, the third indicator of SF (SF3) has limited validity in each group; especially Barbados and Guyana where the loadings fall below 0.40. In spite of this, both the convergent and discriminant validities of the factor (SF) are adequate owing largely to the very high validity of the two remaining items. Thirdly, the validity of the first and fourth indicators of FC (FC1 and FC4) are relatively low except for FC4 in Jamaica. However, both items still appear

to be useful measures of the construct since in each case, the factor loading exceeds 0.40. This factor also shows limited convergent validity overall especially in Guyana (AVE = 0.34), but it provides unique information since it also shows adequate discriminant validity.

Table 5: *Item Loadings*

Item	Barbados					Guyana					Jamaica					Trinidad & Tobago				
	PE	EE	SF	FC	BI	PE	EE	SF	FC	BI	PE	EE	SF	FC	BI	PE	EE	SF	FC	BI
PE1	0.68					0.66					0.68					0.72				
PE2	0.78					0.68					0.75					0.75				
PE3	0.79					0.86					0.87					0.86				
PE4	0.79					0.88					0.86					0.79				
EE1		0.86					0.83					0.85					0.84			
EE2		0.86					0.89					0.91					0.90			
EE3		0.82					0.81					0.86					0.78			
SF1			0.86					0.80					0.91					0.86		
SF2			0.92					0.88					0.88					0.97		
SF3			0.36					0.28					0.51					0.44		
FC1				0.60					0.51					0.53					0.57	
FC2				0.80					0.70					0.75					0.77	
FC3				0.70					0.56					0.68					0.75	
FC4				0.57					0.55					0.70					0.47	
BI1					0.95					0.92					0.97					0.94
BI2					0.92					0.81					0.90					0.92
BI3					0.85					0.79					0.74					0.84
AVE	0.58	0.72	0.57	0.45	0.82	0.60	0.71	0.50	0.34	0.71	0.63	0.76	0.62	0.45	0.77	0.61	0.71	0.62	0.43	0.81
Alpha	0.84	0.88	0.73	0.77	0.93	0.85	0.88	0.65	0.66	0.87	0.87	0.90	0.80	0.76	0.90	0.86	0.88	0.78	0.74	0.92

Factor loadings are the fully standardised loadings of the models in separate estimations. AVE – average variance extracted. Alpha – Cronbach Alpha.

Table 6: *Discriminant Validity*

Group	Construct	PE	EE	SF	FC	BI
Barbados	PE	**0.76**				
	EE	0.07	**0.85**			
	SF	0.07	0.08	**0.75**		
	FC	0.07	0.09	0.09	**0.67**	
	BI	0.05	0.06	0.07	0.06	**0.91**
Guyana	PE	**0.77**				
	EE	0.07	**0.84**			
	SF	0.06	0.07	**0.71**		
	FC	0.09	0.10	0.08	**0.58**	
	BI	0.06	0.07	0.08	0.08	**0.84**
Jamaica	PE	**0.79**				
	EE	0.08	**0.87**			
	SF	0.07	0.07	**0.79**		
	FC	0.07	0.07	0.08	**0.67**	
	BI	0.07	0.06	0.06	0.07	**0.88**
Trinidad & Tobago	PE	**0.78**				
	EE	0.07	**0.84**			
	SF	0.07	0.08	**0.79**		
	FC	0.07	0.09	0.09	**0.66**	
	BI	0.05	0.06	0.07	0.06	**0.90**

The square root of the AVE is placed on the diagonal and is highlighted. The off-diagonal elements are the correlations between the respective factors.

Comparability of the UTAUT Measures

By accepting the model for each group, we have in essence verified configural invariance. The basic form of the model is the same in each group and the models confirm to the specification of the UTAUT theory. In the next stage, factor models contain two groups each are evaluated. The configural invariance models are obtained by simultaneous estimation of the pairs under consideration.

The results for the two-group models (see Table 7) indicate that full metric and scalar invariance are achieved for the comparisons of Jamaica and Trinidad & Tobago, Jamaica and Barbados, Barbados and Trinidad & Tobago. In the evaluation of scalar invariance between Barbados and Trinidad & Tobago one item intercept (PE1) has a high modification index. At the same time, the power of the Jrule test for this path is larger than the 80% threshold while the expected parameter change (EPC) is not very large. The test therefore appears to be too sensitive in this case, and hence the large modification index for the parameter is ignored.

Whenever, Guyana is included in a two-group evaluation, violations of MI are encountered. Full metric invariance of the measurements is observed when Guyana is compared to Jamaica and Trinidad & Tobago, but when compared to Barbados the loading of the second indicator of EE (EE2*: Finding or using features in mobile technologies is easy.*) is higher in Guyana indicating that the validity of this item as a measure of EE is lower in Barbados than Guyana. Nevertheless, given

that the loading is generally large and that the expected change in the parameter is not (0.17), the bias resulting from comparisons based on this non-invariant item is not expected to be large.

Table 7: *Measurement Invariance Evaluation*

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*RMSI*	ΔRMS	*CFI*	ΔCF	SRMR	ΔSRM	Mod. Ind.	EPC	Power	Path
Two-Group Models														
Groups: Jamaica and Trinidad & Tobago														
Configural	408.21*	218			0.050		0.962		0.057					
Metric	427.53*	230	19.32	12	0.050	0.000	0.961	-0.001	0.063	0.006				
Scalar	456.72*	242	29.18*	12	0.051	0.001	0.956	-0.005	0.064	0.001				
Groups: Jamaica and Barbados														
Configural	411.70*	218			0.055		0.959		0.060					
Metric	431.13*	230	19.43	12	0.052	-0.003	0.958	-0.001	0.067	0.007				
Scalar	473.94*	242	42.80*	12	0.055	0.003	0.950	-0.008	0.072	0.005				
Groups: Jamaica and Guyana														
Configural	420.65*	218			0.052		0.956		0.060					
Metric	437.95*	230	17.30	12	0.051	-0.001	0.956	0.000	0.066	0.006				
Scalar	510.12*	242	72.16*	12	0.058	0.007	0.939	-0.017+	0.074	0.008	45.36	-0.42	0.36	FC1:GY
Pscalar1	454.50*	241	16.54*	11	0.051	0.000	0.954	-0.002	0.068	0.002				
Groups: Guyana and Barbados														
Configural	431.26*	218			0.055		0.949		0.062					
Metric	458.41*	230	27.15	12	0.055	0.000	0.946	-0.003	0.072	0.010	12.64	-0.17	0.56	EE2:BB

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*RMSI*	ΔRMS	*CFI*	ΔCF	SRMR	ΔSRM	Mod. Ind.	EPC	Power	Path
Pmetric1	443.93*	229	12.67	11	0.054	-0.001	0.950	0.001	0.067	0.005				
Pscalar1	586.00*	240	142.07*	11	0.069	0.015+	0.913	-0.037+	0.082	0.015+	63.10	0.35	0.62	FC1:BB
Pscalar2	508.60*	239	64.67*	10	0.060	0.006	0.935	-0.015+	0.075	0.008	31.00	-0.26	0.57	FC3:BB
Pscalar3	472.09*	238	28.16*	9	0.056	0.002	0.945	-0.005	0.069	0.002	11.88	-0.12	0.84	BI3:BB
Groups: Guyana and Trinidad & Tobago														
Configural	427.77*	218			0.054		0.952		0.060					
Metric	446.91*	230	19.14	12	0.053	-0.001	0.952	0.000	0.066	0.006				
Scalar	530.03*	242	83.12*	12	0.061	0.008	0.932	-0.020+	0.075	0.009	37.11	0.31	0.49	FC1:TT
PScalar1	485.09*	241	38.18*	11	0.055	0.002	0.944	-0.008	0.070	0.004	10.49	-0.17	0.47	FC3:TT
Pscalar2	472.56*	240	25.66*	10	0.054	0.001	0.947	-0.005	0.068	0.002	10.98	-0.12	0.78	BI3:TT
Groups: Barbados and Trinidad & Tobago														
Configural	418.82	218			0.054		0.956		0.059					
Metric	430.23	230	11.41	12	0.052	-0.002	0.957	0.001	0.064	0.005				
Scalar	462.23	242	32.00*	12	0.054	0.002	0.952	-0.005	0.067	0.003	12.54	-0.12	0.85	PE1:TT
Three-Group Models														
Groups: Guyana, Barbados and Trinidad & Tobago														
Configural	638.91*	327			0.054		0.953		0.060					
Metric	677.01*	351	38.11	24	0.053	-0.001	0.952	-0.001	0.069	0.009	11.67	-0.20	0.41	EE2:BB
Pmetric	661.95*	34	23.05	22	0.052	-0.002	0.954	0.001	0.066	0.006				

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*RMSI*	ΔRMS	*CFI*	ΔCF	SRMR	ΔSRM	Mod. Ind.	EPC	Power	Path
		937												
Pscalar1	827.09*	371	165.14*	22	0.063	0.011	0.928	-0.026+	0.078	0.012+	61.39	-0.58	0.27	FC1:GY
Pscalar2	744.60*	369	82.65*	20	0.056	0.004	0.943	-0.011+	0.072	0.006	24.85	0.28	0.42	FC3:GY
Pscalar3	708.07*	367	46.12*	18	0.054	0.002	0.949	-0.005	0.069	0.003				
Groups: Guyana, Jamaica and Trinidad & Tobago														
configural	628.35*	327			0.052		0.957		0.059					
Metric	666.41*	351	38.05	24	0.051	-0.001	0.956	-0.001	0.067	0.008				
Scalar	769.14*	375	102.73*	24	0.058	0.007	0.939	-0.017+	0.074	0.007	51.42	-0.51	0.29	FC1:GY
Pscalar1	722.30*	373	55.89*	22	0.053	0.002	0.950	-0.006	0.070	0.003	11.94	0.19	0.43	FC3:GY
Pscalar2	708.10*	371	41.69	20	0.052	0.001	0.952	-0.004	0.068	0.001	12.75	-0.11	0.91	BI3:TT
Groups: Guyana, Jamaica and Barbados														
Configural	631.81*	327			0.053		0.955		0.061					
Metric	674.43*	351	42.62	24	0.052	-0.001	0.953	-0.002	0.071	0.010				
Scalar	844.98*	375	170.56*	24	0.063	0.011	0.927	-0.026+	0.081	0.010+	65.07	-0.60	0.27	FC1:GY
Pscalar1	760.73*	373	86.30*	22	0.057	0.005	0.942	-0.011+	0.078	0.007	24.11	0.26	0.46	FC3:GY
Pscalar2	723.64*	371	49.21*	20	0.054	0.002	0.948	-0.005	0.074	0.003	14.31	-0.11	0.95	BI3:BB
Groups: Jamaica, Barbados and Trinidad & Tobago														
Configural	619.35*	327			0.052		0.959		0.059					
Metric	652.36*	35	33.01	24	0.051	-0.001	0.959	0.000	0.066	0.007				

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*RMSI*	ΔRMS	*CFI*	ΔCF	SRMR	ΔSRM	Mod. Ind.	EPC	Power	Path
Scalar	721.73*	1375	69.37*	24	0.054	0.003	0.951	-0.008	0.071	0.005	12.31	-0.16	0.60	FC3:BB
pscalar1	707.52*	1373	55.16*	22	0.053	0.002	0.953	-0.006	0.070	0.004	11.15	0.13	0.74	BI3:JA
Pscalar2	694.64*	1371	42.28*	20	0.052	0.001	0.955	-0.004	0.069	0.003	13.75	0.13	0.84	PE1:BB
Four-Group Model														
Groups: Jamaica, Guyana, Barbados and Trinidad & Tobago														
Configural	839.47*	436			0.053		0.956		0.060					
Metric	896.33*	472	56.85	36	0.052	-0.001	0.955	-0.001	0.069	0.009	9.19	-0.19	0.36	EE2:BB
Pmetric1	881.11*	469	41.63	33	0.051	-0.002	0.956	0.000	0.067	0.007				
Pscalar1	1069.71*	502	188.61	30	0.060	0.009	0.936	-0.020+	0.076	0.009	62.97	-0.61	0.26	FC1:GY
Pscalar2	983.85*	499	102.74	30	0.055	0.004	0.947	-0.009	0.072	0.005	22.00	0.27	0.41	FC3:GY
Pscalar1	946.66*	496	65.55	27	0.052	0.001	0.951	-0.005	0.069	0.002	13.64	0.13	0.79	PE1:BB

* significant at the 5% level. Mod. Ind. – modification index. EPC – Expected parameter change. + significant change in fit index. GY – Guyana. BB – Barbados. JA – Jamaica. TT – Trinidad & Tobago. Pmetric – Partial metric invariance. Pscalar – Partial scalar invariance. The chi-square tests for the nested model – $\Delta\chi^2$ – are done with a Bonferroni correction for multiple tests. Therefore p-value = $0.05/\Delta df$ for an overall 5% test.

As in the case of metric invariance, full scalar invariance of the measurements is observed for the comparisons of Jamaica with each of Trinidad & Tobago and Barbados and for the comparison of Barbados with Trinidad & Tobago. Both the item loadings and the intercepts are therefore equal when these groups are compared in a pair-wise manner. Violations of scalar invariance occur whenever Guyana is paired with another territory. These violations are due generally to the intercepts of the first and third indicators of FC (FC1: *In general, my University campus has support for mobile learning.* FC3: *I have the knowledge necessary to use m-Learning.*) (Table 7). FC1 has a lower mean in Guyana than the other groups whereas the mean of FC3 is higher in Guyana compared to Barbados and Trinidad & Tobago.

An interesting result obtained from the three-group analyses is that the measurements are not fully invariant when Jamaica, Barbados and Trinidad & Tobago are estimated simultaneously. This result is interesting since there is full scalar invariance when any pair-wise combination of these groups is considered. Pair-wise MI therefore does not guarantee, MI if the elements of the pairs are estimated together. Full metric invariance of the measurements is demonstrated in the simultaneous estimation of these groups, but not full scalar invariance. Scalar invariance is hindered by the intercepts of the third indicator of FC (FC3) and the third indicator of BI (BI3: *I have a plan to use m-Learning technologies in the near future*.). The reported average level of knowledge about mobile learning technologies (FC3) is lower in Barbados whereas the students from Jamaica report a higher likelihood of having a plan to use mobile learning in the near future.

Whenever, Guyana is included as one of the three groups, the same MI violations encountered in the two-group comparisons are encountered. In each, case, full scalar invariance is hindered by the intercepts of FC1 and FC3. However, full metric invariance is obtained in the three-group models which include Guyana as long as both Barbados and Trinidad & Tobago are not the remaining two groups. When the models for these two groups are estimated simultaneously with Guyana, only partial metric invariance is achieved, due to non-invariance of the loading of the second indicator of EE in the Barbados group. However, if the models for Guyana, Jamaica and Barbados are estimated simultaneously, full metric invariance is achieved.

In some of the three-group models, BI3 and PE1 are flagged because they have large modification indices when scalar invariance is evaluated (see Table 7). However, apart from the case already discussed in which the item is indeed non-invariant, we do not regard the respective item intercepts as non-invariant in these remaining cases because the power is above 80% while the expected parameter change is not large.

The final model estimated contains the four groups under study. The results (Table 7) are largely consistent with what is already discussed, but some of the details are lost. Full MI is not obtained from the simultaneous estimation of the models for the four groups. Partial scalar invariance is achieved due to the loading of the second indicator of EE. This loading is lower in the Barbados group. The model also requires two additional modifications when scalar invariance is evaluated. These modifications are made to the intercepts of the first and third indicators of FC. The intercept of FC1 is lower whereas the intercept of FC3 is higher in Guyana.

Comparisons of the Means of the UTAUT Factors

In addition to evaluating the validity and comparability of the UTAUT factors in the Caribbean region, we provide comparisons of the average levels of the factors between the groups. The comparisons of the factor means are based on the results of the four-group model. Given that only partial scalar invariance is established, only the invariant items contribute the factor means (see Table 8).

As observed in Table 8, there are several significant differences in the average levels of the UTAUT factors between the territories, but there is also a notable lack of significant difference in many cases. PE is highest in Guyana followed by Jamaica. The students from Guyana in comparison to those from Barbados and Trinidad & Tobago in particular appear to feel more strongly about the usefulness of mobile technology in education. EE is also higher in the Guyana than both Barbados and Trinidad & Tobago. While the average level of this factor is similar between Guyana and Jamaica and between Jamaica and Barbados, the students from Jamaica feel more confident in their ability to use mobile technologies than the students from Trinidad & Tobago. There are no differences in the levels of the social factors (SF) except when Guyana is compared to Barbados and Trinidad & Tobago. In both cases, the students from Guyana report

higher levels of social support. The only difference in the evaluations of the facilitating conditions occurs for the comparison of Guyana with Barbados. In this instance, the students from Guyana are less optimistic about the conditions in support of mobile learning. Finally, BI is higher in Guyana than both Jamaica and Trinidad & Tobago, but higher in Barbados than Jamaica.

Table 8: *Comparisons of the Factor Means*

Factor	Group									
	Jamaica	Guyana			Barbados			Trinidad & Tobago		
	Mean	Mean diff.	SE	t	Mean diff.	SE	t	Mean diff.	SE	t
Baseline: Jamaica										
PE	ref	0.08*	0.05	1.80	-0.17**	0.05	-3.64	-0.16**	0.05	-3.21
EE	ref	0.06	0.07	0.88	-0.11	0.06	-1.63	-0.14*	0.06	2.23
SF	ref	0.09	0.09	1.06	-0.08	0.08	-0.92	-0.06	0.08	-0.75
FC	ref	-0.04	0.10	-0.45	0.13	0.09	1.42	0.09	0.10	0.92
BI	ref	0.26**	0.09	2.96	0.16*	0.09	1.72	0.12	0.09	1.25
Baseline: Guyana										
PE		ref			-0.26**	0.05	-5.49	-0.24**	0.05	-4.96
EE		ref			-0.16**	0.06	-2.57	-0.20**	0.06	-3.17
SF		ref			-0.17**	0.08	-2.06	-0.15*	0.08	-1.84
FC		ref			0.17*	0.09	1.92	0.14	0.10	1.39
BI		ref			-0.10	0.09	-1.20	-0.15**	0.09	-1.67
Baseline: Barbados										
PE					ref			0.04	0.10	0.38
EE					ref			-0.06	0.10	-0.61
SF					ref			0.01	0.09	0.15
FC					ref			-0.05	0.11	-0.44
BI					ref			-0.04	0.09	-0.46

**Significant at the 5% level. *Significant at the 10% level. SE – Standard error. t – test statistic from the t-distribution. ref – indicates the reference group for the comparisons. The mean of the reference group is set to 0.

In the UTAUT model, BI impacts directly on technology adoption. Given the results of the comparisons of the means, the students from Guyana seem poised to adopt mobile learning. The sizes of the coefficients (0.24 to 0.26) when Guyana is compared to the other territories are also the largest of all the mean differences. Given the sizes of the t-statistics corresponding to these differences (Table 8), the effect sizes are also expected to be large.

Aside from the differences in BI, a few notable patterns emerge for the comparisons of the factor means. Firstly, Barbados and Trinidad & Tobago form homogeneous groups with respect to the means of all the factors. Secondly, Jamaica is distinguished from the other groups with respect to two factors in each case. Significant differences from Jamaica occur for PE in all cases and with respect to BI in comparison to both Guyana and Barbados. The only remaining significant difference involving Jamaica is in relation to EE with Trinidad & Tobago. Although it retains a few distinguishing characteristics, Jamaica appears to have many similarities with each of the other

territories. In contrast, the results for Guyana contains several distinguishing points. The mean levels of the factors in Guyana differ from those in Barbados and Trinidad & Tobago in relation to all but one factor each. However, Guyana and Jamaica have similar means for most of the UTAUT constructs.

DISCUSSION

With the exception of the facilitating conditions factor which has relatively low convergent validity, the UTAUT constructs are recovered adequately from the data in each territory (Thomas et al. 2013). Apart from the measurement validity issues of the facilitating conditions, this finding is similar to that of Oshlyansky et al. (2007) who focus on a combination of Western and non-Western countries. The UTUAUT measures are therefore generally both valid and reliable and this supports the generalizability of the measurements to the Caribbean region. The UTAUT theory may therefore be used to evaluate mobile learning adoption in the region. However, there are some caveats to this general conclusion.

The consistently low convergent validity of the facilitating conditions factor is enough to raise concerns about the measurement of the factor. While there is a need for improvement in the measurement of FC, discarding it altogether is not recommended (Thomas et al. 2013) especially since the construct provides unique information. Closer inspection of the items reveals that they focus on a combination of sources of support that are external (FC1 and FC4) and internal to the individual (FC2 and FC3). Splitting this construct into two separate factors capturing the external and internal facilitating conditions respectively may result in more appropriate measurement of the facilitating conditions in the Caribbean region. This approach requires a modification of the UTAUT in relation to the measurement of the facilitating conditions and it should be explored in future studies. However, researchers should also attempt to identify two additional items; one to go along with FC1 and FC4 to measure external conditions and one to go along with FC2 and FC3 to measure internal conditions. This is suggested because the resulting two factors will be under-identified if only two items are used with confirmatory factor analysis. In some cases, further restrictions (loadings equal 1) will need to be imposed for the model to be estimated successfully if only two items are used.

It is also noteworthy that the expected parameter change for the first indicator of the facilitating conditions (FC1: *In general, my University campus has support for mobile learning*.) when scalar invariance is attempted is large. This suggests that in comparison to the other groups, the Guyanese students are much less optimistic about the level of support for mobile learning at their campuses. This is supported by the comparisons of the factor means. The facilitating conditions is the only construct on which the Guyanese students report a lower average than the students of any other territory. This particular observation may be reflective of the country's comparatively poor standing on the ICT development index and rank together with only approximately 34% of the population using the Internet (International Telecommunication Union 2013; International Telecommunication Union 2012).

A final caveat to the generalizability of the UTAUT measures, is the consistently low loading of the third indicator of social factors (*SF3*: *University teachers are supportive of the use of mobile technologies*). This indicator captures the influence of university teachers on the adoption of mobile learning. The supportiveness of university teachers therefore appears to play a limited role in determining the social factors responsible for mobile learning adoption in the region. This item was modified to fit the university context, but it is apparent that a replacement may be necessary for mobile learning studies in the Caribbean. In the Caribbean, mobile learning has not yet become integral to higher education and the general poor performance of the third social factors item may be due to domain specificity. It may be that the teachers are themselves less technology savvy

and that the students do not look to them for inspiration in this regard. The low loading of this item in Guyana was highlighted previously (Thomas et al. 2013) and the consistency of this finding across the territories in this study, suggests that there is a need to modification of the item to improve its validity. Such modification is necessary at least for mobile learning studies, but we advise against modifying this item for the general application of the UTAUT model until it is tested more widely in the region in other domains.

The UTAUT measures are generally comparable across the territories; however, one violation of metric invariance is encountered. This is a limitation on the robustness of the measures (Byrne & Watkins 2003; Van de Vijver & Tanzer 2004). This violation of metric invariance occurs for an item that has a quite high standardised loading (greater than 0.80). We do not believe that this particular parameter will bias research results substantially. In spite of this, researchers should still be cautious about pooling data across the territories (Byrne et al. 1989). Under partial metric invariance, cross-national comparisons of structural relationships is permitted. Researchers can therefore compare the regression effects included in the UTAUT model among the territories. This is an important result since these effects are most often the subject of research. Based on the results, comparisons of structural relationships under full metric invariance can be done with any group of three of the territories except when Barbados and Trinidad & Tobago are included with Guyana.

Comparisons of the mean levels of the factors are also important. Such comparisons can indicate the relative standing of the territories on the factors so that areas of focus for mobile learning intervention may be identified. Given that only partial scalar invariance is found, comparisons of the mean levels of the factors are likely to be biased unless adjustments are made (Vandenberg & Lance 2000). In particular, only pairs of territories excluding Guyana may be compared under full scalar invariance. Once Guyana or more than two territories are included adjustments for scalar non-invariance are necessary (Byrne et al. 1989). The construct that is most affected is the facilitating conditions primarily due to the Guyana group. This construct may also show non-invariance in Barbados as observed in the three-group models. In addition, behavioural intention may also show non-invariance in Jamaica when Guyana is excluded. The reason for this is that the violations are more severe in Guyana. This is notable given that Guyana performs the poorest of the four territories on both ICT rankings and ICT development (Table 1). The difference in the ICT environment appears to indeed affect usage and user experience and thus accounts for the results obtained. The issue of usage and user experience across the Caribbean territories should be investigated in the future

Once partial invariance is invoked, the freed items no longer contribute to the substantive comparisons. This is true for the results provided on the mean differences between the UTAUT factors. The facilitating conditions is most affected and as such the results should be interpreted with care. It is also important to note that methods such as analysis of variance or the use of sum scores or averages for the UTAUT construct, ignore the measurement issues highlighted in this paper. These approaches are therefore not optimal for comparing the regression effects in the UTAUT model or the mean levels of the measures between the Caribbean territories. Methods that permit adjustments for lack of measurement invariance should be employed.

CONCLUSION

With the exception of the facilitating conditions, the UTAUT measures exhibit adequate reliability and the factors are adequately recovered in each territory. The interpretations of the items per factor are generally similar across the groups, but similarity of the item intercepts is more problematic. With potentially one adjustment, the structural relationships among the UTAUT factors may be compared, but more adjustments are required for comparisons of the factor

means. Pair-wise pooling of the data across the groups is justified except for some cases in when Guyana is involved. However, once more than two groups are included, researchers should be cautious about pooling the data especially when the factor means are to being studied. We conclude overall that the UTAUT model may be used in the Caribbean region but that researchers should focus attention on improving the measurements. In particular, the UTAUT model may be modified for the Caribbean region to allow the facilitating conditions to be measured by two separate factors; one capturing the contribution of the individual and the other capturing the contribution of the environment. This represents a departure from the UTAUT theory as it relates to the measurement of facilitating conditions in the Caribbean context. However, the need for this modification should be investigated in domains other than mobile learning before it could be generalised.

LIMITATIONS

This study has three important limitations. Firstly, university campuses that come under the UWI brand entirely compose the samples of two territories. We do not anticipate this this has affected the results substantially (see description of data) but the possibility is not altogether eliminated. Secondly, response styles are not controlled (Van Vaerenbergh & Thomas 2013). Response styles are examples of method bias which can affect the extent of MI obtained and group comparisons regardless of whether or not MI is demonstrated (Thomas et al. 2014). However, corrections for response styles have not become commonplace in research and data collection instruments do not generally cater for this. Thirdly, we used student samples which is necessary for the topic investigated. As such, the results may not be generalised to other groups and to other domains. Furthermore, the issue of self-selection in web surveys may further affect the results. Researchers should examine both the impact of response styles on the cross-national comparability of the measures and the generalizability of the findings in domains other than mobile learning and such studies should include other Caribbean territories and other university campuses.

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Exploring interactions of cultural capital with learner and instructor expectations: A case study

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ABSTRACT

In this case study, we are able to take a close look at a situation not often encountered in the literature on ICTs in emerging economies: a private company from an emerging economy provided much-needed funding for a US NASA higher learning consortium through a contract for training and research and development in 3D visualization. This study examines this training program by asking: How do bidirectional flows of cultural capital interact with learner expectations and instructor preconceptions in the case of a cross-sector, cross-border training program? Researchers and practitioners concerned with education in a globalized context may consult findings here to deduce a set of criteria underlying these learners' expectations for this NASA branded program and preconceptions of the instructors about the learners that may help instructional designers prepare for comparable cross-cultural training programs.

INTRODUCTION

Policy advisors have made a global call for nations to prioritize their knowledge-economy-building initiatives, and this call is being answered by a surge of non-profit and market-driven strategies to produce innovative educational technologies (Britz, Lorc, Coetzee & Bestere, 2005; Dahlman & Utz, 2005; Daniel, 1996; Morey, 2004; van der Wende, 2002). For organizations to innovate in the educational technology space, they have been forming partnerships across sectors and across borders in order to train personnel for high level innovation. Such cross-sector, cross-border training for innovation environments continue to increase in number and provide rich ground for examining dynamics of culture in the process of instructional design and technology (IDT) in a globalized knowledge economy.

The roots of instructional design cling to the soil of the military-industrial complex and its call for more effective, efficient and productive processes for uniform training (Reiser & Dempsey, 2007). Though still of legitimate concern in today's learning environments that reflect the transitional growth from industrial to knowledge-based economies, calls for effectiveness, efficiency and productivity are accompanied by calls for equity, sustainability and innovation (Vrasidas, Zembylas & Glass, 2009). For example, development was once seen from the Western point of view as a measure of economic growth through attention to gross domestic product indices; whereas, newer, more globally inclusive views show attention to development as a process of improving individual human rights and attention to environmental sustainability (Sen, 2006 qtd. in Vrasidas, Zembylas & Glass, 2009). Petrina (2004) argues that the models proposed by instructional designers are lacking because "universal formulas" could only work in apolitical environments which arguably, do not exist. Visser and Suzuki (2007) observe that "the professional literature of the instructional design field draws heavily on the experience of its application and development in one country, the United States of America" (p.235). These critiques of applying Western-based models gain more significance as the practice of IDT continues to occur in increasingly global contexts.

This study seeks to problematize traditionally reductionist approaches of IDT, in particular because of the cross-cultural implications of imposing only one world view as the truth by exploring how bidirectional flows of cultural capital interact with learner expectations and instructor preconceptions in the case of a cross-sector, cross-border training program.

Case

In 2007, NextGenEd (pseudonym), a private education software company headquartered in India, contracted with the Institute for Advanced Learning (pseudonym) (IAL), a consortium of three US state universities, a community college and one of NASA's Space Centers, to train up to fifty employees to build applications that produce 3D graphical representations for CAVE (Cave Automated Virtual Environments). NextGenEd initiated this training program as a research and development project to potentially produce software and build immersive three-dimensional virtual (i3Dv) environments for thousands of higher education, primary and secondary institutions in India, the US and Europe. The IAL team, subject-matter experts in i3Dv programming with minimal experience as educators, prepared and offered an on-site training program at their location on the campus of a NASA space center. From January 2008 to December 2008, NextGenEd sent twenty-four employees to participate in this training program as students. This case study examines this training program from the initial planning stages beginning in late 2007 until post-training stages of research and development still in progress in late 2010.

THEORETICAL FRAMEWORK

The theoretical framework for this study draws from Young's (2008) Culture-Based Model (CBM) for instructional design. As part of the empirically-based framework, Young proposes twenty-five cultural elements in three categories: anthropology of culture, psychology of culture and science of culture (p.64). Drawing from a broader study examining all of these elements, this study presents a narrowed focus on the one element of cultural capital in order to examine how it interacts with learner expectations more closely (Russell, Kinuthia, Lokey-Vega, Tsang-Ksoma, & Madathany, 2013). Cultural capital represents factors related to the economics and material wealth of a culture (Young, 2009). In defining cultural capital and forming guiding questions, Young (2009) focuses on economic categories of production, distribution and consumption of goods and services.

Guiding Question

How does cultural capital interact with learner expectations and instructor preconceptions in the case of a cross-sector, cross-border training program?

LITERATURE REVIEW

Anecdotal, qualitative and analytical approaches in the literature provide multiple perspectives and particularistic findings on cultural factors, learner expectations and instructor preconceptions in the instructional process and integration of technology across borders.

In "Taking Ownership: Strengthening Indigenous Cultures and Languages Through the Use of ICTs" Lieberman (2003) considers the dynamics of using ICTs for the benefit of indigenous cultural causes. The argument he makes in this article is that 1) the use of ICTs is already widespread and inevitable, and 2) policies towards productive and positive uses of ICTs may mediate the potential for negative consequences. Lieberman's analysis is relevant to this case study which offers an opportunity to examine cultural interactions with the decisions and

perceptions of stakeholders in a project to introduce an educational technology innovation in a country where indigenous cultural causes are still prevalent.

In the context of higher-education, Ezer (2006) interviews faculty and students in India to get an impression of the attitudes towards ICTs and ICTs in education in India. Ezer explores what Indian faculty and students believe to be the purpose of ICT. He concludes that students and faculty show optimism about ICT and seem to have whole heartedly adopted the Western model of individualistic, rational and imperialistic success. Ezer's research is particularly relevant to the case in this research because attitudes towards ICTs by faculty and students in India interact significantly with the purpose of the training program, the students' experience in the training program and the potential market for the i3Dv product.

Studies on open learning and distance education in nations with emerging economies show a trend of collaborations with universities and expert instructional designers from nations with developed economies (Merrill, 2001; Perkins, et al., 2005; Visser & Berg, 1999). This same trend of cross-border collaboration is evident in the literature on the impact and integration of ICTs in nations with emerging economies. In a case study describing a World Bank Institute sponsored project encompassing East and West Africa, Burniske (2003) found that participants faced cultural challenges in "fundamental activities in the telecollaborative process" (p. 108). Luschei, Padmo and Spector (2009) report on a partnership between the Open University of Indonesia and Florida State University and emphasize the importance of building friendships beyond professional relationships across borders to increase the "potential for real collaboration" (p. 22).

Several case studies in the literature provide general descriptions of international projects and conclude with a list of challenges or lessons learned about the process of design in the cross-cultural, cross-border or cross-sector context. Common themes that emerge include: 1) culture as an important factor during stages of the instructional design process (Chitiyo & Harmon, 2009; Eastmond, Gutierrez & Shanley, 2010; Lim, 2007; Perkins, et al., 2005); and 2) calls for design models or modifications to models that better fit such situations by taking culture into account (Arya, Margaryan & Collis, 2003; Soulier, 1999; Visser & Berg, 1999; Zagoumennov, 2010). This study seeks to take culture into account by considering the dynamics of cultural capital in the IDT context.

METHODOLOGY

This research uses the qualitative approach of case study and applies a cultural design framework to examine learner expectations and instructor preconceptions in a sample case. I take a pragmatic view with this case study approach in assuming knowledge about this training program is context-dependent but potentially useful for cross-referencing with other cases.

Purposeful sampling was used to select participants. One member of NextGenEd management in the US participated in the study; no members of NextGenEd management in India participated in this study. Twelve members of NextGenEd's training program team participated in the study: one project manager, one team lead, and ten students.

The sample of artifacts includes documents, websites and 3D visualization applications.

Interviews were conducted over an eighteen-month period in the US and India while the training program was still being conducted and after it had concluded. Transcripts of interviews were e-mailed to participants for their feedback. Participants acknowledged receipt of the transcripts, but no feedback was offered. Artifact analysis was conducted over a two-year period while the training program was still being conducted and after it had concluded. Observations were

conducted on site at IAL in July 2012 and at the Indian headquarters of NextGenEd in September 2010. Transcribed interviews, artifacts and field notes were coded in NVIVO through multiple stages and with multiple coders, all advanced levels of instructional design credentials and experience.

Units of data were coded in accordance with the instructional design process and cultural element of cultural capital as defined by Young's Culture-Based Model. NVIVO generated a matrix of overlapping coded references between emergent themes related to the design process and cultural capital. Units of coding were cross-referenced between units of analysis for triangulation of data, and validated data was chosen to present in the findings. Data were analyzed to identify where components of the design process, decisions of the design team, and perceptions of the stakeholders overlap with culture as defined by Young's CBM framework.

FINDINGS

Findings related to cultural capital are presented with supporting excerpts from the data to reveal:

1. where decisions were made and stakeholder perceptions were formed that relate to learner expectations or instructor preconceptions;
2. where the connection between these decisions and program outcomes are related;
3. what stakeholder perceptions were expressed about these decisions and program outcomes; and
4. where these decisions, stakeholder perceptions and program outcomes interact with or are related to cultural capital.

The findings reveal systemic cultural interactions in the bi-directional flow of cultural capital and the impact of this flow on design decisions, stakeholder perceptions and project outcomes. The emergent themes reflecting this interaction include: 1) multiple roles of instructors and students influenced by exchanges of cultural capital; and 2) misconceptions about cultural capital.

Multiple roles of instructors and students influenced by exchanges of cultural capital

The training agreement between IAL and NextGenEd included the completion of marketable i3Dv products as part of the training program. This goal resulted in members of the IAL team serving multiple roles as instructional designers-by-assignment, instructors, marketing and salespeople, project managers and product designers. These findings show overlap of cultural capital related motivations and opportunities for the instructional design team to become more culturally-informed about their audience.

The Director of IAL visited India to promote the NextGenEd i3Dv initiative.

> *Director*: It was a big marketing tour for me, I mean, that was the goal… to get people to sign up to commit to this.

The Director's trip, which took place before the training program began, was for the purposes of finalizing the agreement with NextGenEd and to promote the program and its outcomes to potential clients. Though the visit was not for the purpose of cultural awareness, the Director learned a lot about the culture of the students from the trip.

> *Director*: They're all from India…so they're all going to be the same. Well that's so wrong. I mean there's a billion people in India, it's a huge country, and they're vastly different...And that's what-I learned that. To assume that just because they're all from India that they'd all be the same, have the same habits, have the same ideas, speak the same languages, even have the same religions, dress the same-no. Their differences are, I think, even magnified more than the cultural differences we see within the United

> States...like the dress, for instance...I mean the regional dress, I mean you go to LAX, and you go to JFK, or you go to O'Hare, you're going to see people basically wearing the same stuff. But you go to Delhi compared to Mumbai, and it's not going to be the same, it's going to be much different...the other thing about just the Indian culture...that I took out of... the visit was the stark contrast between the people-the rich and the poor.

The Primary Instructor of IAL visited India to consult with potential clients on projects for the students to complete, serving both a sales and marketing role as well as a project manager and instructional design role.

> *Primary Instructor*: The main goal [of the trip to India] try to make a sale, try to convince them that this is needed.

Before this trip, the Primary Instructor based her understanding of the target student audience primarily on the information gleaned in this recruitment process.

> *Primary Instructor*: I asked them who are these people and they say programmers...Okay, what type of education they have. They said... college. How old are they? In their 20s so they just finished their school and some has a few year experience, some has none...So these people that came, they were less than 30 years old...So they are young adults with programming and zero experience in graphics...With the exception of one at most two who had worked in the area involving graphics. So that helped me determine how basic I had to be at the beginning.

In this excerpt, we see the Primary Instructor restrict her understanding of the target audience to profession, education, age and experience. However, related findings reveal that additional encounters with the culture of the students expand her understanding of the audience.

> *Primary Instructor*: So I went to India...I snuck out and walk around and you know I noticed that people don't speak English...they have maids which we don't… that manager guy, he has his own driver and this driver is like a permanent position because when he doesn't need to drive he stay with the car.....I saw different classes of people, because I saw the drivers and I saw the group of taxi driver or auto driver and then there's high lows at the manager level, so I know that the students must have come from different backgrounds.

The marketable product goal of this training also created dual roles for the students: they were both students and employees The projects that IAL designed for students were collaborations with potential clients in India and involved students in direct interaction with these clients, creating teams of all Indian natives for introducing the i3Dv technology into India, including collaboration with IGNOU, India's open university system.

> *Student 10*: We collaborated in India here in Mumbai with a professor on this project…a 3D simulation of an earthquake which is completely realistic.

During my observation at the Mumbai site, I experienced this completed simulation which, according to interview data and artifact analysis, had attracted the most attention from potential clients in India.

Misconceptions about cultural capital

The IAL team considered India's cultural capital in making an important curriculum decision: to train the programmers only in OpenGL. The Program Manager thought it was a good fit for the NextGenEd students because it would not cause any licensing problems for the future business plan. In the business plan, NextGenEd lays out a vision of producing thousands of applications to distribute across India.

> *Program Manager*: That's why we went Open GL...That's why I decided that ten years ago, I came here, I said let's not to buy packages because it is open source... and especially when this India project came along, I was just like-it's open...So if they want to print out 10,000 copies, there's no licensing issues.

The client representative and several students expressed disappointment in this content decision: the singular focus on OpenGL.

> *Senior Project Manager*: One of the failings of the program, was that despite the company's frequent and clear communications with [IAL Team] about what we were hoping to achieve, the training team focused more on the theoretical aspects of OpenGL development.

The students also expressed disappointment about this content decision because they felt they could have learned OpenGL in India.

> *Student 1*: We could have gotten better training over here in India [on OpenGL]. The CAVE technology and the hardware part we couldn't have gotten in India. So the best solution was to have instead of a year-long training we could have gone there only for the CAVE training.

> *Student 8*: What we learned there, we could have learned, the open GL part at least, we could have learned on by our own.

The students, like the Program Manager, view OpenGL as shared cultural capital, and they believe this makes OpenGL a less desirable choice of content.

Many of the students stated that the CAVE technology was the only reason the training program needed to be located in the US:

> *Student 2*: For this training... CAVE and the crystallized glasses... Anything else we could have got anywhere.

> *Student 3*: The leading technology was the CAVE, but now we have a better system I think.

The CAVE represented the primary reason for the training program, and it was cultural capital that was not available in India at the time. However, as a result of this training collaboration between IAL and NextGenEd, there is now a CAVE in India that is more updated and powerful than the IAL's model. This CAVE is the first and only fully immersive, stereoscopic three-dimensional visualization environment in India.

Another misconception about cultural capital prompted disappointment from the students. The students' ideas about NASA led to a misconception about what IAL would be and influenced their perception of the quality of the training program.

> *Student 9*: After hearing the name of NASA, I thought there would be some high-profile teachers who had written a lot of research papers, and a lot of research background.

> *Student 7*: We expected that some NASA scientist will come and do classes, training, something like that, we thought. We thought that we would be completely submerged with NASA scientists. But actually it was that some institute... Not that much good. Our

> expectations when they say NASA is too much. But the quality of instruction we got is very inferior.

These findings indicate impactful cultural capital interactions with the decisions, perceptions and outcomes of the instructional design process of this cross-sector, cross-border training for innovation case.

DISCUSSION

In this case study, we are able to take a close look at a situation not often encountered in the literature on ICTs in emerging economies: a private company from an emerging economy providing much-needed funding for a consortium in the US non-profit sector. Shifting economic patterns in India have changed the deficit narrative to one of growth and opportunity, and this shift is evident in this case study where funding flows from India to the US as part of a project for India to introduce a US cultural resource into its educational market. As a result of this funding structure, the Director of IAL visited India to secure financing and promote the i3dv project for NextGenEd and the Primary Instructor visited India to collaborate with potential NextGenEd clients for i3dv applications. Personal visits to India by two of the design team members allowed them to understand the target audience, explore environmental and individual/group cultures, form a more culturally-informed team, and secure and maintain financial support. Luschei, Padmo and Spector (2009) emphasize the importance of on-site visits to the success of their long-term cross-border project. Findings in the training and development literature also support the value of global relocation for cross-cultural exposure (Kho, 2001; Sofo, 2007).

One of the more intriguing findings is in the students' disappointment at what the US had to offer. The students describe an idea of NASA as the pinnacle of cutting edge technology and knowledge. They express disappointment at finding that the design team is part of a NASA consortium rather than actual NASA scientists. They thought the faculty were not prestigious enough because they did not have any patents and were employed by the consortium, not NASA; they were disappointed in the curriculum choices, claiming they could have covered the entire subject matter of the course in one tenth of the time in India and wishing the course had been more advanced and challenging; and they were disappointed in the equipment as they became aware that the CAVE on site was ten years old and that other centers had more up-to-date technology. Working backwards from how members of this cohort described their disappointment, one can deduce a set of criteria underlying their expectations for this NASA branded program: caliber of the faculty, challenge of the curriculum, and quality of the learning environment. This finding is peculiar to this study, yet many prestigious institutions across the globe are seeking to leverage their brands for educational collaborations across borders and across sectors. This finding highlights the important influence a brand may wield on students' perceptions of their learning experience.

The students were disappointed, yes, but did they learn? From a program evaluation standpoint, how is this question answered?

If the purpose of a program evaluation is to determine whether or not it served its purpose and accomplished its intended objectives, the point of view of multiple stakeholders must be considered. From the point of view of the NASA consortium they delivered the training program they were contracted to provide. All students passed the summative assessments designed to evaluate their attainment of the learning objectives of the program by creating authentic project deliverables.

Asking whether or not the students attained the learning objectives set by the NASA consortium reveals the insufficiency of the construct of objectives-based assessments as a means for program or course design evaluation. Were the objectives appropriate in the first place? The cohort response was no. Findings showed that the cohort needed to supplement the learning significantly in order to develop 3D visualization demos after returning to India from the training program. To get at whether or not the objectives are appropriate, the learners' perspective becomes essential because they are aware of how the learning is put into practice and whether or not it serves them well.

This assessment plan was designed to measure the cohort's ability to create a commercially viable product to suit the purposes of the US India company's R&D program. Since the end of the program, members of the cohort who are still employed with the company have developed 3D visualization programs, yet no products have been sold. Looking at whether or not the cohort could produce commercially viable products as a measure of the cohort's learning, however, would be problematic. There are confounding variables related to bringing products to market that are unrelated to cohort ability.

Researchers and practitioners paying attention to the connection between development trends, ICTs and education in emerging economies express both enthusiasm and caution for such projects as the one in this case study where a private company seeks to introduce a high-level technological innovation into a new market (Lieberman, 2003; Marchessou, 1999; Visser, 2007). Lieberman (2003) considers this type of initiative widespread and inevitable and advocates for a "pro-active and culturally-sensitive approach to technology introduction." Here, the systemic significance of instructional design decisions in the cross-border, cross-sector training for innovation context is particularly clear. The projects designed for real-world assessment involved students in direct interaction with clients in India, creating teams of all Indian natives for introducing the i3Dv technology into India, including collaboration with IGNOU, India's open university system. Updating traditional ISD models should include prompts for designers to consider the systemic implications of assessment and feedback decisions in a globalized knowledge economy.

Researchers and practitioners concerned with broader issues of education in a globalized context may also consult findings here related to the bi-directional flows of cultural capital across borders and across sectors in this case. These findings reveal that the client and the students share a general sense of enthusiasm for the introduction of high-level technology that is the focus of the training program. These findings support the findings of Ezer (2006) that attitudes towards ICT and ICT in education in India show optimism for ICTs and openness to Western models of success. For example, the students felt the training in the US was only necessary for the one cultural resource available in the US and not available in India, the CAVE; once the CAVE was available in India, the private company brought the students back to India. Also, the students' cultural ideas of a training program promoted as part of NASA were noted as part of their eventual disappointment with the quality of the training program. This shared sense of high-expectations interacted with their reactions to the learning environment, technology, instructors, content and achievement.

In this case, cohort disappointment in the program caused some students to complain to the company in India that the program was not worthwhile. They became a disgruntled cohort in many ways and this mood was presented to the second cohort of new employee/trainees to arrive six months later. Cohort complaints were noted by leadership as a factor in the decision to bring the cohorts back to India and continue the training remotely. It was also a factor in the leadership's decision to discontinue the training program, originally envisioned as a long-term partnership.

The India-US company and the NASA consortium originally envisioned the training program as a research and development partnership where the HLC would continue to train developers and serve as part of the development team to create commercially viable products and help attract and excite clients and investment. As such, the faculty, staff and trainees of the NASA consortium participated in client meetings for demonstrating and exploring possible projects with potential clients. In the end, once the training was over, no clients were in place to serve and continue the partnership.

These findings offer prompts for inquiry in the instructional design discipline into the complex interaction of power politics, market forces and knowledge flows across cultures and across sectors.

CONCLUSION

Findings from this study reveal that cultural capital interacts with multiple components of the instructional design process, in particular learner expectations and instructor preconceptions, in complex ways that are not reflected in or addressed by traditional ISD models. If we ground our discipline in the understanding of systemic processes, we cannot continue to ignore a prevalent and impactful variable in that system.

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Agro-students' appraisal of online registration of academic courses in the Federal University of Agriculture Abeokuta, Ogun State Nigeria

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ABSTRACT

With integration of information technology tool for academic course registration in the Federal University of Agriculture, Abeokuta, the study assessed the agro-students' appraisal of the online tool for course registration. A simple random sampling technique was used to select 325 agro-students; and validated and reliable questionnaire was used for collection of data on the study objectives. Results of the analysis data showed that the use of online registration tool was appraised valuable for convenient course for registration ($\bar{x}$ = 4.47; SD = 0.682), reduction of attendant stress/rigour of manual course registration ($\bar{x}$ = 4.59; SD = 0.573), guaranteed eligibility to write examination on registered courses ($\bar{x}$ = 4.06; SD = 0.992) and creation of database for students' record of registered courses ($\bar{x}$ = 4.03; SD = 0.993). The Spearman's rho correlation analysis of the study hypothesis showed a significant and positive association between the agro-students' appraisal of online registration of academic courses and their academic performance ($r = 0.155$, $p < 0.05$); educational background ($r = 0.128$, $p < 0.05$); mode of entry into FUNAAB ($r = 0.127$, $p < 0.05$). The linear regression analysis showed that the students' appraisal of the online tool for registration of courses was significantly determined by their frequency of usage of the eduportal ($\beta = 2.185$, $p < 0.01$). It was thus concluded that online registration of academic courses in FUNAAB is a worthwhile development, and recommended that it should be sustained; and the students should be well trained on usage of the eduportal in order to develop skilful and efficient use of the online tool for registration of their academic courses.

Keywords: *Online registration tool, course registration, appraisal of eduportal, agro-students, FUNAAB*

INTRODUCTION

The Federal University of Agriculture, Abeokuta (FUNAAB) was established on January 1st 1988 (www.unaab.edu.ng) with the mandate of training and developing students' capacity for efficient production and management of farm enterprise as agribusiness. The developmental training, as intended by the Nigerian policy on agricultural development, is meant to bring about a new generation of farmers that would innovatively transform Nigeria's agricultural system and gradually replace the aging, poor-resourced and less educated farmers that currently dominates the country's agricultural system (Lawal-Adebowale, 2012; Karami, Karami & Attaran 2013). To achieve the mandate of manpower development, the university adopted an academic structure that entails class (course) work, laboratory and field practical for training of the students on theoretical and practical farm production and management. The class work, alongside the laboratory and field practical, take a 5-year academic calendar or ten semesters (University of Agriculture, 2012).

Although the university runs both agricultural and non-agricultural programmes, all admitted students take general science courses in their first two semesters or first year, often referred to as 100 Level, in the university with a view to providing them basic knowledge of science and its

relevance and application in agriculture. The remaining four years or eight semesters however focus mainly on agro-based courses. In essence, admitted students into agricultural programmes begin the mainstream agricultural courses from their second year, often referred to as 200 Level, and this runs till their fifth year or 500 Level. By then, every student is expected to have taken a minimum of 240 course units, comprising course work, laboratory and fields work, and passed them all as a requirement for graduation. But for any of the agro-students to be eligible to take any of the outlined courses in a particular academic session such students have to register for the courses as prescribed by the university's academic regulations (University prospectus, 2012). For instance, every student is expected to register a minimum of 16-course units and maximum of 24-course units per semester or a minimum of 32-course units and maximum of 48-course units per session. In view of this, every student picks up course forms and manually fills them (by hand writing) in quadruplet and thereafter have the concerned lecturers signed against each of the courses handled by them. The appended signatures and submission of the duly signed forms to their respective Departments for documentation thus serve as evidence of course registration by the students and the qualification to attend lectures and take examinations on the courses.

This style of course registration, which was the practice from inception of the university till 2006, however takes a great deal of time, and sometimes becomes strenuous, especially where the students have to skip lectures or shuttle between lecture hours to get their course forms signed by the concerned lecturers. The acts of shuttling between lecture hours for course registration was observed to have been induced by the need for the students to meet up the appointment as may be fixed by a particular lecturer to have their signed, and the need to have course registration exercise completed within the stipulated time by the management of the university. This format of course registration however took a new dimension in the university in 2006/2007 academic session, following the installation, configuration and deployment of educational portal (eduportal) for electronic or online registration of the academic courses. The eduportal/online registration tool, as deployed by the management of FUNAAB, is meant to enhance the creation and documentation of students' academic database through a progressive annual course registration.

In order to effectively accomplish the task of electronic or online registration of academic courses, the university had the Information and Communication Technology Centre (ICTREC) established to develop and manage electronic resources for creation of database for prospective and admitted students during admission process and when finally admitted; and for registration of academic courses by the students. The centre thus has Internet connection, through a Virtual Small Aperture Technology (VSAT), and computers in place for use by the students whenever they visit the ICTREC for course registration. Based on this development, the agro-students no longer have to embark on manual registration of courses but rather visit the ICTREC for registration of their academic courses at beginning of every academic calendar year. In view of seven years of operation and usage of eduportal for electronic course registration by the students, it becomes essential to ascertain their judgement or appraisal of the online registration of courses in the university with view to ascertaining whether or not the online registration tool is of value to the students. The value of the electronic tool, as may be appraised by the students, is expected to stem from comparison of their experiences on manual registration of academic courses with the use of eduportal for course registration in the university. In the light of this, the study addressed the following specific objectives.

1. Describe the personal characteristics of the selected agro-students,
2. Ascertain the agro-students' experience on the use of eduportal for educational registrations,
3. Assess the students' appraisal of the value of online registration of academic courses in the university
4. examine the constraints to a hitch-free online registration of academic courses by the agro-students

Hypothesis

H_{01}: There is no significant relationship between the agro-students' personal characteristic and their appraisal of on-line registration of academic courses

H_{02}: Agro-students' appraisal of the online registration tool is independent of their experience of usage of the tool for registration of pre-varsity examinations

RESEARCH METHODOLOGY

The study was conducted in FUNAAB. The University has a three-fold (tripodal/triad) mandate guiding its educational and community-based operations, and these are teaching, research and extension. In order to adequately accomplish the three-fold mandates, the university structured its operational system into three arms, namely academic colleges, research institute and extension centre. The academic colleges, which comprise College of Agricultural Management and Rural Development (COLAMRUD), College of Animal Science (COLANIM), College of Plant Science (COLPLANT), train the enrolled agricultural trainees on skilful development and management of agriculture through course work taken as lectures in the classroom and practical training in laboratories and field demonstrations. The research institute, tagged Institute for Food Security, Environmental Resources and Agricultural Research (IFSERAR), has the mandate to conduct science based-research for agro-innovation or technology discovery and development of technical information that would meet the needs of local farmers and fits the farming condition of the southwest farming zone of Nigeria. The extension arm of the university, dubbed Agricultural Media Resources and Extension Centre (AMREC), functions to disseminate generated agro-technologies or technical information to the local farmers in the university's model villages and communities for their education and empowerment.

Unit of analysis: this comprised the agricultural students whose year of studentship or level is between the second year (200 level) and fifth year (500 level) in Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State, Nigeria.

Sampling frame: this consists of 3852 agricultural students who are listed in FUNAAB students' directory for the 2011/2012 academic session.

Sampling technique and procedure: from the available comprehensive list of 3852 agricultural students in the university's student directory was stratified sampling of 386 the agro-students. The stratification was based on the three colleges of agriculture, namely COLAMRUD, COLANIM and COLPLANT thereby signifying that students across the options of the available agricultural programme in the university were fairly represented in the sampling. On another note, the students were stratified based on the year or level of studentship in the university – second year (200 level), third year (300 level), fourth year (400 level) and fifth year (500 level) in order to ensure that all the agro-students by year of studentship were adequately accommodated in the sampling. In essence, the stratified sampling technique was found appropriate basically because it makes it possible to have a fair representation of all the agricultural students, across colleges and levels, in the sample size. Table 1 shows proportionate sampling of the students across colleges and levels at 10% to give 386 of them as respondents.

Table 1. *Agro-students' stratification of agro-students for selection based on colleges and levels/year of studentship in the university*

Levels / Colleges	200	300	400	500	Total
COLAMRUD	296	199	172	125	792
COLANIM	443	450	352	292	1537
COLPLANT	424	464	305	335	1528
Total	**1163**	**1113**	**829**	**752**	**3857**

Source: *FUNAAB (2012)*

Measurement of variables

i. **Appraisal of online registration:** was measured at interval level using a 5 point rating scale of 10 items. Students' responses on ratings of Strongly Agree (SA), Agree (A), Strongly Disagree (SD), Disagree (D) and Undecided (U) were assigned the score of 5 to 1. Based on this, it implies that a respondent could obtain a maximum score of 50 (if all responses were SA) and minimum score of 10 (if all responses were U) to the 10 items on the scale.

ii. **Appraisal mean score:** based on the respondents' responses to the 10 items it implies that each of them could only obtain a maximum mean score of 5.0 and a minimum mean score of 1.0. Mean value of items that falls between 1.0 and 1.70 implies that the registration tool was appraised less valuable, between 1.71 and 3.40 implies that it was appraised to be averagely valuable and between 3.41 and 5.0 means that the tool was appraised highly valuable.

iii. **Index score for determination of the level of online registration appraisal:** was estimated by cross sectional ranking of the score obtained by each of the students against the obtainable score of 50. Thus, a score range of 10 to 27 implies that the registration tool is appraised as less valuable, between 28 and 35 signifies that the tool is appraised as averagely valuable and between 36 and 50 denotes that the eduportal registration tool is appraised as highly valuable.

iv. **Experience of eduportal usage:** this was measured at interval level using indicators such as forms or previous usage, frequency of usage and capacity for usage. Previous forms of usage was assigned the score of 1 for registration usage at secondary school level, 2 for registration usage at Colleges of Education or Polytechnic level, and 3 for registration usage at university level (FUNAAB). For frequency of usage, this was rated as once, twice, thrice and quartet over time or years. On capacity for usage, the score of 1, 2, and 3 were assigned the capacity for usage by the someone else (done for me), with the assistance of someone and by self (personally) respectively.

Validity and reliability of data gathering instrument

Validity: of the data gathering instrument was ascertained by the use of face and content validity. Based on the theoretical concept of validity and reliability by Babbie (2005), the face validity was done by ensuring that the study variables were accurately measured using indicators that actually reflect the concepts under consideration in this study. For instance, indicators such male and female are indicators reflecting sex as a variable, "form, frequency and capacity for eduportal

usage by the students" as indicators that reflects experience of eduportal usage for online registration; items such as "limits students-lecturers contacts for course registration" as one of the several items of indicators for measuring students' appraisal of the value of online registration of academic courses etc. The content validity on the other hand was done by development of a wide range of indicators or item statements that adequately capture the study concepts thereby ensuring that each of the study concepts was comprehensively captured. The developed indicators or array of statements were based on extensive review of literature on similar studies. For instance about 10 statements were developed as a way to adequately or comprehensively reflect appraisal of the value of online registration in the study.

Reliability: to ascertain reliability of the data gathering instrument, a test-re-test method in which the instrument was administered on 20 students at interval of two weeks. The selected students for the conduct of the reliability test, were not part of the set of students that were eventually surveyed in the study, Correlate analysis of collected data for reliability test, using the Spearman rho analytical tool, showed that the items were significantly correlated to reflect a reliability of the data gathering instrument. For analysis of the item or rating scale component of the data gathering instrument, using the Pearson Product Moment Correlation (PPMC) analytical tool, reflects a correlate value of 0.73 based on which the rating scale was considered reliable. However, items that were cumbersome or less responded to were either eliminated or adjusted as a way to improve the quality of the instrument.

Data collection: Structured questionnaire was used to obtain information on the selected agricultural students' personal characteristics, their experiences on usage of eduportal for online educational registrations, attendant constraints to a hitch-free course registration exercise, and a self developed scale items, inferred from extensive literature review on online educational activities, was incorporated in the questionnaire as means of eliciting information on the students' appraisal of online registration of courses in FUNAAB.

Data analysis: Data obtained from the retrieved 325 questionnaires were subjected to descriptive statistics, using frequency count and percentage, and inferential statistics, using correlation matrix linear regression statistical tools. The descriptive statistics made it possible to have a clear presentation and discussion of responses of the respondents. The inferential statistics created the platform for cross-tabulation of measured variables such as the students' personal characteristic and their appraisal of online registration of academic courses; and between their experiences on usage of online registrations tool for academic course registration. Spearman rho correlation matrix became appropriate for hypothesis one on the ground that most of the students' personal characteristics were measured at nominal level, and linear regression was found appropriate for hypothesis two on the ground that students' appraisal and their experience, particularly frequency, of usage of online tool for registration of academic courses were measured at interval levels.

RESULTS AND DISCUSSION

Personal characteristic of the respondents

Table 2 shows that most of the surveyed agro-students were male (62.8%). This observation suggests that more male enrolled as agricultural students in FUNAAB than their female counterpart, (FUNAAB, 2013) and this may be due to the fact that agriculture is considered a masculine profession probably due to the rigours involved in agricultural activities, especially in a developing country like Nigeria. This finding goes in line with Adesope, Adebayo and Agumagu (2006) indication that the Nigerian agricultural organisations, namely the Agricultural Development Programme (extension agencies), Colleges of Agriculture, Agricultural Research

Institutes and University/Faculties of Agriculture; had more male workers than their female counterpart in Nigeria. These results thus imply that the Nigerian agricultural system is largely dominated by male agro-practitioners.

Examination of the agro-students' age shows that more than half (55.7%) of them were within the age range of 21 and 25 years, and this suggests that the enrolled agricultural students in FUNAAB were young and in their active years. This is similar to Raman (2011) findings, whereby most (65%) of the students surveyed on Information and Communication Technology (ICT) application in University of Utara, Malaysia were within the age range of 21 and 24. The results thus implies that the University (FUNAAB) is on the verge of turning out new generation of young and educated farmers with the potentials to transform Nigeria's agriculture through the application of the acquired knowledge of modern farming techniques in agricultural practise; and to replace the less educated and aging farmers that currently dominate the country's farm production system.

Table 2. *Personal characteristic of the respondents (n = 325)*

Variables	Frequency	Percentage
Sex		
Male	204	62.8
Female	121	37.2
Age		
< 20	34	10.5
21 – 25	181	55.7
26 – 30	92	28.3
> 31	18	5.5
Attended secondary school		
Public school	188	57.8
Private school	137	42.2
Educational background		
SSCE	233	71.7
OND/NCE	56	21.2
HND	93	7.1
Mode of admission		
Pre-degree	108	33.2
UTME	161	49.5
Direct entry	56	17.3
CGPA		
< 1.00	14	4.3
1.00 – 1.50 (Pass)	33	10.2
1.51 – 2.39 (Third Class)	47	14.5
2.40 – 3.49 (Second Class Lower Division)	125	38.4
3.50 – 4.49 (Second Class Upper Division))	86	26.4
> 4.50 (First Class)	20	6.2

Consideration of the agro-students' history of pre-university education shows that as much of 56.6% of the students attended public secondary schools; 67.3% of the students had the Senior Secondary Certificate Examination (SSCE) as their highest level of education; 18.9% had Ordinary National Diploma/National Certificate of Education (OND/NCE) and 13.8% of them had Higher National Diploma (HND) as additional educational status. Although, candidates with SSCE are admitted into 100 level (first year) and those with OND/NCE and HND admitted into 200 level (year two) and 300 level (year three) respectively, SSCE remains a pre-requisite for any candidate to be enrolled as a student in FUNAAB or any other university in Nigeria.

About 49.5% of agro-students were observed to have gained admission into FUNAAB through the Unified Tertiary Matriculation Examination (UTME) and a lesser proportion of them gained admission into the university through either pre-degree programme (35.1%) run by them University or direct entry (18.4%) administered by the nation's matriculation exanimation body known as Joint Admission and Matriculation Board (JAMB), in the country. This observation suggests that the strength of admission into FUNAAB for its agricultural programmes is in line with the Federal Government of Nigeria's policy on education that admission into the tertiary institutions in Nigeria should be through the UTME.

Given the obtainable maximum Cumulative Grade Point Average (CGPA) of 5.0 and minimum CGPA of 1.0 for any candidate to graduate from the university, examination of the agro-students' academic performance shows that about 38.2% of them were within the CPGA range of 2.40 – 3.49 and 26.4% of them were within the CGPA range of 3.50 – 4.49. With this observation, it suggests that most of the agro-students' academic performance was above average. This implies that the agro-students had good knowledge of the taught agricultural courses and as such could express gained acquired knowledge in written form to the satisfaction of their lecturers during examinations.

Agro-trainees' usage experience of online registration tool

With the emergence and integration of ICT in the Nigerian education system, students had become exposed to the use of electronic-based educational activities, at least from the secondary school. Although ICT such as computers, internet and television and video player are generally used as teaching and learning tools in some schools across the country, use of eduportal is largely for registration of examinations and processing of admission into the universities in the country. Examination of the agro-students' previous usage (experience) of the eduportal for online registration thus shows that as much as 68% of the students had used the eduportal for online registration of the Senior Secondary Certificate Examination (SSCE) – a unified or general examination written by all secondary school leaving students and organised by the two main examination bodies in the country, namely the West African Examination Council (WAEC) and National Examination Council Examination (NECO). The use of eduportal tool for registration of the unified examinations must have been induced by requirement of the two examination bodies that all eligible secondary school leaving students for both the May-June and November-December examinations have to register for the examinations online via their respective eduportals. While 87.1% of the students had their registration for admission into the university done online, all of them had their registration of courses done online in the university.

Assessment frequency of usage of the eduportal for online registration of courses or examinations by the agro-students (Table 3) shows that about 37.6% of them used the tool for at least a quartic-time over time or years; 23.7% used the online tool at least thrice over time or years; 21.8% of them used the tool at least twice over time or year and a few of them (16.9%) used the online tool at least once in time or year. Indication of once time usage of the online tool for educational registration by the students could be adduced to the fact that registration of courses in the university, and for a particular

pre-university examination, takes place once a year. Those who had more frequency of usage might have used the eduportal tool for registration of two or more unified secondary school examinations in a year and at the same time used the electronic tool for processing of their admissions within the same year. In addition to the students' pre-university usage experience of the online tool is the yearly usage of the tool for course registration at the beginning of every academic session in the university. Usage of online tool by students over time or years thus implies that they had either used the tool at least once in a year and over two or more years; or two or more times within a year, depending on the number of different pre-university examinations they registered for in a year or over the years; and on the number of university admissions they processed in one or more years.

On account of the agro-students' capacity for usage of the online tool for course registration in the university, the result shows that about a quarter (22.5%) of the students personally used the eduportal for successful completion of their course registration without the assistance of any other person. About 40.9% of the students on the other hand sort assistance of experienced personnel in order to scale over technical hitches they might experienced while operating the electronic system for course registration. As much as 36.6% of the students however lacked competence for use the online tool and as such handed over the course registration exercise to someone else to have it done for them. This finding suggests that the observed 22.5% of the agro-students were computer literate and information technology compliant and as such could readily make use of the registration tool successfully. The students' personal ability to use the eduportal tool for course registration without the assistance of any other person might have been influenced by their previous and frequency of usage tool either before gaining admission into the university or while in the university. The required assistance by certain set of students for successful use of the electronic tool for course registration is not necessarily because they were computer illiterate, but due to technical hitches in the process of online registration of their courses. With regard to the set of students who had the online registration of their courses done for them someone else, it could be inferred that such ones were computer illiterate and less information technology compliant.

Table 3. *Agricultural trainees' experience (previous usage) of on-line registration tool (n = 325)*

Variables	Frequency	Percentage
Previous form of eduportal usage		
WAEC/NECO examinations	221*	68.0
Higher institution Admission process	283	87.1
FUNAAB academic registration	325	100
Frequency of online registration usage		
Once over time/years	55	16.9
Twice over time/years	71	21.8
Thrice over time/years	77	23.7
Quartic over time/years	122	37.6
Capacity for registration execution		
Personally	73	22.5
With someone's assistance	133	40.9
Done for me	119	36.6

***** Multiple responses

Agro-students' appraisal of the value of online registration of academic courses in FUNAAB

In an attempt to ascertain the agro-students' appraisal of the value of the online registration of academic courses in FUNAAB, a 10 item scale was administered on them for their responses. Based on the students' obtained mean scores in relation to the obtainable mean score on each of the 10 item statements, the level of appraisal was established as less valuable (1.0 – 1.7), moderately valuable (1.8 – 3.4) and highly valuable (3.5 – 5.0). Result of the online appraisal by the agro-students, as indicated in Table 4, thus showed that they appraised the registration tool as of high value because of reducing, if not eliminated, the stress ($\bar{x}$ = 4.59; SD = 0.573) of having to go round individual lecturers for their signatures against the courses taught by them; and for making course registration easily done ($\bar{x}$ = 4.47; SD = 0.682). The ease of ICT application for educational activities, as opined by Adam, Nelson and Todd (1992); Ramayah and Osman (2005); Sime and Priestly (2005); Raman (2011), has a strong influence on users' willingness to use and sustain the usage of the online tool for educational registration purposes.

Table 4. *Agro-students' value appraisal of online registration of academic courses in FUNAAB (n = 325)*

Item statements for appraisal of eduportal	**Mean* Score**	**Standard deviation**
It eases course registration	4.47	0.682
Saves time wastages on registration	2.99	1.066
Checkmates over-registration of courses	3.11	1.319
It enhances clear identification of courses to be registered	3.85	1.090
Limits students-lecturers contacts for course registration	3.92	0.843
Reduces the stress often experienced in manual registration of courses	4.59	0.573
It helps to quickly detect left out/outstanding course(s) that out to be registered for	3.87	1.034
Assured students the qualification to write examination on registered courses	4.06	0.992
Reduces paper/manual registration of courses	2.87	1.184
Establishes students' course data-base throughout duration of the academic programme	4.03	0.993
Pooled appraisal score**	**Freq**	**%**
10 – 23 (Less valuable)	9	2.8
24 – 36 (averagely valuable)	78	24.0
37 – 50 (Highly valuable)	238	73.2
Mean of pooled score	37.78	
Standard deviation	4.28	

* Mean score of 1.0 – 1.7 implies less valuable, 1.8 – 3.4 as averagely valuable and 3.5 – 5.0 as highly valuable

** Index score of 10 – 23 implies less valuable, 24 – 36 averagely valuable and 37 – 50 as highly valuable

Although the agro-students no longer have to manually fill course (paper) forms, usually in quadruple, they certainly have to print out the online-registered courses for their individual and departmental records. This probably accounted for their appraisal of the online registration as of

average value ($\bar{x}$ = 2.87; SD = 1.184) as the tool does not completely eliminate the paper work. In the same vein, the electronic registration tool was adjudged to be of average value with regards to saving of time wastage ($\bar{x}$ = 2.99; SD = 1.066) in comparison with manual registration of academic courses. This observation goes in line with Miah and Omar (2011) findings that online registration of courses takes lesser time to accomplish than having to contact lectures for paper-based course registration.

Cumulative assessment of the agro-students' appraisal of the value of the online tool for academic course registration in FUNAAB shows that as much as 73.2% of the students appraised the registration tool to be of high value (37 – 50; $\bar{x}$ =37.78) thereby suggesting that the initiated online registration exercise by the university is a welcome idea among the agro-students. This cannot be unconnected with the fact that the online tool enhances the students' registration of their academic courses in an efficient and convenient manner. This observation goes in line with Al-Ahmad (2010) findings that as much as 98.8% of the surveyed students on ICT application in educational activities adjudged the electronic tool as veritable technology for effective management of academic records.

Constraints to hitch-free online registration of courses by the agro-students in FUNAAB

Table 5 shows the constraining factors to a hitch-free online registration of academic courses by FUNAAB agro-students. About 94.8% of the students considered inadequate computer systems as constraints to smooth running of the online registration of academic courses as each of them had to take turns for registration of their courses. This situation, coupled with inadequate supporting staff to attend to the students (75.1%) and the given duration for all students to have their courses registered, which they considered insufficient time period (77.5%), cost the students a great deal of effort and patience to eventually have their courses registered.

Table 5. *Constraints to hitch-free online registration of academic courses by FUNAAB agro-students (n = 325)*

Variables	Frequency	Percentage
Poor knowledge of computer usage	130	40.0
Inadequate computer system to serve the students	308	94.8
Inadequate supporting staff to attend to students for course registration	244	75.1
None provision of training for students on the use of eduportal for course registration	235	72.4
Need to shuttle between lecture hours and time for course registration	238	73.3
Slowness of the university's internet server	221	68.1
Insufficient allocated period of time for course registration	252	77.5
Unfriendliness computer centre's staff to the student during course registration	207	63.8
Epileptic power supply	280	86.2

The need for the students to skip lectures or shuttle between lecture hours and course registration centre (73.3%), and lack of training for them on the use of eduportal for course registration (72.4%) were considered constraints to smooth online registration of courses by the students. This observation, particularly the none provision of training on usage of the online registration tool, could have accounted for why most (36.6%) of the students could not personally

use the online tool for their course registration and 40.9% of them had to seek the assistance of a knowledgeable person for successful completion of their course registration (Table 3).

Alongside the problem of none provision of training that warranted assistance for the students on the use of online tool for course registration was poor knowledge of computer operation by 40% of the students. Provision of little or no training for students on the use of online tool for academic purpose was equally observed by Miah and Omar (2011) among 70% of the students of Southern University at New Orleans' (SUNO). With these observations, it could be inferred that the students were probably not expected by the university management to personally operate the eduportal for registration of their courses but to have it done for them by the ICTREC staff. But unfortunately the staffs on ground, as observed in FUNAAB, were not enough to adequately accommodate the large population of students turning up at the electronic resource centre (ICTREC) for the course registration exercise thereby making the registration exercise to take longer period of time to have all the students' course registration completed.

Other factors found to have constrained the smooth running of the online registration tool, as highlighted by the students, were epileptic power supply (86.2%) and slowness of the internet server (68.1%). These factors, which were generally beyond the control of the students and ICTREC staff, made the course registration to stop temporarily until power supply becomes restored or the server becomes faster for use. Temporary stoppage of the course registration thus constitutes additional reason for the prolong period it takes all the agro-students to have their course registration done and completed in the university.

Spearman's rho correlation matrix of the relationship between the agro-trainees' personal characteristics and their value appraisal of online registration of academic courses

Spearman rho correlation analysis of the relationship between the agro-students' personal characteristics and their appraisal of the value of the online registration of academic courses (Table 6) shows a significant and positive relationship ($r = 0.155$, $P < 0.01$) between the students' Cumulative Grade Point Average (CGPA) and their appraisal of the online tool as valuable for making course registration easy to complete (EASEREG). Based on this, it was inferred that students' with higher CGPA or better academic performance values the deployment of the online tool for registration of academic courses; and this may have been influenced by their developed competence for computer operation and usage of the online registration tool. As opine by Lawal-Adebowale and Omotayo, (2012), effective use of the electronic tool requires a good understanding of its functionalities and utilities.

The observed significant and positive relationship ($r = 0.128$, $p < 0.05$) between the agro-students' educational background (EDUBACK) and clear identification of courses to be registered for (COURSEID) suggests that previous usage of the online registration by the students during the SSCE examination and admission into College of Education or Polytechnics accounted for their ability to use the online tool to sort courses from the database and have them registered as expected at beginning of the academic session. In essence, the students were able to use the acquired knowledge of eduportal usage for subjects and course registration at the pre-university education system – secondary school, College of Education and Polytechnics – to intuitively use the university-based eduportal for successful registration of their courses

Similarly, a significant and positive relationship ($r = 0.127$; $p < 0.05$) was observed between the agro-students' mode of entry (MODEENTRY) into FUNAAB and their appraisal of the online registration as valuable for limiting contact with course lectures (LIMITCONTACT). This observation implies that irrespective of the agro-students' mode of entry into FUNAAB, all appreciated the value of having their course registration done online without having to contact

individual lecturers for course registration. By implication, this saves the students the time and rigours of going round the individual lecturers to have their registered courses signed.

Table 6. *Spearman's rho correlation matrix of the relationship between the agro-trainees' personal characteristics and their value appraisal of online registration of academic courses*

Variables	AGE	SEX	SECSCH	EDU-BACK	MODE ETNRY	CPGA
EASEREG	.033	-.021	-.046	-.028	-.036	.155**
	.555	.703	.411	.620	.515	.005
SAVETIME	.001	-.048	-.011	.002	.026	-.011
	.990	.386	.839	.973	.636	.839
CHECKMATE	.037	.012	.051	.036	-.040	-.074
	.506	.827	.356	.523	.470	.182
COURSEID	-.048	-.011	.006	.128*	-.005	.075
	.390	.846	.913	.021	.931	.180
LIMITCONTACT	-.017	-.080	-.018	.080	.127*	-.041
	.758	.149	.741	.149	.022	.466
REDUCESTRESS	-.058	.025	.050	.020	.003	.005
	.296	.648	.368	.719	.956	.923
DETECT	-.023	-.039	.020	-.017	.036	-.105
	.680	.487	.722	.760	.517	.059
EXAM QUAL	.008	.016	-.078	.058	.034	-.065
	.890	.775	.158	.294	.545	.243
PAPERWRK	-.054	-.024	.043	-.077	-.065	-.028
	.334	.666	.435	.163	.240	.610
DATABASE	.056	.006	.024	-.029	.059	-.034
	.315	.915	.672	.604	.287	.542

** Significant at p < 0.01level
* Significant at p < 0.05level

In view of the observed significant relationship between certain personal characteristics of the agro-students and their appraisal of the value of the online tool for course registration in FUNAAB, the stated hypothesis that there is no significant relationship between the agro-students' personal characteristic and their appraisal of on-line registration of academic courses was thus rejected. In essence, it implies that personal characteristics such as educational background and good academic performance are associated with appraisal of innovations or technology as either of value or not.

Linear regression analysis of the determinants agro-trainees' appraisal of the online registration of academic courses

Linear regression analysis of the relationship between the agro-students' appraisal of online registration of academic courses and their experience of eduportal usage, as indicated in Table 7, shows that the appraisal was significantly influenced by the students' frequency of eduportal usage ($\beta = 2.185$, $t = 6.640$) at $p < 0.01$. These observations suggest that appraisal of the online tool as valuable for registration of academic courses by the students was influenced by their past exposure to eduportals and frequency of usage for educational related registration purposes. The exposure and experience of usage certainly began from their secondary school education when they had to register for unified or leaving certificate examinations (SSCE) under WAEC and NECO. In addition to this was the use of universities-based eduportals for processing of admission into their choice universities. The experience of eduportal usage is thus an aggregation of the students' series of usage the eduportal tools over time, beginning from usage for examination registration at secondary school level, through the usage for processing of admission into the universities, to continuous usage for online registration of courses in FUNAAB.

With this outcome, the stated hypothesis that agro-students' appraisal of the online registration tool is independent of their experience of usage of the tool for registration of pre-varsity examinations was rejected. In essence, it implies that acquired experiences on eduportal usage over time makes possible for the users to adjudge whether or not it is of value in relation to the kind of educational tasks it is used for. In line with this submission was Murphy and Karasek's (1999); Murphy (2002), position that acquired experiences on usage of certain tool or practice enhances one's better understanding of the practice and ability to effectively utilise the tool. In the light of this, experience or frequency of eduportal usage by the agro-students thus constitutes an explanatory variable of their appraisal of the online registration tool as of value.

Table 7. ***Linear regression of analysis of the determinants agro-trainees' appraisal of the online registration of academic courses***

	Unstandardized Coefficients		Standardized Coefficients		
Model	**β**	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	26.464	1.939		13.647	0.000
Forms of eduportal usage	-0.178	0.242	-0.042	-0.797	0.426
Frequency of eduportal usage for registration	2.185	0.329	0.348	6.640	0.000*
Capacity for registration execution	-0.119	0.296	-0.021	-0.402	0.688
Secondary school attended	0.632	0.460	0.073	1.373	0.171
Educational background	0.505	0.375	0.072	1.348	0.179

*Significant at $p<0.01$

CONCLUSIONS AND RECOMMENDATIONS

In view of analysis of the study data, it could be concluded that online registration of academic courses in FUNAAB is a worthwhile development as it was appraised to be of highly value by the agro-students basically because for making their course registration easier; eliminating or reducing associated stress with the manual registration of courses; giving the assurance of writing examinations on registered courses and creation of registered course database. The agro-

students' appraisal of the online registration of courses as highly valuable was however associated with certain personal characteristic of the students, namely heir academic performance/cumulative grade point and mode of entry into the university, thereby necessitating rejection of the first hypothesis that there is no significant relationship between the students' personal characteristics and their appraisal of the online registration tool. Similarly, the second hypothesis that agro-students' appraisal of the online registration tool is independent of their experience of usage of the tool for registration of pre-varsity examinations was rejected on the ground that frequency of eduportal usage for registration of examinations/courses by the agro-students was significantly related to their appraisal of the online registration of academic courses as a valuable tool. Effective use of the online tool for course registration was however constrained by factors such as lack of training for agro-students on usage of the online tool for course registration, inadequate computer systems for use by the students, inadequate supporting staff for the students and epileptic power supply. Based on these observations, the following recommendations were thus proposed.

i. The online registration of academic course in FUNAAB should be sustained and improved upon for quality and efficient services
ii. The students should be provided training on the use of the online registration for development competence for self application
iii. Given the population of students going online for registration of courses at a time in the university, there should be adequate supporting or technical staff to attend to the students during course registration
iv. In view of the poor electricity supply in the country, a steady alternative power supply should be put in place by the university for powering of the Internet especially during the period of course registration by the students

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Creation of audiovisual presentations as a tool to develop key competences in secondary-school students. A case study in science class.

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ABSTRACT

New curricular plans based on key competences create the need for new educational proposals that allow their development. This article describes a proposal to develop key competences through project-based learning. The project's objective is the creation of a digital video. The following study was carried out with students in their final two years of non-mandatory secondary-school, in the subject of "Physics and Chemistry". The students created didactic documentary videos describing different aspects of kinematics. The planning of the project focused on to involve the students in all steps of the process, in order to be able to evaluate the competences developed during each part of the project. The results showed an important improvement in both the digital and science competences. It was also shown that the necessary stages to create an audiovisual presentation involve the use of the competences related to communication, personal initiative or learning to learn; this provides an opportunity for the student to develop said capacities.

Keywords*: Key competences, project-based learning, didactic video, non-obligatory secondary-schooling, kinematics.*

INTRODUCTION

At the end of the twentieth century, the Organization for Economic Co-operation and Development (OECD) proposed a system to evaluate students in their last years of secondary education. This system was a tool that verified the abilities and knowledge that the students had acquired necessary for integration and participation in modern society (PISA 2000). At first the tests were done in the areas of mathematics, reading and problem solving; however, it was soon seen that these tests should be extended to other fields, introducing a wider range of competences. In this way the project for Definition and Selection of competences was created, establishing the concept of key competence and its areas of applicability of the following years (DeSeCo 2005:4). According to the OEDC, a key competence is defined as:

> *A competency is more than just knowledge and skills. It involves the ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular context*

From an educational standpoint this was an important innovation, as its application to school curricula enabled a change from traditional, closed bodies of knowledge to a more cross-curricular perspective (Rouvrais et al. 2006).

Competences in Spain

Initially, the OECD defined nine key competences divided into three categories: Use tools interactively, Interact in heterogeneous groups and Act autonomously (DeSeCo 2005). Using these as the starting point, the European Union defined a series of key competences (EU 2006) that cover all areas of knowledge and were adopted by member states. The following table shows

the correlation between European key competences and their adaptation in Spain, the latter under the name of basic competences (MEC 2006).

Table 1. *Comparison of European key competences and their adaptation in Spain (basic competences).*

European Union (key competences)	Spain (basic competences)
Communication in the mother tongue	Competence in linguistic communication (LC)
Communication in foreign languages	
Mathematic competence and basic competences in science and technology	Mathematic competence (M)
	Competence in knowledge of and interaction with the physical world (KIPW)
Digital competence	Information processing and digital competence (IPD)
Learning to learn	Learning to learn (LL)
Social and civic competences	Social and civic competence (SC)
Sense of initiative and entrepreneurship	Autonomy and personal initiative (API)
Cultural awareness and expression	Cultural and artistic competence (CA)

In Spain, the curricula developed incorporated competences in the case of mandatory education (BOE 2006a; BOE 2006b). They were also included in the university education reforms brought about by the European Higher Education Area (MEC 2003; Riesco 2008). There is however an intermediate stage spanning ages 16-18 called Bachillerato (the final two years of secondary school, non-mandatory, prior to university), in which the competences are not taken into account as an element of the curricula and instead are mentioned in passing, as in article 2 of RD (Spanish law) 1476/2007 (BOE 2007): “The finality of Bachillerato is to provide students with an educational grounding, intellectual and human maturity, knowledge and abilities that will allow them to develop social functions and to join adult society with responsibility and competence.”

This means that the competences do not appear in the curricular development of the final two years of secondary school, at least explicitly. This seems incoherent, taking into account that the educational stages prior to and following the non-mandatory stage do have competence-based curricula. The objectives of Bachillerato pursue the best possible preparation of the student for their future navigation in society (BOE 2007), which appears to coincide with the objectives established for mandatory education; we consider, then, that it is viable to approach learning during Bachillerato using the same competences (UE 2006; González 2012).

In this sense, this study outlines a proposal of project-based learning, which looks for work on and improves of key competences by non-mandatory secondary students in scientific-technological studies. We believe that it will be seen that the applied methodology is easily extendable to other areas of study.

Project-based Learning

Project-based learning consists of student-developed research on topics of interest to students; this research forms the core that the elements of the teaching-learning process are linked to. This means, as stated from the beginning of this learning, that the students must choose the topic and play the leading role in their own learning process (Katz & Chard 1989). This guides their interest and motivation towards the object of study and simplifies the student's learning process (Tatar & Oktay 2011). In addition to this, Aurora Lacueva (1998) considers that an educational project

belongs to this category if it has duration of three to four weeks and a high degree of participation of the students at every stage of the process.

Students' involvement in building their own knowledge (Bell 2010) must be particularized to the choice of topic, approach to be used, structure of group work, attainment of results, writing of conclusions and communicating the project. This teaching strategy therefore promotes the communication, negotiation and collaboration abilities necessary to share the different ideas that evolve during the process. These characteristics are shared by Thomas (2000), who adds that the project should be the principal educational strategy, structured by directed questions, promoting the construction of knowledge and be realistic. In this way, students can develop the capacity to think up hypotheses and solve problems through projects related to their local environment (Pewnim et al. 2011).

In addition, it seems that technology is an ideal tool for this type of teaching, as its use in project-based learning creates a link to real-world situations, making the students take part in various actions that lead to the cooperation (Reeves 1999; Ringstaff & Kelley 2002; Gu, Zhu & Guo 2013; McCarroll & Curran 2013). Furthemore, ICT favors creativity and reflection on importance of making decisions (Ezquerra, Iturrioz & Díaz Pérez 2012).

As for curricular content, they obtain new knowledge that derives from their own research and exploration (ChanLin 2008). In short, it seems that the fulfillment of a school research project as the core of a teaching strategy can have a positive impact on multiple dimensions of learning.

In this sense, actions derived from the use of new technologies in science teaching allow different abilities to be worked on, such as gathering and analyzing data, backing up hypotheses and research, facilitating the building and communicating of knowledge, promoting students' independence, improving their productivity or confronting difficulties successfully (Ruthven, Hennessy & Brindley 2004; Hennesy 2006). For all these reasons the combination of these tools with project-based learning emerges as a natural and effective option, connecting curricular content and the way today's students interact with their environment. This fact has been taken into account by an increasing number of teachers who have decided to add technological tools to their assignments (Ramírez et al. 2011).

We must differentiate these methodologies from the numerous activities that aspire to the category of project-based learning but allow students little or no power of decision or initiative, e.g.: homework assignments to search for information without its analysis or laboratory experiments that consist in following instructions.

Audiovisual media

A very important part of our social interaction and much of what we learn is presented in audiovisual form (Ezquerra 2003; Aguaded 2005), which makes it fundamental to promote the handling audiovisual of media at an academic level (Senado 2003, Tan & Towndrow 2009; Masats & Dooly 2011). The most common use of audiovisual media in schools is the viewing of movies, documentaries or TV series by students, followed by their critical commentary (Perales-Palacios & Vilches-González 2005; García 2011).

In addition to these, the existence of websites such as YouTube, understood as an environment for visual learning, the search, selection and application of audiovisual media in the classroom have become far easier. This tool permits users to share and see documentaries, making possible a more cooperative, participative and interactive learning. This resource is widely used among students, who often spontaneously search there for complementary study materials. We find that teachers have an excellent opportunity to help them participate in a critical selection of

said content (Mitra et al. 2010; García-Barriocanal et al. 2011). With this tool one brings science closer to students' day-to-day life integrating it into their usual way of obtaining information. Another advantage is that visual media can show real scientific concepts that are difficult to access via other types of communication, which can help students develop alternative conceptions.

Another, much less common, option is to film and create digital videos (Ezquerra & Polo 2011). This can be done either by the teacher (Ezquerra 2010; Koscianski, Ribeiro & Da Silva 2012), who later shows the results to the students, or the students themselves can make the videos, giving rise to a much more interesting and enriching project (Torres, 2009; Piliouras, Siakas, Seroglou 2011; Harness & Drossman 2011). In this article we will show an educational proposal based on the methodology of project-based learning where the guideline is the creation of audiovisual documents by students.

RESEARCH DESIGN

Using the characteristics of participating students, we designed a sequence of actions - educational proposal- to analyze how the students created a documentary video (Manso & Ezquerra 2014). The objective was to evaluate how this process enables students to collaborate, acquire key competences, work on school science topics and develop audiovisual abilities. We focused on Information processing and digital competence and Competence in knowledge of and interaction with the physical world. The search was stated as qualitative study using interviews.

Study sample

The study took place at a secondary school in a town in the south of the autonomous community of Madrid and one of the authors was the teacher of the group and he led the entire process. The socioeconomic environment is lower middle- to middle-class. 35% of the inhabitants are immigrants. Our sample consists of whole classroom, 12 students (5 boys and 7 girls) in non-mandatory, university access secondary education, aged 16 and 17.

The students were divided into three groups of four students, each group creating a video. The generic topic assigned was the same for all groups: kinematics, but the specific topic was chosen by each group. The remaining aspects of the video were developed freely by the students.

Steps of our educational proposal

The proposal to be described in the following schematic was designed with the aforementioned intention of involving the students in the entire creation process, as well as the evaluation of the student's academic progress:

1. Initial evaluation of audiovisual and scientific knowledge possessed by the students. We designed a specific questionnaire for each topic.
2. Two sessions to explain the use of the proposed video editing program.
3. Formation of work groups and selection of kinematic topic to be developed: horizontal projectile motion, parabolic projectile motion and uniform circular motion.
4. Information search and rough draft (this initial document including a first summary based on the information search). Our interview focused on how the students did it.
5. Script generation (adaptation of the initial text to audiovisual requirements). The script had to detail the sequences planned for filming. Afterwards, we analyzed how the students did it.

6. Filming of sequences planned in technical script (document including all information necessary to film scenes). Coordination of cameras, sets, costumes, actors...The students were asked about the way they did it.
7. Edition and production of final video with help of initial tutorial.
8. Final evaluation of audiovisual and scientific learning by students. We repeated the initial evaluation with some minor adaptations.

RESULTS AND DISCUSSION

In the following we describe the analysis carried out on the described educational process. The focus of the analysis is to compare the results with the specific abilities worked on and their associated competences.

Initial evaluation

In order to check students' evolution it is key to know what prior knowledge the students possess in relation to audiovisual abilities and the scientific topic to be worked on. So, we asked students about their audiovisual capacities and scientific knowledge as follows:

***Table 2**. Some of the questions used*

Audiovisual capacities	Scientific knowledge
Which subjects have your teachers used audiovisual documents in?	Give an example of uniform linear motion
What kind of audiovisual documents?	What do you understand composite motion to be?
How have your teachers used audiovisual documents?	What do you know about parabolic projectile motion?
Have you ever filmed with a videocamera?	Do you think that horizontal projectile motion is usual in your day-to-day life?

Audiovisual knowledge

First, we focus on the use of audiovisual media for academic purposes, and on the other hand, on personal use.

The result for academic use of audiovisual media indicates that the students had never previously made didactic videos and that the use of audiovisual media in their classrooms had been limited to viewing commercial films. But, we observed a much higher level of personal use of audiovisual media. The actions that the students repeated most often were viewing and copying videos from YouTube to their computers. On the other hand, a high number of participants said they have never or seldom partaken in actions related to the creation of audiovisual media, such as editing their own videos, creating a script or directing a short film.

Furthermore, we saw that the students who participated in this project had used technological resources to search for information and, to a certain extent, to manage it (identify, compare, judge, order hierarchically, select and save). These results show abilities related to the Information Processing and Digital Competence (IPD). However, they neither generated new

information nor communicated their knowledge through this medium. I. e., the students have not yet developed or used this double function, to transmit and generate, as well as receive, information and knowledge, necessary to be truly digitally competent.

Knowledge on the scientific topic

To evaluate the students' previous knowledge on the topic to be treated in the video, the following questions were asked:

- *Give an example of one of the following motions: uniform linear motion, uniformly accelerated linear motion, horizontal projectile motion, parabolic projectile motion, uniform circular motion and uniformly accelerated circular motion*

The examples given by the students show some understanding in the case of linear and circular motion, uniform (*walking, or a big wheel respectively*) as well as accelerated (*starting to run or driving curvy road respectively*). however, composite motions caused some confusion, which is a logical result taking into account that this topic had not yet been covered in the classroom. For example, they identified parabolic projectile with javelin or basketball throw, but they confused horizontal projectile with linear motion.

- *What do you understand composite motion to be?*

The analysis of the students' answers allows these to be split into three groups:

a) Those that state that it can be divided into two parts, uniform linear motion and uniformly accelerated linear motion.

b) Those who state it can be separated into its components.

c) Those who state that it is a motion in which there are different magnitudes.

Option a) was chosen by 41.6% of students, b) by 25% and c) by 16.7%. 16.7% did not answer the question. As a) and b) are correct but incomplete, as a first estimate we can say that students' ideas on this subject indicate that it is a familiar topic.

On the other hand, students were asked for examples on these topics drawn from their day-to-day lives. Results show students were more familiar with linear motion, both accelerated and not, and somewhat confused about projectile motion. In general we detected that kinematics were not present in our students' daily lives.

We analyzed the results of the questionnaire with the students. This type of discussion develops the competence in knowledge of and interaction with the physical world (KIPW). We were also able to observe, to a certain degree, the interpretation and application of their knowledge.

It should be pointed out that during the interactions with the students it became clear that they had never been the protagonists of their education; they had never been asked for their opinion on what they should study, why and how it should be studied. Our impression is that they had never received a satisfactory answer to the question “what is this good for?” We perceived a clear change in their attitude when exposed to a proposal of this type, which they can select the topic.

Information search and rough draft

During the first part of the creation of the audiovisual document, the different groups searched for the necessary information on the Internet, making use of different websites. They consulted didactic material from the [Spanish] Ministry of Education's program, Descartes, as well as the

content from the websites of different secondary schools and other websites dedicated to teaching secondary-school science. However, they did not use any textbooks.

The initial text by all three groups shared similar characteristics. All the information found and used was highly relevant to the task, as each type of motion was adequately described. The theoretical explanations given by all groups included the equations of motion, characteristic parameters and illustrating examples. These actions were done entirely and spontaneous by students. Let us indicate that these actions are close to traditional classwork.

Throughout the entire process, the teacher gave feedback to the source of information and the academic level of the information. He tried to take into account what information would be relevant to elaborate the video. For instance, the teacher proposed not to use excessive mathematical expressions, as the as the audiovisual format is not suitable to reading.

In this first stage of creating the video, the different actions undertaken by the students require capacities related to certain competences, among them the IPD and the KIPW. The former is necessary for the bibliographic search, using different strategies to access, decipher and select information, and the latter for the students to be able to use the information. In addition to these, an indirect use of two further competences takes place: linguistic communication (LC) and learning to learn (LL), although we did not go deeply into this aspect.

Specifically, information treatment requires comprehensive reading and coherent writing skills in order to communicate the information one has found. It seems reasonable to think that learning to learn skills are employed insofar as students must reflect on the state of their knowledge on the assigned topic and develop a strategy as to what information was necessary, how to search for it and what learning objectives the project entailed.

Script

The scripts created by the three groups follow the information detailed in the initial text closely. In all three cases the final result, defined as the technical script, have the correct structure and include all the information necessary to film the planned sequences.

The scripts created by the three groups closely follow the information detailed in the initial text. In all three cases, the final result had a correct structure and included all the information necessary to film the planned sequences. Despite this, the teacher had to give a lot of indications. Specially, it was necessary to underline the importance of images, that is, that the students must avoid letting words and text dominate over the images (Mathewson 2005). Initially, the students only took the dialogue into account.

This phase is extremely important, as at this point the information must be adapted to audiovisual requirements. The necessary actions involve the interaction with the physical world and linguistic competences. The students had to analyze and transform the information in order to use it in an unfamiliar context. But, step by step the images began appearing in the script spontaneously: trajectory, the parabola, the velocity vector…

In addition, they had to create a dialogue for the video, adapting the initial text from a more narrative structure to a more dynamic and interactive medium. This task of approximating real speech is a notable factor in all audiovisual creation process (Feldman 1990; Pérez Tornero 1994). However, this action seemed obvious to the students. That is to say, the students took this aspect of the project upon themselves and did not view it as “pointless schoolwork”. As soon they chose the topic, students had good ideas for their videos. For instance, the parabolic projectile group knew that playing football would be a suitable example of this kind of motion.

Filming

Each group filmed their own images and they did 3 or 4 sequences. The filming took place daily in one-hour sessions and they used 4-5 days to complete the filming. The students did both theoretical demonstrations and experiments on their topic.

A high level of organization was observed within each group, in which each member fulfilled a different role (camera, directing, acting, etc.). During the filming process the students had to handle videocameras and choose which scenes to use and how best to present the relevant information. All three groups used high-resolution videocameras (720p or even 1080p), which was slightly problematic when it came to edition.

During this stage the students work involves the following competences: KIPW, IPD and LL. We would also like to show, as a sign of the students' implication, the efforts they made with the props to stage their small production. We must also take into account other dimensions of the project; these were group projects, which seem to indicate that the students may work using the social and civic competence (SC), as well as the autonomy and personal initiative competence (API). This is because the group members discussed the different ideas they proposed; it seems reasonable to think that they made use of social skills to relate to each other, cooperate, work as a team and make decisions.

Edition and final video

Given that cameras generate videos with mp4, mov, mts or avi formats, some of which are incompatible with the video editor we used, the clips had to be converted to a lower quality format that was compatible (wmv) and they needed to help with this task. Specifically, the teacher indicated that there are several converter video programs, and he had to show and explain how these programs work. However, students were able to look for a converter program and run it, later. So despite that, initially, the students showed doubts, finally they seemed to handle these undertakings successfully. We think, from their comments, they put their previous ability to use videos into practice. We must remember that young people often seek, find, download and interchange YouTube videos (European Commission 2008; Nielson 2010:58). And, these actions require the selection of a specific audiovisual format, so we think this gave the students previous practice/experience.

The exposition of each group's topic presents a similar structure, in which an explanation of the topic is narrated. To this end, the students show fragments of a classroom exposé using a blackboard, mounting sequences filmed outside the classroom in between classroom shots. At the end of the videos they included outtakes, which show that this type of project can be fun and creative without losing its didactic nature.

The analysis of the videos shows they are highly related to the proposed technical scripts. We can assume that the organization of the concepts they wished to transmit and the filming of sequences followed the order the students initially proposed. In general terms, the videos are mainly based on sequence shot presentation, i.e., uncut sequences, of the typical characteristics of each type of motion, and solving theoretical problems with relation to the topic at hand. For example, one of the groups (parabolic projectile motion) used a sequence in which a ball was kicked to solve a problem they had proposed: finding the initial velocity with which it was put in motion.

During this final stage, the students' work is related fundamentally to competence IPD, and both LC and API competences may also be involved. The mounting of the filmed sequences requires managing audiovisual information, searching for clear and effective communication. This implies

generating a product coherent with audiovisual standards. In addition, they had to face using video edition software, many of them for the first time.
Finally, this last phase is the corollary to a complex project, which implies fixing concrete knowledge out of initially diffuse information. This requires making decisions, responsibility, critical thinking and teamwork. It is necessary to develop flexibility towards others' ideas and motivates personal initiative, interpersonal relations and the capacity to improvise (Collazos & Mendoza 2006).

Final evaluation

The evaluations described in the following have the object of contrasting knowledge on the scientific topic and audiovisual knowledge gleaned thanks to the process of audiovisual creation.

Knowledge on the scientific topic

Students' knowledge on the topic was evaluated by asking questions similar to those asked at the beginning. The answers obtained at this point of our study were more adequate than those given at the start. Furthermore, the students carried out a self-evaluation of their degree of knowledge of the types of motion. They said they had improved their notions about the different motions after finishing the video and we also observed an increase in the students' perception of these types of motion. Clearly the sample size is too small to generalize our results. Had that been our goal, in addition to a larger population to study, an analysis of what other elements had influenced the learning process would have been necessary.

In order to study the process of project-based learning, the students were asked to compare this type of project with those that they usually did (written papers, directed laboratory experiments, etc.) The aspects to be contrasted were: hours dedicated, effort, collaboration within the group, originality of the process, motivation to carry it out, usefulness for learning concepts and knowledge acquired. The answers received allow project-based learning as a type of work requiring more hours and effort, but comes across as original, motivating and useful when it comes to acquiring knowledge and favoring teamwork.

Audiovisual knowledge

In order to evaluate acquired audiovisual knowledge we used different types of analysis. We repeated the initial questionnaire that posed questions relative to the students' audiovisual abilities. We studied and categorized the specific actions that had been carried out and did multiple interviews to get a better understanding of this aspect.

The results of the interviews indicate the students' self-evaluation of their capacity to do certain acts. The data show that the students feel capable for the most part to do almost all of the things necessary to create an audiovisual document. Specifically, a high number of students stated not having any difficulty obtaining audiovisual material or with its edition. A large majority of the students stated they felt capable of making an audiovisual document with their own resources (their camera, computer, etc.), while only two students gave negative answers. Of those who answered affirmatively, the majority considered that they could perform part of the process (only script and filming) or the complete process (including edition) if the work were done in a group. However, a considerable percentage, one out of four, does not feel capable of converting videos to different formats. But, when we asked the students which actions they found more complicated, they said that they found the initial text more difficult. They argue that in order to create the literary text they started from zero, whereas the technical script is made by re-elaborating the literary text. Summarizing, after finishing the project, more than half of students

felt capable of carrying out a similar project the following year, whereas less than half either responded negatively or did not answer.

On the other hand, we grouped the data in order to contrast the initial and final audiovisual skills. We used the initial audiovisual questionnaire to make a graphic of initial evaluation (Figure 1a: initial evaluation). Here we can see that the students stated that the actions repeated most often were viewing of videos and copying of videos from YouTube to their computers. Moreover, a high number of participants (>80%) said they have never or seldom partaken in actions related to the creation of audiovisual media, such as editing their own videos, creating a script or directing a short film.

This graphic contrasts with the final evaluation (Figure 1b: final evaluation). You can see that our results indicate that after having completed the project, the students feel they are capable of performing actions which they previously did not believe themselves capable of. So, if we compare these initial results with the final evaluation, we can see that the majority of the answers have risen all across the table, markedly so in the columns on the right. That is to say, the students feel that their capacity to handle the different steps of the process of audiovisual creation has increased. This in particular is true for creating a script and video editing, the answers to which have passed in their majority from one extreme to other, i.e., from never (initial questionnaire) to somewhat (final questionnaire). Moreover, students actually made their videos, so that, they really increased their ability and their perception.

We also observed that they had passed from a heterogeneous distribution of abilities to a fairly homogeneous one (see Figure 1).

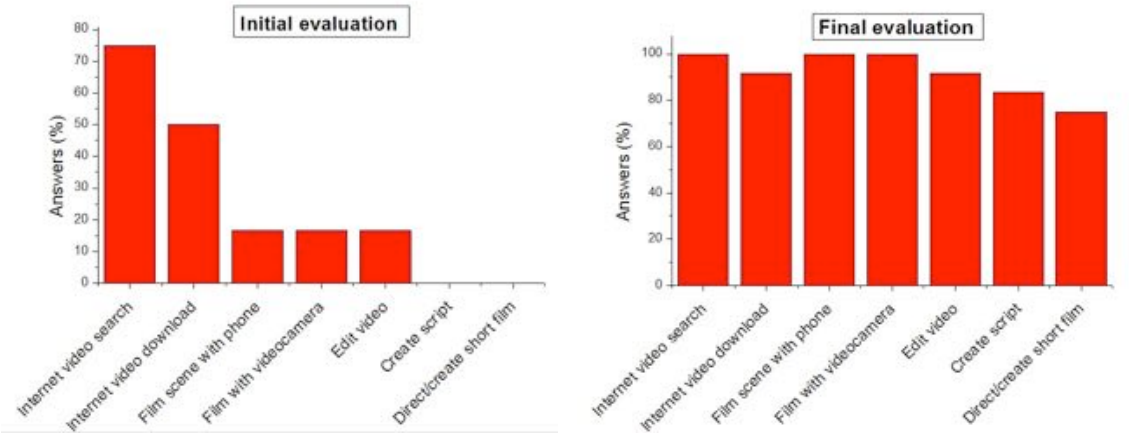

Figure. 1. *Students' self-evaluation of their audiovisual capacities, before and after making the video.*

CONCLUSIONS

Many individual studies report gains from cooperative learning in science compared to traditional instruction (e.g., Acar & Tarhan 2008; Balfakih 2003; Chang & Mao 1999). However, other studies failed to find gains (e.g., Topping et al. 2011; Hanze & Berger 2007; Faro & Swan 2006). But, not all these studies espoused the same construction of cooperative learning. Provided the evidence that structured cooperative groups work better than unstructured groups (Webb et al.

1998; Lumpe & Staver 1995), we believe that design of educational proposal in project-based learning is an essential factor and this tend to improve different capacities implicit in key competences. In this sense, we have a very structured approach to creating videos. We hope that this scheme can serve other teachers. Also, we think that this structure can serve other teachers to assess how to develop video creation, if they decided to use this method in their classroom.

Moreover, in this study, it has been possible to assess certain aspects such as information management, ICT abilities, knowledge on the subject matter or the ability to do research, without the students perceiving the tasks as more difficult or provoking rejection or boredom (Chu 2009; Chu, Tse & Chow 2011). In addition, it seems that communication, negotiation and collaboration abilities are promoted, all necessary to the joint discussion of the ideas proposed during the development of the project (Gómez & Insausti 2004). These stages and their results show how our proposal affects different abilities and skills. And maybe, this can encourage other teachers to try this method out with their students.

Moreover, we believe that the task of converting the collected information into audiovisual language plays an important part in developing many of the competences worked on here. Namely, the students were forced, starting at the search for information, to think up a sketch, elaborate an initial text, create a script and, additionally, prepare, organize and carry out the filming and posterior assembling and edition of images. In short, to transform linear discourse into a multi-channel message. The complexity and novelty of these actions entail the need to organize the work, arrange locations and timeframes divide responsibilities, create a hierarchy of priorities, etc. All of these capacities seem to be tied to the LL and API competences, as well as the SC competence, due to the difficulties inherent to this type of work.

Let us recall that the information the students gathered from different sources was in text form, i.e. one word after another. However, both reality and the audiovisual format generally present multiple channels at the same time (speech, images, text, music, etc.). This fact led them to transpose the content. Obviously, they had to adapt the initial text to a, to them, unusual format. This change was not brought about directly by the teacher, but was initiated by the students' proposals; the teacher's only role was to help the students complete their objectives, once these had been precisely defined by the students. We believe this task provoked the development of the linguistic competence in a way that is difficult to work at using other methods.

On the other hand, and due to the characteristics of this concrete project, the digital competence, ICT, has been one of the most exercised. The students made use of their preexisting abilities with video cameras, managing computer equipment, Internet searches, etc. The students indicated at the end of the project that they felt capable of putting their new knowledge about the computer programs used (digital video editing, video format conversion, etc.) to use. In general we can say that although the creation of a digital video as a tool for autonomous learning required a greater effort and more time than the students' usual assignments, but it proved to be a satisfactory task, as declared by the participants in this study.

In addition and in our opinion more importantly, the project's evolution caused the students to need to use an ample arsenal of tools to organize and manage information, as well as orient it towards a previously established learning objective. It is our opinion that all of this effort to make use of their knowledge is quite different from the traditional approach, which interrogates students on their knowledge in contexts unrelated to these concepts. On the contrary, during this project students had to use their knowledge in concrete situations with objectives comprehensible to them and while attempting to create a product shared by the group.

It would seem that the combination of these technological tools in the context of a project-based learning strategy appears as a natural option. Specifically, we believe it allows to efficiently

connect curricular content to the way current-day students interact with their environment. This fact has been taken into account by a growing number of teachers who have decided to include tools of this type in their assignments (Ramírez et al. 2011; Annetta, Cheng & Holmes 2010).

Ultimately, our analysis, which includes the participating students' opinions, indicates that the subjects felt an important improvement of their abilities in relation to the KIPW competence (scientific competence). E.g., the students began unable to identify the motions they were to study, of at best considering them rare in their daily lives, and at the end were able to recognize them as a frequent and mundane.

In any case, the analysis of the improvement seen in knowledge of these scientific topics cannot be extended beyond what we have done in this study; we of course do not conclude that learning has taken place due exclusively to the creation of videos. Here we only show that improvement was observed. This improvement could be due to many factors such as the initial search for information, the creation of the text and its posterior reelaboration to create the script, the filming process or to the teachers comments throughout the process. We leave open the question of which effects each part of the process has on the learning process.

Based on our experience, we would like to indicate that teachers showed no intention of obtaining a professional audiovisual. Nowadays anyone has access to very advanced media that were unthinkable just a few years ago (HD cameras, video editing programs, voice recorders...) but at most schools there is neither the media nor the personnel typically found at professional productions. A very different goal is that our students become excited about the creative process and the teacher takes advantage of it to boost their learning.

We would advise that, given the technical complexity and the multitude of formats and possibilities, it is a good idea to do a small test before starting the process. In particular, we recommend choosing a camera, shooting a few short scenes and on our computer use the editing program to mount the scenes, dub the sound and add FX, then check to see if the audiovisual document can be reproduced correctly on another computer. A possible problem is that sometimes a camera's format only works on some computers.

Lastly, as we hope to have shown in this text, it is convenient to let the students make mistakes and try again, to boost their use of their particular skill set in a class setting and their use of dialogue and allow them to search for solutions to the problems that arise in the complex process that is the creation of a scientific documentary. The evaluations described at each step of the process are designed with this idea.

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