MOBILE TECHNOLOGIES REINVENTING TEACHER PREPARATION FOR EDUCATION 4.0 OUTCOMES IN MARGINALISED COMMUNITIES

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ABSTRACT

Mobile technology is a promising area of research post COVID-19 and helps the realisation of education 4.0 The purpose of this paper is to conceptualise mobile learning in Education 4.0 paradigm in the South African context. This descriptive study used a questionnaire made in a google form and distributed amongst pre-service teachers at a faculty of education. The survey questionnaire explored perspectives, ownership and use of mobile technologies by pre-service teachers. The data was analysed using the frequencies of the answers to the questionnaire. The findings establish the need for all stakeholders to holistically invest in the technical and capacity building of mobile technologies for learning purposes and help realise and develop the education sector to partake of the Education 4.0 opportunities. The study recommends the need for further studies that will explore additional knowledge on effective mobile technologies that make learning mobile aligning with the fourth industrial revolution innovations.

KEYWORDS

Mobile Learning, Mobile Technologies, Smartphones, Pre-Service Teachers, Education 4.0, 4IR

1. INTRODUCTION

The unprecedented revolution of the digitalised world is disrupting every sector of our society. The shifts are enabled by the advancements in technologies. The disruptive effects of Fourth Industrial Revolution (4IR) are transformative and reveal a broad repertoire of superhuman performance. Therefore, higher education institutions (HEIs) must innovate to prepare students to work alongside smart machines, hence the need for a transformative approach to education. An introspect into the current education systems, needlessly to say the current education serves to prepare students to take on tasks of traditional jobs. The danger of an unreformed curriculum is producing students whose roles will be easily replaced by automation. Educators and stakeholders must note that the purpose of education evolves on the needs of society. The World Economic Forum (WEF) reports aptly the digital skills gap (WEF, 2018). Mobile technologies have evolved and become powerful and can help bring transformation in education, hence raising the quality of teaching and learning.

The onset of the COVID-19 pandemic disrupted the normal operation of all sectors of society through restrictive protocols that encouraged virtual meetings. This transitioning opened a pandemonium and challenges specifically in education, due to their unpreparedness for such eventualities. Most institutions were reluctant to explore the integration of technologies afforded by the third industrial revolution into their practices, maintaining their traditional teaching and learning strategies. Nevertheless, this article conceptualizing the use of mobile technologies in teaching and learning that lines up with the 21st-century lenses within the Education 4.0 phenomenon.

Mobile technology refers to all technologies both hardware and software, that typically goes where the user goes (Kukulska-Hulme & Shield, 2008). They consist of network-enabled internet technology that connects them globally. For example, technologies are smartphones, tablets and watches that operate under android, iOS, and Applications. For this study the term, mobile technology is used to refer to the device's hardware and software.

Education 4.0 is about transforming the current and future of learning that aligns with the 4IR using advanced technologies. The 21st century advocated for a new skill set that challenges the status quo of traditional strategies that promote lectures and memorization (Education 1.0), Internet Enabled Learning (Education 2.0), and Knowledge-based education (Education 3.0) is not enough. Teacher preparation institutions must focus on innovation-based education (Education 4.0). The 4Cs skills are the foundation of Education 4.0 Therefore, the need to transform the educational curriculum to equip pre-service teachers with Education 4.0 skills. Today, the emphasis is on applying the knowledge (available freely on networked devices), translating that knowledge to solve the problem is more important than having the knowledge without applying it. It is the result or product that is more important in making a difference in society. Consider the unlimited possibilities of having billions of people connected by mobile devices, giving rise to unprecedented processing power, storage capabilities and knowledge access.

The use of mobile technology in teaching and learning has focused on facilitating interactions, however, few have engaged with other facets of mobile learning, such as human learning capacities and pedagogical issues in learning. Several models have been developed to help in-depth knowledge generation of mobile learning. Koole (2009) designed a FRAME that assists in implementing mobile learning in both formal and informal learning settings. The FRAME incorporates concepts that highlight technical characteristics of mobile technology and social and individual aspects of learning. Koole's (2009) FRAME model is founded on Vygotsky's Cultural Historical Activity Theory (CHAT), instituted on constructivism principles, whereby every element of the mobile learning process plays an active role. The FRAME was originally developed to understand the process of mobile learning. This framework resonates very well with the current Another framework is the TRIPLE E whose goal is to measure the effectiveness of a technology to help meet the learning outcome. The application of this model could help guide educators tap into the 4IR revolutionizes teaching and learning. The 4IR is rooted in the integration of networked technologies that facilitate the application of knowledge automation.

Most mobile learning studies have explored the theoretical aspects of mobile learning. However, is the initial phase of a longitudinal study that is exploring mobile learning technology use in marginalized communities. The project aims to highlight the real application of mobile learning in teaching and learning relevant for 4IR, Education 4.0 The following questions are guiding phase one of fact-finding,

The question used to explore this study

1. What should be the focus areas for teacher training institutions in pre-service teacher preparation foreducation 4.0?
2. How can teacher training institutions transform their curriculum to harness education 4.0?

2. REVIEW OF LITERATURE

The COVID-19 pandemic brought the popularity and rise of mobile technology use, many learners used mobile technologies for their learning (Karim et al., 2020). The advancements of the smartphone revolution have made it easier and brought major changes in how people do business and learn. This development indicates that mobile technology is no longer a want but a need to succeed in today's digital world.

2.1 Mobile Learning

The popularity of mobile technologies is growing fast and powerful with each innovation. Today's young generations that were born and bred during the 1990s rely heavily on technology and are skilled hunters of finding digital resources. Of the current university students 97% have access to smartphones and other mobile technologies (Statistica, 2021). In a study, Clayton (2016) noticed that students lacked the skills of using their mobile technologies for classroom learning activities, such as downloading or forwarding a voice memo of a class lecture, they could not set calendars to keep track of their progress or access tutorials in their subject disciplines.

The use of mobile technology for teaching and learning is ubiquitous, students use them for researching, collaboration, social interaction etc. The flexible learning afforded by eLearning initiated mobile learning (m- learning). Three concepts of m-learning are mobility of the learner, mobility of the learning and mobility

of the learning (Kukulska-Hulme & Shield, 2008). Mobile technologies are interconnected and becoming smarter, disrupting geographic boundaries, and opening more students' study options. During the COVID-19 pandemic, mobile technologies foresaw a significant growth in their acceptance in the educational sphere of influence. Most students are using mobile technology for their learning and mobile technology accounts for digital technology (Karim et al., 2020). Many studies have observed that mobile devices have an exceptional potential to replace other e-learning devices in the Education 4.0 learning setting (Karim et al., 2018, 2020). (Karim et al., 2020) administered a questionnaire to 120 HEIs students, and the results indicated that all students used their smartphones in their studies. Studies further revealed students use mobile technology for downloading learning materials, watching content-related videos, participating in the discussion on social media, WhatsApp and for searching for content online. Therefore, implying that mobile technologies are used effectively in HEIs.

2.2 Fourth Industrial Revolution and Education 4.0

Technological innovations and human creativity have made it possible to disrupt traditional business models and ceded power to smaller innovative businesses in a very short span of time. Given the imminent technological-driven changes, HEIs' traditional strategies require transformation, regular reviews and updates. According to WEF (2018), white paper, education is expected to produce graduates with skills for the unknown future.

HEIs are mandated to produce agile, multi-skilled, independent, adaptive, and lifelong graduates. HEIs' strategic plan grapple with such questions as 'how to remain relevant and sustainable for the success of current students, graduates and alumni.' The future of 4IR in developing nations has lower barriers than the first revolutions. Similarly, Education 4.0 technology solutions should be efficient, innovative, and lower costs. Education 4.0 comments under the 4IR embracing advancements in technology that align the physical with the biological realm (Karim et al., 2020). It is in response to the current development and needs of society. The Education

4.0 paradigm cultivates educational innovation-producing processes. This aligns with Jean Piaget's constructivist theory which states that students create knowledge through the interaction between experience and idea (Bhattacharjee, 2015), which is then translated into applied knowledge to solve societal problems.

The current generations are already living this 4IR life, hence transforming educational institutions is better than it was some decades ago. This generation is already exposed to the drivers of 4IR technologies and skills, namely cloud computing, the internet of Things (IoT), virtual reality (VR) / augmented reality (AR), Artificial Intelligent (AI), Big data, and Robotics (Cobots). It was critical for educational institutions to create an environment and resources

that help students to learn the tools that make them stand out in the 4IR. Education 4.0 adaption is never determined by institutions' readiness per se, teacher preparation institutions need to explore and incline towards foundational elements of 4IR technologies.

2.3 Linking Mobile Learning to Education 4.0

The education 4.0 characteristic is to harness the opportunities interconnected devices bring into the learning arena. Mobile technology is highly connected and is getting smarter and more powerful, this means it is highly connected to Education 4.0 qualities. Mobile technologies provide a wider variety of opportunities for finding and sharing information. A study by Shahroom and Hussin (2018) confirmed that mobile technology is a feasible device that supports education 4.0 learning outcomes. The ubiquitous nature of mobile technology innovation using devices like smartphones, tablets, and iPads supports anytime, anywhere access to learning (Mafenya, 2014). Mlearning has become the mainstream of educational technology. Mobile applications provide diverse access to quality educational content. The adoption of a learning management system (LMS) built using the responsive theme that can scale across all devices.

Internet of things (IoT) has the potential to transform teaching and learning as both educators and students have better access to teaching and learning materials, are better connected and collaborate and communicate in real-time using mobile technologies (Islam et al., 2020). For example, the use of learning management systems creates a connected environment that keeps all stakeholders with events and attendance updates in real-time.

Most sectors in society have benefited from robotics – manufacturing, transportation, medicine etc. Educational Studies explored the potential of robotics in education, e.g., educational, assistive, and social robotics with the aim of enhancing teaching and learning (Bhattacharjee, 2015). However, studies reveal the adoption of social and assistive robots has greater potential, but more effort is needed to evaluate educational robots (Scaradozzi et al., 2019). Empirical studies are still exploring how best to exploit the benefits of new 4IR innovations in teaching and learning.

Gamification in Education 4.0 is a concept of designing a learning environment that motivates learning a skill or behavior. The user experience influences engagement amongst students, henceforth increasing learning output (Urh et al., 2015). Artificial intelligence (AI) is used for various parts of the game and aspects of nonplayer characters. AI is applied in behavior modelling aspects such as situation analysis, target selection, resource allocation, learning, and simulated perception. Smartphones offer more practical, easy access, and are easy to carry anywhere. Mobile devices allow learners to play mobile games anywhere at any time.

Virtual reality (VR) and Augmented Reality (AR) intend to increase learners' satisfaction, enjoyment, creativity, audio, and graphics quality. VR and AR pedagogical process that creates authentic learning using 3D models (Lubega et al., 2014). The student actively experiences rather than receives passive information. VR and AR immersive student thereby building their emotional intelligence, and critical thinking and boosting creativity (Shahroom & Hussin, 2018). AR is used to create events that could be dangerous to explore like observing a tornado or veldfires, which in turn helps understand these natural disasters and help think of solutions and testing them virtually (Potkonjak et al., 2016; Shahroom & Hussin, 2018). Experts argue VR and AR catapult us from the information age to the knowledge age (Shahroom & Hussin, 2018). VR and AR afford students to learn, feel, remember, and process new ideas more experientially and deeply.

Artificial Intelligent in education is a technology that enables the machine to simulate human behavior, solving complex using mathematical models to learn and improve themselves with no program in this regard. Machine learning (ML) is the ability for applications to learn and adapt without following explicit instructions. The applications use algorithms and statistical models to analyze and draw inferences from patterns to accurately predict outcomes using historical data input.

Machine learning (ML) has the capability to transform education and fundamentally changing teaching, learning, and research. ML is used by internet search engines, email filters to sort out spam, websites to make personalized recommendations, application to detect unusual execution, GSP systems, and lots of apps on our phones (Chhaya et al., 2020). ML in education can help educators to easily identify struggling students earlier and take action to improve success and retention. ML further brings personalization in education to a new level (Kuleto et al., 2021). Importantly, ML derives meaning from all the data generated by the student and tailor the system to meet their needs. Consequently, a student doesn't lose motivation and the retention rates remain high (Hussain & Khan, 2021). The innovation of smart technology is promising to transform education by opening a new world of learning that is not bound in physical spaces. Students has access to diverse subject experts, collaborate beyond their classroom, and importantly self-paced and self-regulated learning.

3. METHODOLOGY

The purpose of this paper is to conceptualize mobile learning in Education 4.0 paradigm in the South African context. This is the initial phase of a longitudinal study that is exploring mobile learning technology use in marginalized communities. The study engages with quantitative data using descriptive statistics.

All respondents were given information about the purpose of the study and the anonymous processing of their data, A Google form link was shared with all (Foundation Phase (FP) (Grade R to 3), Intermediate Phase (IP) (Grades 4 to 6), Senior Phase (SP) - (Grades 7 to 9), Further Education and Training (FET) – Grade 10 - 12) pre-service teachers. the form could not start before consenting or not consenting and the form would close thanking the participant. The pre-service teachers, 256 voluntarily consented, the next page of the survey questions would open. The survey used close-ended multiple choice and multiple answers scale questions with open-ended options on every question. The questions were used (learning/teaching) of mobile technologies, duration spent using mobile devices, Mobile Apps used, and pre-service teachers' willingness to learn Apps for teaching and learning.

Data were analyzed using SPSS analysis. The data was presented in tables and bar graphs to visualize checking for patterns and outliers. Permission to conduct this study was obtained from the Research Ethics Committee in the institution at the onset of the longitudinal study. Privacy and confidentiality concerns were always given the deserved consideration.

4. RESULTS AND DISCUSSION

4.1 Demographic Data of the Participants

The pre-service demographic data was examined in terms of gender, age, teaching phase; FP/IP/SP/FET across all the academic years, 1st year to 4th years. To understand mobile learning the study designed a survey in the google form and shared it with all pre-service teachers, 226 pre- service teachers voluntarily completed the form. 160 (70.8%) were females, 64 (28.3%) were males and 2 (0.9%) preferred not to say their gender. Most students are between 20 – 25 years of age. Most pre-service participants came from the SP-FET phase, with none coming from the FP phase.

Table 1. Participating Pre-service teachers' demographic data

	Classification	Frequency	Percentage (%)
Gender	Female	160	70.8
	Male	64	28.3
	Prefer not to say	2	0.9
Age	18 to 19 years	71	31.4
	20 – 25 years	126	55.8
	26 – 35 years	27	11.9
	36 – 40 years	1	0.4
	Above 40 years	0	0
Phase	FP	0	0
	IP	20	8.8
	SP-FET	175	77.4
	PGCE	30	13.3

Most participating pre-service teachers were females. Most of the students 56% were aged between 20-25 years, and none of the participants was above 40years. Global indicators reveal that majority of Smartphone users are younger people termed Generation Z, born in the 1990s. Generation Z has unique characteristics, especially its dependence on mobile technologies. In terms of the phases, the SP-FET had the highest number of participants who volunteered.

In a study on mobile phone usage among university students in Kenya, Ogutu, Mariita, Nyakerario, Wanekeya and Akoth (2014) reported that female student rated higher in terms of mobile technology usage for academic purposes. This entail that gender is significantly related to mobile technology usage in university settings. Similarly, a Pew research on mobile usage fact sheet, shows that there is an insignificant difference between males and females (Vogels, 2021). However, in this study, demographic data is unlikely impacting on the usage of mobile technology in teaching and learning (Vogels, 2021).

4.2 Availability of Digital Devices amongst Pre-Service Teachers

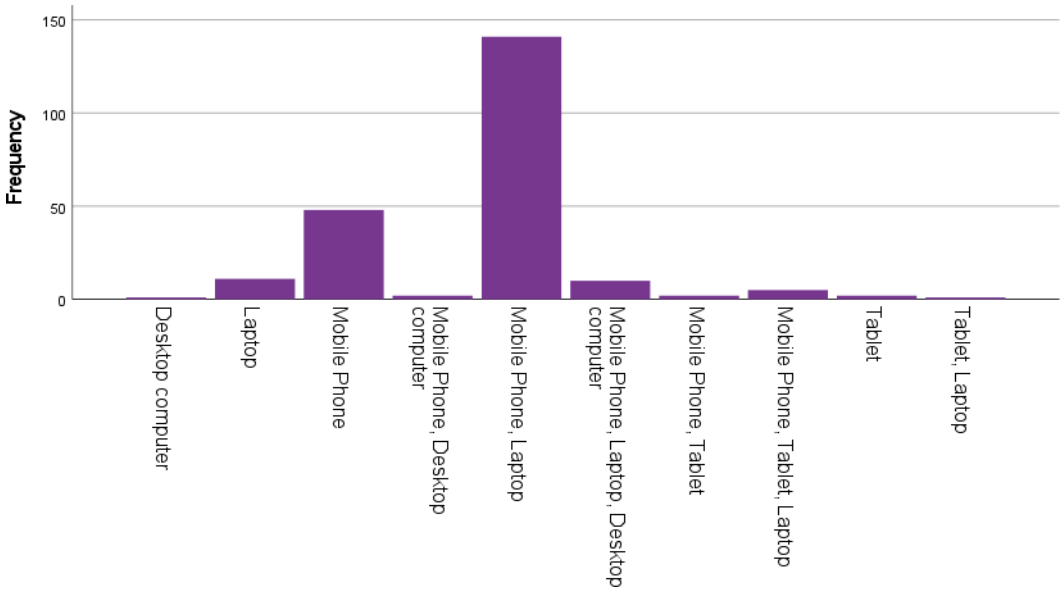

Figure 1. Digital Technological Devices pre-service have access

Figure 1 below, shows the frequency of devices at the disposal for students to use. Most students have access to both mobile phones and laptops. It is interesting to note that frequency of students having mobile phones only are fewer than those who have a mobile phone and a laptop. Mobile phones and laptops maybe the most owned digital devices because the probably portable and use applications that are tailored for student specific needs.

According to (Aheto & Cronje, 2018), noted the increased support for technology integration from organization and institutions. Since mobile phones and Laptops allow for multiple communications, easy access information, therefore students have found educational use for them. Students choose not to own tablets and Desktop computers, implies that mobile phones and laptops perform all functionalities that are needed (Aheto & Cronje, 2018). This further implies that students could be seeing mobile phones and laptop as portable and transformative tools in education.

4.3 Using Mobile Phones Technology for Learning and Teaching Purposes

The pre-service teachers spend time at university learning the art and concepts for professional teaching and get to go on teaching practice under the mentorship of a qualified and experienced teacher. During their teaching practice, they are also assessed on the application knowledge as they are taught at university. 65.5% mentioned that they always use smartphones in teaching, 13.7% mentioned that they sometimes use and 20.8% never use their smartphones for teaching. The results reveal that most the pre-service teachers use technology for both learning in their learning and teaching practice. Studies have demonstrated that using mobile technologies in teaching and teaching purposes (Chaka, 2022; Karim et al., 2018; North et al., 2014). The number of pre-service teachers using mobile technology learning is more flexible and easily used to access information (North et al., 2014). Using mobile phones promotes multitasking and flexibility, this is consistent with (Wasiaya et al., 2021) findings. Therefore, this implies that mobile phones are appropriate for teaching and learning.

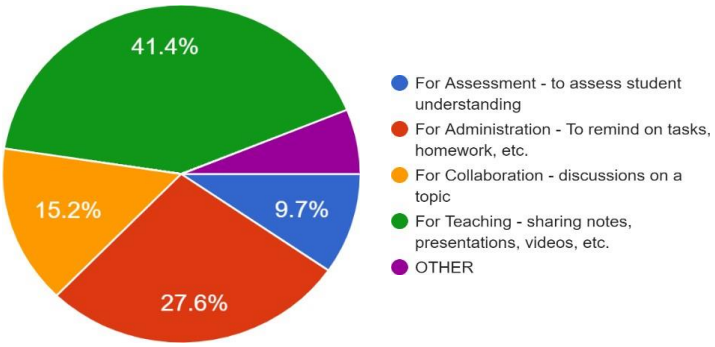

Figure 2. How pre-service use smartphones in teaching practice

Figure 2 shows the responses on when and how they use mobile technology, 41% use smartphones for teaching, 28% for administration, 15% for collaboration 10% for assessment and the 6% selected other. The functionality of Smartphones is on one hand increasing rapidly, on the other, the cost of these devices is decreasing, therefore making them more affordable than any other mobile technology.

The pre-service teachers used mobile applications for teaching and learning. Studies highlight mobile technologies have a greater influence on the teaching and learning experiences (North et al., 2014; Wasiaya et al., 2021). However, studies have also raised questions on the appropriate use of mobile technology in teaching and learning (Ally & Tsinakos, 2014). Pre-service emphasized that mobile technology can easily access online content and share links with others on social media. Mobile technology is becoming a mainstream technology, as devices come pre-loaded with search engines i.e., Google, for Android and Safari, for iOS smartphones.

4.4 Mobile Application Explored by Pre-Service Teachers

The study explored mobile applications that pre-service were using. The pre-service teachers indicated that 71.7% use Google Classroom app, and 37.6% use Quizlet in their teaching practice. The pre-service teachers specified other Apps they used besides the listed ones were blogs, google scholar, Vodacom e-school, wikis, Padlet, MS Teams, eBooks, Socrative, Content creation, and Chegg study. According to Burden and Kearney (2017), pre-service teachers are engaging in using these Apps authentic and with real experts. Furthermore, Burden, Kearney, Schuck, and Hall (2019), observed that students controlled what Apps they use and what connections they made through these Apps to tailor their preferred ways of learning and communication on more customized closed networks.

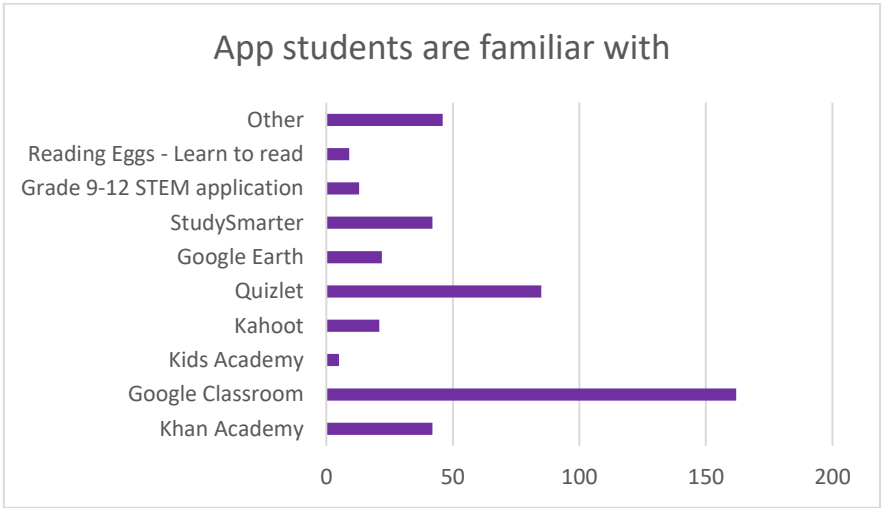

Figure 3. Teaching and Applications pre-service are using

The apps are not limited to independent one, it was interesting to observe that students mentioned Microsoft educational apps as well under other.

4.5 Pre-Service Interest to Learn More on a Mobile App for Teaching and Learning

The study observed that pre-service teachers appreciate and can identify with applications they can use for for teaching and learning.

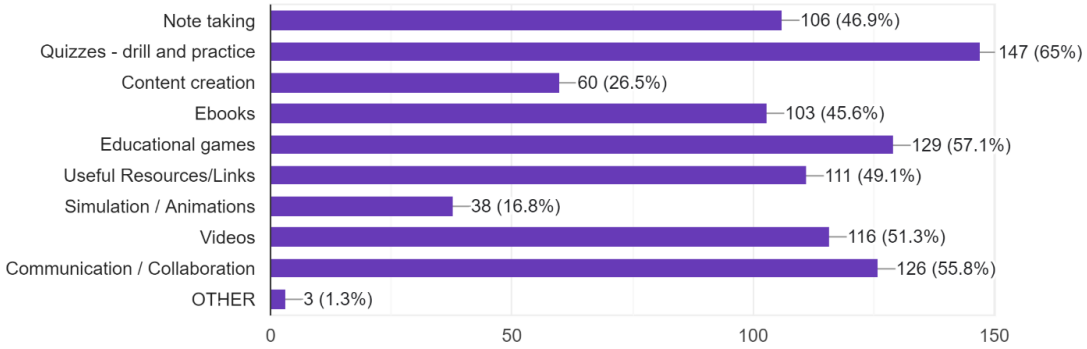

Figure 4. Pre-service Apps of interest to learn

Figure 4 shows pre-service teachers' interest to learn on how to use a variety of mobile apps to enhance teaching and learning. The result indicates most pre-service teachers require professional training on how to use mobile applications for quizzes (65%), educational games (57%), communication & collaboration (56%), use videos (51%), notetaking apps (47%), using eBooks (46%) etc. The finding reveals mobile technology has gotten mainstream offering more applications and functionalities (Chifamba, 2013). A study (Serdyukov, 2017) highlights that mobile technologies have positively impacted education making them essential technologies to support teaching and learning. Interesting to note that most mobile apps are changing the learning landscape that is bringing acrobatic invention. It is interesting to note that students understood various application that support the achievement of learning outcomes.

4.6 Mobile Technology is Highly Connected to Education 4.0

Mobile technology holds great potential in transforming teaching and learning. The results have shown that pre- service teachers have already revolutionized their individual learning capacity and even applied mobile technologies in their teaching practice. 110 students indicated that they always use their mobile devices for learning purposes. 148 students use their mobile devices to teach and assess students' understanding using real-time applications that will give students immediate feedback and help keep track of results. Reinventing education using the reality of 4IR into Education 4.0 is promising to make learning fun, interactive as well as experiential. Cloud computing, software as a Service (SaaS) system architecture serves education on licenses, hardware, and maintenance cost. The amalgamation of cloud computing and mobile learning is promising to transform conventional educational strategies with Education 4.0 strategies.

5. CONCLUSION

In conclusion, the advancement in mobile technology propagates Education 4.0 paradigm as a student-centered instruction and takes advantage of the limitless opportunities 4IR has created. The study provides teacher educators and researchers with what Mobile Learning Apps that pre-service teachers are using and how they are using them. The study then relates mobile technology to the current development in 4IR in turn to Education 4.0 The study additionally highlights the need for research into the design of a mobile learning curriculum in pre-service teacher preparation in line with the Education 4.0 contexts.

However, the limitation of tapping into the Education 4.0 is the lack of curriculum in preparing pre-service teachers. Educators are unprepared to exploit mobile learning opportunities and dynamics. It is recommended, for researchers to explore issues to deal with Education 4.0 developments in the conventional education setups.

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