

A Systematic Review on Mobile Learning in Higher Education: The African Perspective

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ABSTRACT

The spread and popularity of mobile devices has led to their increased application in higher education. While studies have reviewed mobile learning initiatives in different contexts, none has explored this subject in Africa. This systematic review collates and compares studies published between 2010 and 2016 on mobile learning in higher education in the African context to explore the application, impact and challenges of mobile technology-supported learning. Findings show that mobile learning within higher education institutions in Africa increased student and lecturer collaboration and, provide dinstant communication, increased student participation and engagement, facilitating authentic learning and reflective practice, as well as fostering learning communities. A change in the lecturers' approaches to teaching also occurred. The findings also indicate significant challenges in integrating mobile learning in higher education institutions within Africa: poor technological infrastructure, lack of access to modern mobile devices, lack of mobile learning pedagogical skills among lecturers, poor attitudes among students and lecturers, and incompatibility of mobile devices with the university online management systems. Policies to guide the implementation of mobile learning were also lacking.

Large-scale studies assessing the effectiveness of mobile learning within African higher education institutions are lacking and existing studies lacked a theoretical framework. The review highlights enabling conditions for successful integration of mobile learning in African institutions addressing access, training, curriculum design, support and technical requirements. The absence of studies reporting on existing mobile learning projects reflects the limited penetration of this technology and associated pedagogies and a need to strengthen research in this emerging field.

Keywords: Mobile technologies, mobile devices, mobile learning, educational technology, Africa, developing countries.

INTRODUCTION

Higher education plays a major role in the economic development of a society. It provides advanced skills, which enable high productivity and improved quality of life (UNDP, 2012; World Bank, 2000), which is why the developed world prioritises higher education for advanced skills that command a premium in today's workplace (UNESCO, 2011). For example, in the USA, human capital is perceived to be three times more important than physical capital (ISI, 2009). However, despite its importance, access to higher education in the developing countries and Sub-Saharan Africa in particular remains very low as compared to its developed counter-parts. According to UNESCO and OECD statistics, developed countries such as Australia, UK and USA, the enrolment in higher education stands at >50% while that of developing countries such as Uganda is <5% (UNESCO, 2011). These figures suggest that the developing countries need to employ appropriate strategies to increase higher education enrolments, to become equal players in the competitive global knowledge economy. If this is not done, they face a future of increasing exclusion from the rest of the world because they lack the necessary skills needed in the 21st century.

The recent findings on the spread and subscription to mobile phones report a tremendous growth and penetration of mobile devices in both developed and developing countries (Johnson, Onwuegbuzie, Turner, 2015). For example, countries such as China and the USA, 97% and 90% respectively of adults own a cell phone with 64% being smart phones. In wealthier countries in the developing world such as South Africa, 89% of people own a mobile device. In contrast, countries in the most impoverished region of Sub-Saharan Africa such as Kenya and Uganda stand at 83% and 65% mobile ownership respectively, with an estimated increase of 130 million new mobile users each year in the developing world (Johnson, et al., 2015; Pew research, 2014). A study by

eTransform ranks Africa as the second fastest growing region in mobile penetration with 650 million mobile subscribers, which is more than in the USA or European Union (World Bank, 2012).

Based on this evidence, there is considerable interest in utilising the availability of these technologies to increase access to higher education particularly in Sub-Saharan Africa (Naismith, 2008). This is because mobile learning that utilises mobile devices is one of the approaches that provide great promise to increase access to higher education within developing countries (Davison & Lazaros, 2015; Maleko Munguatosha, Muyinda, Lubega, 2011; Mansureh, 2010).

Mobile technologies are defined as electronic devices that are small enough to fit in a shirt or jacket pocket and these would include devices such as mobile phones, portable digital assistants, (PDAs) and ipods (Mellow, 2005; Yousuf, 2006). Research into the current state indicates that mobile technologies support the learner in many ways. Their functionality ranges from relatively simple use of SMS texting providing a non-threatening and private availability of on-demand study support to the more advanced use of mobile and smartphones for pedagogy. Pedagogical functionality includes content delivery, task collaboration and planning, searching for information and assessment and accessing virtual environments such as discussion boards (Caudill, 2007; Davison & Lazaros, 2015).

The other positives of using mobile technologies in higher education include social and emotional presence, as well as pedagogical change where learners are able to learn anytime and anywhere, through mobile learning which has emerged as an innovative learning approach. Mobile learning makes learning more enjoyable, flexible and interactive since learners are not rendered immobile by the restrictions of desktop computer technology or the traditional classroom settings (Conole, 2007; Ishtawaiwa, 2014; Kukulska-Hulme & Traxler, 2007). Moreover, cellular telephones in particular, can enhance and lead to a sense of ambient co-presence and continuous availability (Ishtawaiwa, 2014) among learners.

Just like any other technology, mobile devices have limitations. These can be broadly categorised as infrastructure, policy and perception based. Recent research reports suggest that mobile devices are limited by lack of processing power relative to a laptop or desktop computer, have small screens, low processing speed & storage, short battery life, content and software application challenges (Kukulska-Hulme, 2009). Furthermore, research highlights scarcity of ICT resources, lack of teacher confidence and competence, resistance to change and negative attitudes, (Bingimlas, 2009; Mathevula & Uwizeyimana, 2014). The issue of teacher perceptions is further discussed by Wheeler (2000) who shows that whilst some teachers have passionately integrated technology (such as computers); others have outrightly rejected it. According to Isaacs (2012), the reason for this appears to be the lack of the necessary knowledge, skills and attitude (SKAs) to adapt to the changes. Consequently, the motivation and confidence to integrate MTs in teaching and distance learning could only come from having access to ICT equipment and possessing the required ICT skills (Mikre, 2011, p.12). However, Rodrigo (2011) argues that with the rapid improvement of new mobile products and the advanced functions and numerous applications and accessories available these days, the technical limitations of mobile devices may be a temporary concern.

The Conole et al (2006) study on university students' perceptions of mobile technology use in UK found that, students tend to choose the technology based on the extent to which it improves their learning. Similarly, research done in Australian schools also noted that students report regularly that they would like to be assigned more complex and engaging activities that involve technologies and that such activities should be relevant to their lives. Otherwise, they feel like they are stepping back in time when they go to school especially when education institutions are experimenting with a diverse range of digital tools, and use approaches not always creative or innovative (Essary 2014; Moyle, 2010). This is related to findings by Hwang, Huang, Shadiev, Wu and Chen (2014) who noted that students might feel motivated when using mobile technologies but their educational achievement is still unsatisfactory. This is possibly the reason why some researchers have reported that the effect of mobile technologies on learning has yet to be determined (Brand & Kinash, 2010; Ishtawaiwa, 2014; Mikre, 2011). Some proponents of mobile learning therefore believe that it will only 'come of age' when whole courses can be studied, assessed and learners accredited through mobile devices (Agarwal & Sambamurth, 1997; Sagarmay, 2012). These are arguments that require further exploration since they can possibly be critical factors constraining the application of mobile technologies in developing country contexts. Further, teachers' perceptions are a key challenge in integrating mobile technologies. According to Kukulska-Hulme (2014), emerging technologies pose many practical and ethical challenges to educators. Recent research reports that, some educators see mobile technologies as disruptive tools that are not useful and increase distraction from learning (Gong & Wallace, 2012; UNESCO, 2012). Given such challenges on mobile technology use, its

application in higher education especially in the developing world remains problematic despite their adoption being a continuous trend.

Even though mobile learning is a relatively new field of study, some systematic reviews have been conducted in this area. These include a major review by Crompton, Burke, Gregory and Grabe (2016) which looked at the use of mobile learning in science and found that mobile devices in science education were popular especially in the area of life sciences and in informal and elementary settings. The study also notes that most studies focused on designing mobile learning systems, while others evaluated the effects of mobile learning. Frohberg, Goth and Schwabe (2009) conducted another key study. They reviewed studies between 2002 when the first mobile learning conference took place and 2007. Results showed that few mobile learning projects incorporated a socialising component. They also report that communication and collaboration through mobile phones played a small role in mobile learning projects. Other reviews have been conducted by Baran (2014) focusing on mobile learning in teacher education, Duman, Orhon and Gedik (2015) on characteristics and research trends of MALL studies between 2000 and 2012, Burston (2014) reviewing MALL publications of studies with statistically reliable measures. Wu, Chen, Chen, Kao, Lin and Huang (2012), studied the trends of MALL studies published between 2007 and 2012. Similarly, Nguyen, Barton and Nguyen (2015), reviewed current research using iPads in higher education where results showed that iPads improved the learning experience but without significant better learning outcomes. These studies provide a broad picture of the current trends in mobile learning in education. However, none provides a detailed analysis of mobile learning in an African context, which is the focus of this study. Therefore, in an exploratory approach, this study reviews empirical evidence of the use of mobile learning in higher education from the perspective of African countries.

PURPOSE

The purpose of this systematic review is to analyse published studies focusing on mobile learning in higher education within Africa between 2010 and 2016. This is to understand the use and adoption of mobile technologies, characteristics of the studies in form of research approaches and methods, theoretical frameworks, mobile devices used as well as results in the form of challenges and teachers and students' perceptions towards integration of mobile learning within higher education institutions in Africa. This is the first of its kind to bring together studies focusing on this subject within Africa. The aim is to provide key insights to higher education policy makers and practitioners to assist in the design of appropriate educational programs and policies that support such technologies in higher education classrooms in the context of Africa. In addition, the findings of this study could provide the basis for further research on mobile learning in higher education within Africa and other developing regions.

Four questions drive this systematic review of mobile learning in African higher education:

1. What methodologies, theoretical frameworks, research types and countries dominate mobile learning studies in African higher education context?
2. How are mobile devices used for mobile learning in African higher education institutions?
3. What are lecturers and students' perceptions of mobile learning in higher education institutions in Africa?
4. What challenge sare associated with the integration of mobile learning within higher education in Africa?

METHODOLOGY

In order to produce unbiased and a comprehensive set of findings, systematic reviews make use of an explicit search strategy to guide the inclusion and exclusion of studies in a review (EPPI, 2010). A systematic review is defined as a piece of research guided by an explicit and transparent set of methods and stages with the potential to be replicated and updated (EPPI, 2016). In this study, relevant papers were identified using the guidelines by the EPPI centre. These included (1) scoping the review which involved developing the inclusion and exclusion criteria, (2) searching and screening studies where the two members of the research team searched for all relevant studies in line with the study criteria, (3) describing and mapping where results were grouped as per the relevant categories (*see appendix i*). Other stages included (4), quality and relevance appraisal by checking the usefulness and credibility of studies to answer the set study questions. At this stage, both researchers were involved in extracting and crosschecking the data. The next stage was (5) synthesizing study findings where the included studies were described and analyzed which provided a good picture of the current state of mobile learning in African higher education. The last stage was (6) drawing conclusions and recommendations. This stage provided the basis to make recommendations for future policy and practice of mobile learning in higher education within African context (EPPI, 2010).

SEARCH STRATEGY

The literature search was conducted through electronic search of databases and institutional databases. Further searching was also done based on the reference lists provided by some selected articles. This was to ensure a more exhaustive scope and to reduce the risk of bias. Due to the limited number of studies on mobile learning and higher education in Africa, peer reviewed, and conference proceedings articles based on empirical evidence were included. The electronic data bases searched include, Web of science, A+Education, ERIC as well as general internet search engines such as Google scholar. These were deemed appropriate because, they are the most popular databases in the discipline of education, under which the study belongs. Moreover, authors had free full access to all these databases. The institutional data bases searched include, the University of Cape Town, University of Pretoria and University of South Africa repositories. These are among the traditional universities in Africa with a strong research component thus expected to have relevant research in line with the study.

In both electronic and hand searches, free text and thesaurus terms were used to locate all relevant articles (EPPI, 2010). These include ‘mobile technologies’ and ‘higher education’ ‘Mobile learning in Africa’, ‘Mobile learning and higher education in Africa’ Mobile* OR tablet* OR iPad AND Learning, M-Learning OR Mobile Learning. These terms were used as they are the most frequently used when researching and describing mobile learning. To ensure that no literature was missed, the review team consulted an educational librarian at the University of Adelaide who assisted with checking and exploring all databases using a number of key words, until all available literature was exhausted.

STUDY SELECTION

The initial combined search of electronic and institutional databases produced 423 articles. Further examination of the articles was done based on titles and abstracts from which 80 articles were selected for further analysis. After removing the duplicates and studies that were outside the scope of the study, as at 6 September 2016, the original set of primary empirical studies remained 31.

INCLUSION CRITERIA

Table 1. *Inclusion Criteria*

Criterion	Inclusion criteria
Focus	Use of Mobile technologies such as smart phones, tablets, MP3 players and other handheld devices.
Level of Education	Higher education
Geographical spread	Studies should be conducted within Africa
Language	Published in English for easy and quick analysis, given the authors’ linguistic background.
Design	Both qualitative and quantitative
Period of Research	Selected studies were published between 2010 and 2016 since this is the period that marked the highest growth in the use of mobile technologies in Africa (Isaacs, 2012).
Research base	The study data was based on empirical evidence

DATA EXTRACTION AND ANALYSIS

Once a study was selected, data were extracted and entered into a table, which was constructed based on the inclusion criteria established. The variables noted from each study included author information, country of study, methodology used, key findings and conclusions made. The other features of data extracted from the articles were framed as per the research questions. Since most of the studies reported qualitative findings, free-text narrative data summary was developed for all studies (EPPI, 2010). The numeric data on the other hand was analysed using the statistical meta-analysis procedure where results from independent studies addressing the same questions were collated (EPPI, 2010). This form of analysis later formed the basis for drawing conclusions and recommendations based on evidence from all the studies described.

RESULTS

From a systematic review of educational research published between 2010 and 2016 on mobile learning in higher Education within Africa, only 31 empirical studies were found and these formed the basis for answering the study questions.

QN 1. WHAT RESEARCH TYPES, METHODS, THEORETICAL FRAMEWORKS AND COUNTRIES DOMINATE MOBILE LEARNING STUDIES FOCUSING ON HIGHER EDUCATION IN AFRICA? RESEARCH APPROACHES

There were five approaches to research in the reviewed studies. Thirteen studies employed mixed research, which involves the combination of quantitative and qualitative research within the same project to facilitate a full understanding of a research problem (Bryman, 2008). The next most popular approach was quantitative research, which focuses on explaining and interpretation of a problem using numerical data (Muijs, 2010). This approach had six studies. This was followed by case study research, which involves a detailed examination of a single case to gain greater insight of a given phenomenon (Flyvbjerg, 2006). This approach had a total number of five studies. Further, three studies employed descriptive research which studies groups of people without manipulation or looking for any specific relationships/correlations or change of environment (Shields & Rangarajan, 2013). Lastly, qualitative research emphasising use of words rather than figures in the collection and analysis of data (Hennink & Bailey, 2010) also had three studies.

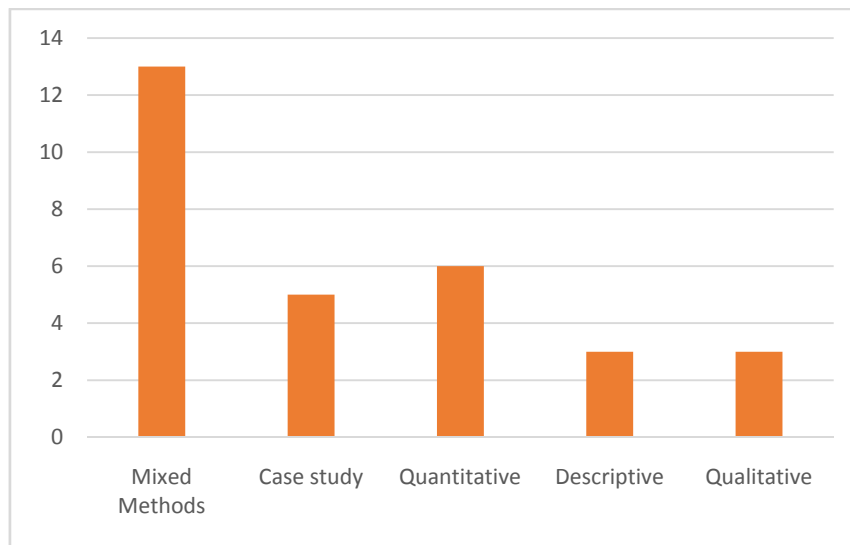


Figure 1. Research approaches

DATA COLLECTION METHODS

The data collection methods included the following:

- i) Questionnaire/survey involving a set of questions answered by respondents without the presence of the researcher (Bryman, 2008)
- ii) Interviews defined as a conversation between two people (*researcher and participant*) discussing a topic of mutual interest of which the respondent is regarded as an expert (Morris, 2015)
- iii) Focus group discussion which is an interview with a number of people focusing on a specific area of topic of interest to the researcher (Smith, 2007)
- iv) Observation which is a tool used to systematically observe the behaviour of study participants following a defined schedule of categories (Bryman, 2008)
- v) Literature review/content analysis, which involves the analysis of documents and texts following a predetermined category (Tracy, 2013).

The results indicated that 26 of the reviewed studies used questionnaire as their instrument, 13 used interviews, 4 employed focus groups, three were literature reviews/content analysis while observation was used in two studies. Table 2 illustrates these figures.

Table 2. Distribution of Data Collection Methods

Method	Frequency
Questionnaire	26
Interviews	13
Focus groups	4
Literature review	3
Observation	2

THEORETICAL FRAMEWORKS USED IN MOBILE LEARNING STUDIES IN AFRICA

The study investigated the theoretical frameworks commonly used in mobile learning studies in African higher education. In total, 14 out of 31 studies were based on a framework while 17 did not have any clear theoretical framework. Most of the frameworks used relate directly to technology adoption and acceptance while others are based on learning theories such as social learning and constructivism. The frameworks include a Bourdieu-based framework, Davis’s technology acceptance, Reeves and Oliver’s nine characteristics of authentic learning, the Unified Theory of Acceptance and Use of Technology, Czerniewicz & Brown’s framework of access to ICT, Framework for the Rational Analysis of Mobile Education (FRAME), Roger’s Diffusion of Innovations (2003) and Social Learning Constructivist theory. The technology acceptance model was the most used being represented in a total of 5 studies.

COUNTRIES OF RESEARCH

Out of the reviewed studies, South Africa is the country that emerged with the highest number of studies (11), followed by Nigeria (five), Tanzania, Kenya and Uganda each had (three) studies, Ghana and Botswana (two) while Mozambique, Zanzibar and Egypt were each represented by one study. Overall, 11 countries out of the 54 African countries were represented in the research.

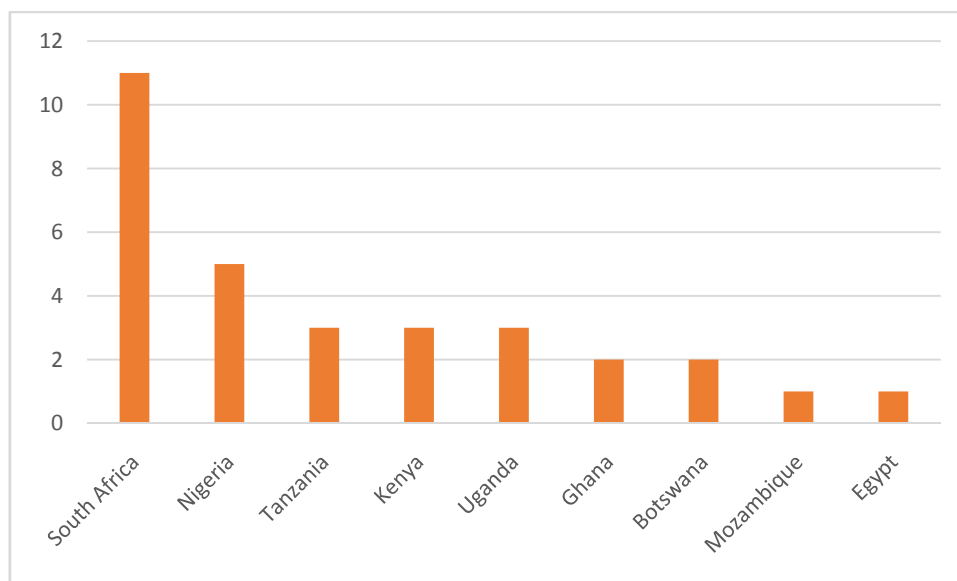


Figure 2. Distribution of studies by country

QUESTION 2: USE OF MOBILE DEVICES FOR MOBILE LEARNING

To explore this question, the researchers started with exploring the most common mobile devices used by students and teachers in higher education within an African context. The results showed that, mobile phones (both smart and normal cellular phones) were the most common mobile devices used by students and lecturers for mobile learning purposes. These were reported in 24 studies. Four studies used tablets while three other studies did not specify the specific devices used.

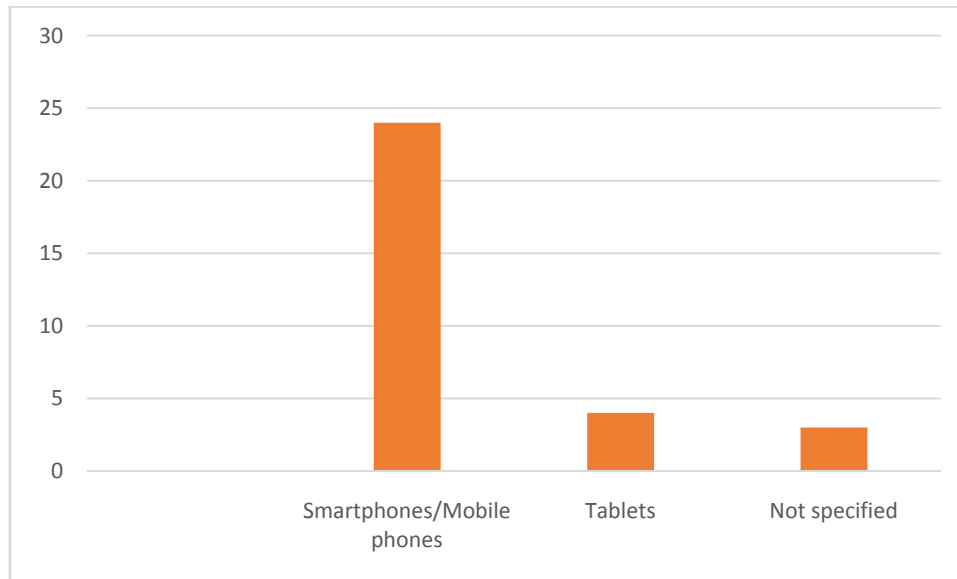


Figure 3. Mobile devices used for mobile learning

The study went further to analyse how such devices are used for mobile learning and whether they have any impact on students' learning in higher education institutions. In the review, 10 studies dealt with this area. These include Asiimwe and Grönlund, 2015; Bozalek, Ng'ambi and Gachago, 2013; Mayisela, 2013; Rambe and Bere, 2013; Wanja, 2014; Akeriwa, Penzhorn and Holmner, 2015; Utulu and Alonge, 2012; Mtega, Bernard, Msungu and Sanave, 2012; Pimmer, Brysiewicz, Linxen, Walters, Chipps and Grohbiel, 2014; Annan, Ofori-Dwumfuo and Falch, 2014 and Witt, Kebaetse, Holmes, Ryan, Ketshogiteng, Cynthia and Nkomazana, 2016). These studies generally focused on how mobile devices such as mobile phones and tablets can enhance learning in higher education as compared to other traditional approaches. For example, Annan et al., 2014, focused on a one-year mobile learning pilot project where a mobile learning tool (AD-CONNECT) was introduced in 44 courses at the Central University in Ghana. Overall, across the discipline areas and different universities where research was carried out, the results suggest that mobile devices can support student learning in higher education contexts. From the analysis, five major categories of the uses of mobile devices were reported. These included enhanced collaboration between students and lecturers, instant communication, cost effectiveness and portability, flexibility and supporting authentic learning and self-directed learning. For example, students at Makerere University in Uganda and the Open University of Nigeria, reported mobile devices as being cheap and giving them greater control over their learning and increased access to course material (Asiimwe & Grönlund, 2015; Osang, Ngole, Tsuma, 2013). This is further supported by findings from the study at a South African University in a blended learning course, which reported that students with access to mobile technology had an increased opportunity to access the courseware of the blended learning course. Moreover, the same study found that mobile technologies enhanced student-to-student and student-to-lecturer communication especially with social networks through use of mobile applications such as Facebook, WhatsApp, twitter among others (Mayisela, 2013; Mansour, 2016). This finding is also shared with other studies by Bozalek, Gachago, Alexander, Watters, Wood, Ivala and Herrington, 2013; Kriek, 2011; Witt, et al., 2016, which reported mobile devices as useful in providing continued access to information and opportunities for communication as well as increasing student engagement since students reported to enjoy classes where mobile technologies were integrated. Mobile devices were also found to increase student participation, foster learning communities and facilitate a gradual change in the lecturer's approach to teaching (Rambe & Bere, 2013). Moreover, in their mobile learning pilot project at Central University College in Ghana, Annan et al (2014) found that mobile learning enhanced collaboration between lecturers and students. This was achieved through lecturers sending course materials such as notes to students and getting instant feedback, tracking students understanding of lessons taught, delivering assignments, conducting polls and surveys, instant examination results and helping students to revise before coming for lectures (Annan, et al., 2014). The other uses reported by studies include use of mobile devices to create, upload, download and listen to stored files as well as facilitating authentic learning, self-directed learning and reflective practice (Adedaja & Oluleye, 2013; Chang, Ghose, Littman-Quinn, Anolik, Kyer, Mazhani and Kovarik, 2012b; Mtega, 2012; Mansour, 2016; Pimmer, et al., 2014). In addition, in Nigeria, during a program for undergraduate students engaged in problem-based learning in three randomly selected private universities, it was revealed that mobile phones can strengthen Problem Based Learning (PBL) in higher institutions and can be used to implement information services provided for students in their university (Utulu & Alonge, 2012). In Zanzibar, mobile learning was reported as key to promoting student motivation and increased engagement (Haji, Shaame &

Kombo, 2013) while Gachago et al (2015) found that use of mobile applications such as WhatsApp increase immediacy and connection between students and teachers.

QUESTION 3: LECTURERS AND STUDENTS' PERCEPTIONS

The study also sought to understand the students and lecturers' perceptions of mobile learning in higher education. The results showed contrasting feelings between students and lecturers on the use of mobile learning in university learning environments. For example, in a study conducted at Makerere University within two courses where Moodle was used as a learning platform, Asiimwe & Gronlund (2015), reported that students had positive attitudes towards the use of mobile phones to access the university learning management systems which enabled them to access learning materials, accomplish learning tasks, communicate and obtain better grades (Mtebe & Raisamo, 2014). With regard to students perceived 'mobile learning acceptance, findings seem to suggest eight key factors that influence the adoption of mobile learning by higher education students in developing countries. These include performance expectancy, facilitating conditions, environmental factors, technological, organisational, individual, social influence, access, nature of the institution's leadership and effort expectancy (Chang, Mwanika, Kaye, Muhwezi, Nabirye, Mbalinda, Burnham, 2012b). The findings further show that students are willing to use and adopt mobile devices and applications for learning purposes if they are made easy to use especially through providing bigger screens, key boards and high processing power (Mtebe & Raisamo, 2014; Macharia & Pelsler, 2014; Wang, 2016). Another important finding regarding access was that some students in higher education institutions reported having adequate knowledge and resources to use mobile devices for learning purposes (Mtebe & Raisamo, 2014).

On the other hand, the study findings showed some perceived concerns among lecturers affecting their use of mobile devices for teaching purposes. For example, in a study conducted among Nigerian lecturers, Shonola and Joy (2014) found that lecturers were concerned about their privacy and feared that confidential information would be exposed to students in the process of undertaking mobile learning activities. They also reported that they feared that the quality of their content would be compromised by the use of mobile learning (Shonola & Joy, 2014). Even where lecturers possessed mobile phones as in the case of lecturers at Mt Kenya University, they did not use them for mobile learning due to the negative attitudes they held towards mobile devices (Wanja, 2014).

QUESTION 4: CHALLENGES ASSOCIATED WITH MOBILE LEARNING

From the reviewed studies, there is reasonable evidence that African higher education institutions face considerable challenges in implementing mobile learning. The main constraints mentioned by the studies are centred on issues such as poor technological infrastructure leading to internet access problems, lack of access to modern mobile devices, lack of mobile learning pedagogical skills and the poor attitude among some lecturers and institutional leaders towards mobile learning. For example, in a study conducted at Makerere University in Uganda to find out the experience of students using the university online learning management system through their devices, Asiimwe and Gronlund (2015) found that 53% of the respondents noted that it was frustrating for them to use and operate the learning management system on mobile phones. This was because they found it hard to understand the best way to use the system using mobile phones, noting that mastering the system required much effort. South African students who participated in a blended learning course that required them to use mobile devices to access the university learning system reported similar challenges. These reported that using mobile devices was very slow especially in loading pages because it needed a large memory, which was lacking in most phones owned by students. They also reported high cost of the internet, limited access to learning materials, as well as the incompatibility of university learning management systems with mobile phones and other mobile devices (Mayisela, 2013). The problem of high costs was further explored in a study conducted at Sokoine University in Tanzania, where students and teachers reported using their VISA cards to purchase online applications, which they needed for learning purposes, as well as paying a lot of money daily for internet access to allow them to download learning content (Mtega, et al., 2012).

Moreover, mobile learning was reported to be distracting in some studies. For example, mature married students were against the idea of using mobile applications such as WhatsApp, saying that this affected their family life especially where fellow students expected them to participate in certain discussions after class hours (Rambe & Bere, 2013). The other reported challenges of mobile devices for learning purposes included network/bandwidth failures, power shortages, limited knowledge in the use of smart mobile devices, lack of internet enabled/smart mobile devices among both students and lecturers and the absence of policies guiding the use of mobile devices for learning (Adedaja & Oluleye, 2013; Annan, et al, 2014; Haji, et al., 2013; Lwoga, 2012, Muianga, Hanson, Nilsson, Mondlane, Mutimucio and Guambe, 2013; Witt, et al., 2016). In addition, from the educators' perspective, lack of special skills and knowledge to use mobile devices in designing curriculum, assessment, among others affects their intentions to integrate mobile devices in the instructional process. This

according to (Agbatogun, 2013) was reported to be worse in situations where the institutional leaders were hesitant to encourage and support the mobile learning initiatives suggested by the lecturers or the institutions themselves.

DISCUSSION

This section summarises and discusses key findings in line with previous studies. Weaknesses identified from the reviewed studies and recommendations for policy and future research related to mobile learning in higher education within African context are presented.

One of the key research questions addressed by this study was to establish the research types, methods, countries of research and the theoretical frameworks commonly applied in mobile learning studies within higher education institutions in Africa. Emphasis on these features was important in order to understand the way research findings and conclusions are constructed. In this review, mixed methods formed a large percentage of studies (13), followed by quantitative studies (six) and case studies (five). These findings are consistent with Crompton et al (2016) who in their systematic review of mobile learning in Science reported mixed methods and case studies as the most used approaches in the reviewed studies. The use of mixed methods in mobile learning studies is possibly due to the desire by mobile learning researchers to understand this phenomenon from multiple viewpoints and perspectives (Bryman, 2008) which is well supported by this approach to research (Johnson, et al., 2007). In addition, the big number of case studies could possibly be justified by the fact that mobile learning is an emerging field of research and therefore the boundaries between this concept and its context are not yet evident thus utilising case studies, which focus on a phenomenon within its normal context (Yin, 2003).

In addition, six methods of data collection were reported in the reviewed studies with questionnaires (26) and interviews (13) being the most used. The use of questionnaires is possibly due to its ability to gather data from a large population (Bryman, 2015) compared to other methods such as praxis, content analysis, and observation, given the large population that characterised most of the reviewed studies. For instance, the study by Macharia and Pelsler (2014) study had 1800 participants, Maleko Munguatosha et al (2011) had 1588, Chang et al (2012) had 1118, Mtebe and Raisamo (2014) had 823 while Utulu and Alonge (2012) had 750. In addition, Schreiberand Aartun (2011) had 729, Czerniewicz and Brown (2013) 543, Annan et al., (2014) 522, Agbatogun (2013) had 492, while Bozalek et al (2013) had 242 study participants. Based on these figures, therefore, the popularity of questionnaires in the reviewed studies is justifiable. However, the absence of tests as a data collection instrument across all the studies can be regarded as a methodological weakness. This is because, tests are among the most useful tools in educational research and since some studies (Utulu & Alonge, 2012; Wanja, 2014) aimed at assessing student achievement through use of mobile learning, achievement tests would have been used to ensure valid and reliable results.

With regard to theoretical frameworks, 14 out of 31 studies employed a theoretical framework while 17 out of 31 studies did not base their research on any framework. The studies employed frameworks such as the Davis technology acceptance framework, Unified Theory of Acceptance and Use of Technology framework, Framework for the Rational Analysis of Mobile Education and Roger's Diffusion of Innovations (2003). This is a strong point within these studies as frameworks provide a basis upon which mobile learning can be implemented and the possible factors that could affect its progress. For example, the Unified Theory of Acceptance and Use of technology illustrates whether users will be able to accept the new technologies and their ability to deal with it (Venkatesh & Zhang, 2010). However, the 17 studies that did not base their analysis on any framework, their findings and conclusions are questionable. This is because without theory, our interpretation and understanding of the social world could be meaningless (Reeves, Albert, Kuper and Hodges, 2008).

In addition, the geographical distribution of studies showed that 11 of the 31 studies were carried out in South Africa. According to the recent research by Pew Research centre (2015), mobile phones are as common in South Africa as they are in the USA with over 89% owning a mobile phone and the country has a well-developed telecommunication infrastructure as compared to other African countries. This possibly explains the big number of mobile learning projects and studies on mobile learning in this African region. The same results are consistent with Crompton, et al (2016) review of mobile learning in science education, which states that Taiwan which was the most reported country also has one of the most advanced telecommunication networks in Asia. The implication drawn from these findings is that, success of mobile learning largely depends on the presence of a well-developed telecommunication network to support the use of mobile devices, which according to the proponents of the Unified Theory of Acceptance and Use of technology model is an important facilitating condition (Venkatesh & Zhang, 2010) for technology acceptance.

Mobile phones were reported as the main mobile device used for mobile learning in African higher education institutions. This finding correlates with current findings on the proliferation of mobile phones in Africa, which report that Africa is currently the second largest and fastest growing mobile phone market in the world with a penetration rate of 60% (Pew Research centre, 2015). This provides promise that increased access may lead to a paradigm shift through emphasising mobile learning as a supplementary approach of learning within higher education. The study findings generally show that mobile learning in higher education can enhance students' learning. This is through increased collaboration between students and lecturers, instant communication, supporting authentic learning, increased student participation and engagement and supporting authentic learning. Other benefits include downloading, listening to stored files, facilitating authentic learning and reflective practice, as well as fostering learning communities and gradual change in the lecturers' approach to teaching (Asiimwe & Grönlund, 2015; Kriek, 2011; Osang, et al., 2013; Pimmer, et al., 2014; Rambe & Bere, 2013; Witt, et al., 2016). Such findings would suggest that students in African higher education institutions believe that mobile learning is useful for their learning. However, with half of the studies lacking a clear theoretical framework to guide the analysis and interpretation of their results as well as over reliance on students and teachers' perceptions of mobile learning, these results should be viewed with caution.

The reviewed studies provide reasonable evidence that mobile learning in higher education institutions within Africa face a considerable number of challenges. These centre on issues such as poor technological infrastructure leading to internet access problems, lack of access to modern mobile devices, lack of mobile learning pedagogical skills among teachers/ lecturers and poor attitude among students and lecturers. Others are incompatibility of mobile devices with the university online management systems as well as absence of policies to guide the implementation of mobile learning (Adedaja & Oluleye, 2013; Annan, et al., 2014; Haji, et al., 2013; Lwoga, 2012; Mayisela, 2013; Muianga, et al., 2013; Witt, et al., 2016). The challenges mentioned in this study are in harmony with those raised by UNESCO and the Horizon Reports (2014, 2015) on the challenges facing the integration of mobile learning. They identified connectivity, which is restricted in many areas due to the cost of data, poor internet speed, poor quality mobile phones with limited functionalities and small screens among others (Isaacs, 2012). However, Allan, Carbonaro and Buck (2006) argues that even though mobile devices are expensive, they provide a cheaper alternative when compared to other devices such as desktop and laptop computers. It is also important to note that in some of the studies (e.g. Mtega, et al., 2012) a good number of students in higher education within Africa reported having good access to modern devices that are internet enabled. This provides a promising ground within higher education institutions in Africa to revolutionise their education systems through mobile learning.

LIMITATIONS & IDENTIFIED GAPS

A number of gaps were identified in studies focusing on mobile learning in African context. First, a significant number of studies (17) did not base their research on any theoretical framework, which puts the findings and conclusions into question. This is because, theory provides the basis for understanding complex problems, interpreting empirical data, avoiding unorganised collection of accounts, as well as providing a basis for explaining and analysing the way institutions and individuals work (May, 2001; Reeves, et al., 2008; Robert & Sari, 2006; Wacker, 1998). Without theory, our findings on the social world are devoid of meaning (May, 2001) which implies that it must be part of the practice of all our research processes (Mills, 1959). The possible reason as to why frameworks are not yet clear is the fact that mobile learning in formal education is still a developing field and therefore methodologies and frameworks are still emerging (Traxler, 2009). Moreover, most of the reviewed studies are small-scale with only one study out of 31 based on a 1-year mobile learning pilot project. However, studies conducted within a very short period can be criticized for failing to address some critical issues. This is because there is no adequate time to explore issues in-depth (Cheung & Hew, 2009), establishing causal inferences, change in knowledge and attitudes as well as providing thick descriptions offered by longer term studies such as those applying a longitudinal research approach (Long & Johnson, 2000; Ruskin 2002). Other researchers such as Rajasingham (2011) also noted that most mobile learning studies and scenarios are based on short term and short funded pilot projects.

In terms of the geographical distribution of studies across the African continent, only ten countries out of the 54 making up the continent were represented. South Africa dominated with 11 out of 31 studies while, Nigeria accounted for five out of 31. This means, the rest of the 52 African countries shared 15 studies. This wide disparity in coverage generally shows that research in use of mobile learning in Africa is still very limited more especially among the least developed countries of sub-Saharan Africa. This demonstrates a need for future research and mobile learning projects to focus on this area. Therefore, it is important to note that the gaps identified in the reviewed studies have strong implications for policy, practice and research in the area of mobile learning within African context. For instance, the absence of

empirical studies reporting on existing mobile learning projects in higher education institutions in Africa implies that mobile learning has not become mainstream in this context. Therefore, further research in this field is needed to explore its impact as the proliferation of mobile devices in Africa increases.

CONCLUSION AND SUGGESTIONS FOR FUTURE RESEARCH

The number of studies on mobile learning in higher education is growing rapidly, even though there are still very few high quality studies to provide evidence for its effectiveness. Nonetheless, the study findings seem to suggest a growing interest in the integration and use of mobile learning in Africa's higher education institutions. With the increasing spread of mobile devices, the future of mobile learning in Africa is encouraging. For instance, the analysis seems to suggest an increasing interest in mobile learning research within Africa. For example, from 2010 to 2011 a very limited number of studies (three) were published, while from 2012-2013 research in this area increased at a fast pace with a record number of 15 studies published, while in 2014 to 2016 13 studies have been published. The big number of papers published between 2012 and 2014 is in agreement with the findings by the New Horizon Reports (2014, 2015) which noted that there was an increasing trend in mobile learning within developing countries (Isaacs, 2012). This is an encouraging trend showing an increasing interest in researching mobile learning in African higher education.

However, as noted in the discussion section, a few challenges remain which require attention if mobile learning is to be fully integrated within higher education institutions in Africa. First, technical support should be provided to students and teachers on use of mobile technologies, learning management systems need to be designed in a way compatible with mobile devices, training should be provided to course developers and internet access on campuses including student residences, classrooms and library should be improved. This will address some challenges such as the internet costs faced by students (Adedaja, Adedore, Egbokhare and Oluleye, 2013; Mayisela, 2013).

Finally, the study recommends future research to conduct longer and bigger scale studies exploring the impact of mobile learning in higher education in African context since the majority of the studies were characterised by short duration. Moreover, studies should utilise the existing mobile learning and other educational technology related frameworks to provide a lens through which study results can be analysed and interpreted. If these issues are addressed, the impact of mobile learning in Africa can be accurately evaluated and study results can be used to design appropriate policies to guide effective mobile learning pedagogies for higher education institutions.

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Appendix: Summary of Reviewed Studies

References	Country	N	Design	Focus	Summary of Findings
Asimwe & Grönlund (2015)	Uganda	30	Mixed	Investigating use of LCMS on mobile phones at Makerere University in Uganda.	The results show positive attitudes towards use of LCMS on phones but also huge challenges which are content and technical in nature.
Adedoja et al (2013).	Nigeria	201	Mixed	This mobile phones for learning purposes study focused on students' acceptance of	The findings confirm that the mobile tutorials enhanced teaching and learning. Challenges such as network failure and the poor supply of electricity were reported.
Agbatogun (2013).	Nigeria	492	Quantitative	Predicting faculty Member's use of digital technologies in Nigerian Universities.	Some environmental factors motivate and frustrate faculty members' use of digital technologies in the classroom. In addition, gender, academic qualification, academic status, motivating and discouraging factors jointly contributed to the prediction of faculty members' use of digital technologies.
Annan et al (2014).	Ghana	522	Mixed	This study was on a one-year m-learning pilot project at Central University College in Ghana	Mobile learning enhances collaboration between students and lecturers, by lecturers sending their notes to them and getting instant feedback, track students understanding of lessons taught
Akeriwa et al (2015).	Ghana	155	Mixed	Investigating the possibility of using mobile technologies to implement social media based services to graduate students at the University for Development Studies Library in Ghana	A great deal of enthusiasm was expressed in this regard suggesting that, with the necessary infrastructure and technical expertise, there exists a real possibility of delivering library services through mobile devices to graduate students at UDS.
Adeboye & Staden (2015).	South Africa	118	Case study	Identifying the challenges experienced by students in their voyage from e- learning to m-Learning.	The study results identified difficulties involving technical problems, distractions by applications on the mobile devices and issues of health such as eye constraint.
Bozalek et al (2013a).	South Africa	262	Mixed	Surveying the use of emerging technologies among 262 South African higher educators.	Findings show that emerging technologies made the most impact on the attainment of authentic context and authentic tasks.
Bozalek et al (2013b).	South Africa	242	Mixed	Exploring the potential of emerging technologies to disrupt current teaching and learning practices.	Emerging technologies address the challenges of Student-student, student-teacher interactions, communication in and out of class, and provision of feedback to students and enhancing student engagement. Institutional infrastructure (54%) and lecturers' attitudes were stated as major challenges
Chang et al	Uganda	111	Mixed	Internet-based survey on	Internet access in rural educational

(2012a)		8		ICT administered to students, tutors, and faculty members associated with a Community-Based Education and Service (COBES) program in Uganda.	sites is still lacking, but students and educators appear eager to utilize mobile technologies to improve the quality of teaching and learning for COBES participants
Chang et al (2012b).	Botswana	07	Quantitative	The role of smartphone based mLearning with student resident (physicians in specialty training) education.	Smartphones loaded with point-of-care tools are effectively utilized by resident physicians in resource-limited settings, both for accessing point-of-care medical information at the bedside and engaging in self-directed learning at home by the medical students.
Czerniewicz & Brown (2013)	South Africa	543	Case study	Investigating South African students' technological habitus by making a link between computer and mobile use.	The findings showed that cell phones are widely used as a core ICT resource yet under-acknowledged as a medium of learning by universities.
Gachago et al (2015)	South Africa	Not specified	Mixed	This study reflects on how three South African higher educators introduced WhatsApp into their teaching practices	Findings showed that mobile technology assist in increasing immediacy and connection not only in informal, but also in formal blended and open distance learning contexts, facilitating reflection, coordination, identification and, in some cases, with students' control and ownership, transformation.
Haji et al (2013)	Zanzibar	106	Case study	Opportunities and challenges of mobile learning among Higher Learning Students (HLS) in developing countries of Zanzibar context.	Encourages self-motivation and increases engagement. Challenges include high cost of mobile devices, poor physical infrastructure and band width.
Kriek (2011).	South Africa	161	Mixed	Investigating whether a private higher education institution in South Africa is using social media for business or educational purposes.	Mixed feelings about using socially-focused technologies for professional purposes, and that technologies are not yet used to their full potential at the institution. The main challenge is the lack of fixed line internet connectivity.
Lwoga, E. (2012)	Tanzania	06	Qualitative	Assessing use of Web 2.0 technologies in Africa's higher learning institutions, with a specific focus on Tanzania's public universities	Adoption of e-learning and Web 2.0 technologies still in its infancy. Challenges include poor technological infrastructure, high costs of devices, attitudes, lack of local expertise.
Mtebe & Raisamo (2014).	East Africa (Kenya & Tanzania)	823	Survey/quantitative	The study investigated factors that contribute towards students' adoption and use of mobile learning in East Africa	The results showed that performance expectancy, effort expectancy, social influence, and facilitating conditions had significant positive effects on students' mobile learning acceptance
Mayisela (2013)	South Africa	36	Case study	Establishing how the use of mobile technology	Students with access to mobile technology had an increased

			(mixed)	could enhance accessibility and Communication in a blended learning course.	opportunity to access the courseware, enhanced student-to-student & student-to-lecturer communication by means of social networks.
Macharia & Pelsler (2014).	Kenya	1800	Descriptive	This study aimed at understanding factors influencing use of ICT in student learning in 16 Kenyan higher education instns.	Environmental, technological, organizational and individual factors play a significant role in ICT uptake
Muianga et al (2013)	Mozambique	19	Qualitative	This study aimed at providing a description and analysis of the current state of ICT4Education implementation in HEIs in Mozambique	The results show that the country has advanced greatly in terms of design and implementation of ICT policies, as well as telecommunication. Challenges such as bandwidth and access to mobile devices remain problematic
Maleko et al (2011)	Uganda	1588	Mixed	Establishing a model for adopting social networked learning in higher institutions of learning in developing countries of Africa	Adoption of social networked learning requires self efficacy, reliable technical and administrative support, infrastructure, system interactivity, adequate budgeting and accountability, and a flexible organisational culture.
Mtega et al (2012)	Tanzania	70	Mixed	The study investigated how mobile phones have been used for teaching and learning purposes in higher learning institutions in Tanzania.	Majority of the respondents used their mobile phones for teaching and learning process. They used SMS. Challenges include costs for downloading content.
Mansour, E. A. (2016).	Egypt	441	Quantitative	Investigating the use patterns and ownership of smart phone apps among students at the South Valley University (SVU), Egypt	The most used apps were Facebook, e-mail, Twitter, WhatsApp, YouTube and Viber. For professional purposes, students used smartphones more for communication purposes than learning purposes
Ng'ambi et al (2012)	South Africa	263	Quantitative	Uses of ET among educators in the context of South African higher education.	Educators in South Africa use a wide range of ET in their teaching and learning
Osang et al (2013)	Nigeria	80	Quantitative	This paper discusses the benefits and prospects of implementing mobile learning in Nigeria	The greatest benefits are mobility and delivery of course materials. Challenges include power shortages, security issues, educator's perspectives and low computer literacy
Pimmer et al (2014)	South Africa	750	Qualitative	Investigating whether nursing students use mobile phones as effective educational tools in marginalized and remote areas.	Mobile phone usage facilitated (1) authentic problem solving; (2) reflective practice; (3) emotional support and belongingness; (4) the realization of unpredictable teaching situations; and (5) life-long learning.

Rambe & Bere (2013)	South Africa	95	Case study	The paper explored using WhatsApp, for an information technology course at a South African university	The findings suggest heightened student participation, the fostering of learning communities for knowledge creation and progressive shifts in the lecturer's mode of pedagogical delivery.
Shonola & Joy (2014).	Nigeria	120	Survey	This paper discusses the security concerns of mobile learning from the lecturers' perspective based on a study conducted in higher Education institutions in Nigeria.	Findings show that lectures felt that their privacy and confidential information being exposed in the course of discharging their duties is a concern unless adequate security measures are in place in m-learning systems.
Schreiber & Aartun (2011).	South Africa	729	Mixed	A pilot study of an online support service via mobile technology using chat facilities at a Higher Education Institution in South Africa.	Results suggest that students utilise online support services and tend to engage easier with an online counsellor compared to a face-to-face counselling intervention
Utulu & Alonge (2012)	Nigeria	750	Quantitative	Evaluating the use of mobile phones by students involved in PBL in three randomly selected private universities in Nigeria	Mobiles phones can be used to strengthen PBL in higher institutions and can be used to implement information services provided for students in their university
Wanja (2014).	Kenya	258	Mixed	Examining the utilization of mobile phones in enhancing learner support services in distance education programmes at Mount Kenya University, in Kenya	Utilisation was ineffective due to attitude and perceptions. In addition, although the information was related to learning, it had insignificant contribution to the entire learning process as a learner support tool.
Witt et al (2016)	Botswana	82	Mixed methods	Use of smart devices (tablets) in undergraduate medical education and medical students' perceptions of the effects on their learning environment.	Tablets were useful in their medical education, allowing them continual access to information and opportunities for communication. Challenges: limited internet access beyond the Wi-Fi zones at the training sites, others' perceptions, security concerns, and technical issues.