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Use of Tablet Computers to Improve Access to Education in a Remote Location

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Abstract: A research project was carried out in using mobile learning to increase access to education. This project is contributing to the achievement of Goal 4 of the Sustainable Development Goals (SDGs), which is to "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". The mobile learning project involved the use of mobile technology to deliver learning materials to students to provide flexibility of access. Students used tablet computers to access electronic learning materials from the Aptus local server without having to connect to the Internet. The Aptus system is portable and was designed by the Commonwealth of Learning to allow learners to connect to digital learning platforms and access course materials without the need for Internet access. The project was implemented in a school in Pakistan. A total of 74 Grade 8, 9, and 10 students were involved in this project. The research revealed a positive impact on students and on learning as a result of their participation in the mobile learning project: students were better able to use the mobile technology for learning. Both students and parents also indicated that the project increased the students' knowledge on the use of tablets for learning. Parents indicated that the mobile learning project increased their childrens' interest in studying. Teachers also acknowledged that the students were taking more interest in classroom learning and concentrated on their tablets during study. Students were tested before and after they were supplied with content on their tablets. The post-test scores were significantly higher than the pre-test scores, indicating the use of the tablets for learning improved students' performance.

Keywords: Mobile Learning, Tablets, Aptus

Introduction

Widespread use of affordable mobile technology is an important development for education in the current era, especially in developing countries and remote areas where computers are not available and there is limited Internet access and unreliable or no electricity. Also, as recent refugee crises show, the most effective way to educate refugees is through mobile technology. There are technologies available that allow for the delivery of education in refugee camps where there is no Internet access and limited or no electricity.

Leaders of nations are committed to achieving "inclusive and equitable quality education and promot[ing] lifelong learning opportunities for all", which is Goal 4 of the Sustainable Development

Goals (SDGs). To provide education for all, governments have no choice but to use mobile technology to educate citizens in some contexts. The technology can be recharged using alternate power sources, such as solar and wind, and learners can access learning materials from local servers. In developed countries, students already have mobile devices that they can use for learning. In some countries the use of mobile technology is banned (Beeston, 2017). Rather than ban the use of mobile devices in schools, teachers should be trained on how to use mobile technology in education and the school system should be mobile-friendly. Use of mobile technology should be integrated into the learning process. There is no turning back, since mobile technologies are here to stay and they have to be part of the delivery mix (Philip, 2017).

The research project described in this paper used flexible technologies to deliver education anywhere and at anytime. Research was carried out in using tablets to increase access to education in Swat, Pakistan. The project was implemented in Allama Iqbal Public School and College Kanju Swat, Pakistan. Grades 8, 9, and 10 were involved in the project. The mobile learning project involved the use of tablets and a local server called Aptus to deliver learning materials to students and to provide flexibility of access to electronic learning materials. The Aptus system was developed by the Commonwealth of Learning (COL). It is a portable system and was designed to allow students to connect to digital learning platforms and access course materials without the need for grid electricity or Internet access. This ideal situation was found in an area like Swat where there is limited or no access to the Internet and an unreliable supply of electricity. Moreover, the costs of the Aptus system and the tablet computers are reasonable, which makes them a good choice for large-scale implementations.

All learning materials were saved on the Aptus device. In the delivery system, students used the wireless capability of the tablet computers to access the learning materials from the Aptus system and then they completed learning activities individually and in small groups. To orient teachers, four days of training was conducted for three teachers from Allama Iqbal Public School & College Kanju Swat, Pakistan.

The following research questions guided the research conducted in this project:

1. How effective is mobile learning as a delivery method for learning and student support as measured by students' performance?
2. How do students react to the use of mobile learning as a learning and support method as measured by students' feedback?
3. What are teachers' experience using mobile learning as a teaching and delivery method as measured by teachers' feedback?

Literature Review

The project provided students and teachers of schools in remote locations with access to electronic learning materials on a local server without the need for grid electricity or the Internet. Without technology such as the Aptus system, teachers and students in remote locations of Pakistan are at a disadvantage in accessing education. They cannot access electronic learning materials that are current. The Aptus system consists of a server that allows students and teachers to access learning materials on

tablets that can be charged (COL, 2016). The project focused on pedagogical approaches including drill and practice, tutorials, project based learning, and problem based learning.

As organizations and governments around the world implement accessible education for all, they must generate a sense of urgency to deliver education on mobile devices so that learners can access learning materials from any locations and at any time, especially for students living in remote areas and in different time zones (Ally & Tsinakos, 2014; Dolan, 2016). The Aptus mobile learning system can be used in remote areas, since the learning materials are stored on a local server and students access them from the server using the wireless capability of the tablets (COL, 2016). With systems such as the Aptus, learning will move further outside of the classroom and into the learner s' environments, both real and virtual, thus becoming more situated, personal, collaborative and lifelong (Naismith, Lonsdale, Vavoula, & Sharples, 2006). However, teachers will need to be trained to develop and deliver education using mobile technology (Harper & Milman, 2016). The effectiveness of mobile learning depends on how creative the teachers are when developing mobile learning materials (Mohamed, Chebbi, and Behera, 2016).

The growth of the use of mobile devices has surpassed the growth of any technology in our history (Pew Research Center, 2017). These devices are seen by citizens around the world as a way to add flexibility to their lives and by governments to give citizens the opportunity to have equal access to education. Mobile technologies such as the Aptus system are here to stay and will be used in all segments of education to reach the goal of education for all (Ally, 2009; Ally, 2014; Gaskell & Mills, 2009). Gaskell and Mills (2009) list the different ways mobile technologies can be used in education. These include administration of learning, monitoring students' progress, providing learner support, presenting interactive activities to promote higher-level learning, delivery of learning materials, use of context specific activities, just-in-time learning, and reaching the disabled. Mobile learning facilitates equal opportunity for all by allowing learning to be accessible across time zones and locations and where distance is not issue for the learner. Wireless mobile devices are small enough to be portable, which allow learners to use the device from any location to interact with other learners from anywhere and at any time to share information and expertise, complete a task, or work collaboratively on a project. The multimedia capabilities of the tablets allow students to access multimedia materials, which motivate students to learn and enhance learning because of the different levels of processing (Mayer, 2009).

Mobile learning benefits learners since they can use mobile devices to learn in their own learning community where situated learning, authentic learning, context aware learning, contingent learning, augmented reality mobile learning, and personalized learning are encouraged (Traxler, 2010). Use of mobile technology by learners will help learners develop the 21st century skills required when they join the work force (Bestwick & Campbell, 2010), such as conducting online research, use of technology, becoming independent thinkers, and using virtual communication. Teachers will have to be creative when they develop mobile learning materials to provide learners with 21st century skills (Dold, 2016; Henriksen, et al, 2016).

Methodology

The mobile learning project was implemented in a school for four weeks. Teachers from Grades 8, 9 and 10 prepared study plans for delivery on the tablets. All learning materials were loaded on the

Aptus server. The project used a blended learning approach, consisting of face-to-face instruction and mobile learning where students used the tablets to access learning materials from the Aptus system to learn independently. The teachers served as tutors while the students worked independently to complete the lessons. Data was collected in the areas of knowledge, attitude and behavior about the use of tablets for learning from the students who were the main target group of the project. Qualitative data was also collected from teachers, parents and students to obtain feedback on their attitude and knowledge on the use of mobile learning. The pre- and post-data provided evidence on how use of tablet in teaching improved the quality of education.

The study was conducted in Allama Iqbal Public School & College Kanju Swat, Pakistan. The data was collected at school level from three grades (8, 9 and 10). The Grade 8 subject was Pakistan Study, the Grade 9 subject was English, and the Grade 10 subject was Physics. Overall, 77 students participated in the study. Three students dropped out during post-data collection, so 74 students participated in pre- and post-data collection. Data collection included pre- and post-questionnaires to get student feedback on the mobile delivery system, and content testing to determine how much students learned. In addition, six (three pre- and three post-) focus group discussions were held with students from each grade and six (three pre- and three post-) focus group discussions were held with parents of students from each grade. Six (three pre- and three post-) interviews were held with three trained teachers who were involved in the project.

The pre-questionnaire was designed to determine students' background on their experience of using technology and how much they knew about the subject. The post-questionnaire was designed to determine if students benefitted from using the technology to learn and how much they learnt about the subject. Focus group discussions were held with the students after they used the technology to get feedback on their feelings and experience of using the technology to learn. Focus group discussions were also held with parents to determine how their children benefitted from the innovative learning method. Also, the teachers were interviewed to determine their experience in using the technology to teach.

Results and Discussion

The data was collected and analyzed by an independent research assistant who had no connections either with the schools involved with the research or with the lead researcher and the research funding agencies.

Pre- and Post-Questionnaire Responses

1. *Used computers or tablets before*: The students were asked whether they had used a computer or tablet before. Seventy-nine percent of students said they had never used a computer or tablet before the start of the project. The 21% who said that they used a computer or tablet before were from Grades 9 and 10. It seems as if the older students had computer experience compared to the younger students. Upon completion of the project all students were able to use the tablets to learn. The students benefitted from the project since the majority of the students were able to use the tablets for the first time. Also, in the focus group discussion, the students mentioned that after they used the computer to learn they understood how the computer could be used for learning purposes.

2. *Have a computer at home*: At the start of the project only 19% of students said that they have computer at home. After the project, 25% said that they have a computer at home. It seems as if the

students' use of the tablets at school influenced some parents to purchase home computers. At the focus group with the students, some students mentioned that before the project their parents did not allow them to use computers at home; however, after the project parents allowed them to use computers at home to learn. It appears that after the project some parents saw the benefit of using a computer to learn and they allowed the students to use a computer at home

3. *Would enjoy using computers to learn*: Before the start of the project, students were asked whether they would enjoy using computers to learn. The response was positive, with 97% agreeing or strongly agreeing. The same response was obtained after the students used the tablets to learn. The use of the tablets in the project did not change the students' positive feelings about using the tablets to learn. Young students are motivated to use technology to learn and if given the opportunity they will use technology to learn. This is clearly demonstrated by a research project conducted by Mitra (2014).

4. *Improved computer skills*: Upon completion of the project, students were asked whether participation in the project improved their computer skills. Ninety-six percent said that using the tablets to learn improved their computer skills. It appears that one of the benefits of using the tablets to learn was improved students computer skills, which is important for the digital era in the 21st century.

5. *Comfort in using the tablets to learn*: Before the start of the project, students were asked whether they would be comfortable using the tablets to learn. Seventy-eight percent said they would be comfortable. Upon completion of the project, students were asked to indicate their level of comfort using the tablets to learn. All students agreed that they were comfortable using the tablets to learn.

6. *Use of tablets improved academic performance*: At the completion of the project, 98% of students said that use of tablets improved their academic performance.

7. *Learning alone*: The project used a blended approach where students used the tablets to learn alone some of the time. Before the start of the project students were asked whether they enjoy learning alone. Fifty-eight percent said that they did. Upon completion of the project, 89% said that they enjoyed learning alone after using the tablets to learn. Learning alone is an important skill for future implementation of mobile learning and for the delivery of education in remote locations.

Pre- and Post-test

A pre-test was administered before students used the tablets to learn to determine their prior knowledge of the course content. Upon completion of the project, where students use the tablets in a blended format to learn, a post-test was administered to determine how much they learned. Both the pre- and post-tests measured the achievement of the course learning objectives and they were parallel, which made sure they measured the same learning objectives. T-test was conducted to determine if there were any significant differences between performance on the pre-test and the post-test. Results indicated that there was a significant difference ($p < 0.05$) indicating that students perform significantly better on the post-test (mean = 62.92) when compared to the pre-test (mean = 43.27).

Feedback from Focus Groups

1. Teachers' Feedback

The teachers prepared their learning materials and loaded them on the Aptus server or they used existing open access materials that were on the server. The teachers liked the option of storing all of the learning materials on the server so that students can access the learning materials from one

location. This also prevented students from having to access the Internet, which is restricted in some school systems. The teachers also mentioned that they developed personally and professionally when using the mobile technology system for teaching. The teachers liked the multimedia capabilities of the tablets, which allowed students to look at videos and pictures. The multimedia made students more attentive to the lessons, which may have improved their performance. Use of video motivated students to learn. The teacher found the blended approach, which combined independent study and teacher directed classes, as appropriate for teaching the students. They mentioned that the blended approach that used the tablets is more effective than the traditional way of teaching, since students are able to access a variety of materials and can review the learning materials at any time using the tablets. The teachers also reported that the students were able to quickly learn how to use the tablets to access the learning materials. The students also showed more interest in learning after they started to use the tablets.

The teachers reported a few challenges. The teachers were trained on how to use the technology three months before the implementation. As a result, the teachers had to re-learn how to use the technology immediately before the implementation. Also, the teachers said that they needed technical support during the implementation. Providing technical support is important for innovative projects, such as this project, to succeed.

2. Students' Feedback

The students mentioned that the tablets make it easy to learn and they can download the lessons on memory card and take the card home to access the lessons using their home computers. Some students also reported that they learn faster when using the tablets. One student mentioned that with the tablets, they could zoom out to make the text larger for easy reading, especially for students with eyesight problems. This is one example of how the tablets and other technologies can be used to educate the disabled.

Conclusion

In the electronic era, where all sectors of society are becoming digital, it is important for students to be computer literate to survive in the 21st century. Allowing students to learn using electronic devices, such as tablets and computers, will improve their computer and research skills. At the same time, as students access learning materials using digital devices, they learn independently, which allows them to be self-directed and become independent thinkers. These are important skills for the 21st century workplace.

Results from this project demonstrate that the use of mobile technology to access and interact with electronic learning materials benefit students' academic performance and improve their ICT skills to prepare them for the technological era. The Aptus system, along with the tablets, provides flexible access to education that can help to reach students in remote locations, especially girls, who face many restrictions in obtaining a basic education. This landmark project is contributing to the achievement of Goal 4 of the Sustainable Development Goals (SDGs) to: "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". Schools in remote locations will benefit from the results of this project. Use of mobile learning is a great opportunity to provide education for all and nations must generate a sense of urgency to innovate education using mobile technology to

educate all citizens to change the world. Based on the outcomes of the project, it is recommended that the project be scaled up to reach more students in remote areas and disadvantaged areas.

Mobile technologies are becoming more powerful and with the use of apps, which students can download in order to learn from anywhere. As technology emerges with wearable devices and 3D glasses, there will be opportunities for using augmented and virtual reality so that students in remote locations and refugee camps can get real life experience in different contexts through virtual worlds (Campbell & Cameron, 2016). The use of wearable devices and 3D glasses requires minimal power so they are easy to re-charge. Learning materials will be available as open education resources and will exist in the Cloud so learning can take place there (Mitra, 2014).

The use of these emerging technologies will revolutionize the delivery of education so that there can be education for all to achieve Goal 4 of the Sustainable Development Goals.

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