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EFFECTS OF DIGITAL TECHNOLOGY ON MATHEMATICAL ACHIEVEMENTS OF PRIMARY SCHOOL STUDENTS; EVIDENCES FROM KHYBER PAKHTUNKHWA PAKISTAN

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ABSTRACT

The purpose of this study was to determine the effects of digital educational technologies on the mathematical achievement of Grade 5th students in primary schools. To compare the effects of digital technology on mathematical attainments, 68 students from a primary school in District Shangla, Pakistan, were divided into two groups control and experimental. An experimental group was taught using digital technology, while a control group was taught using traditional methods. The Mathematics Achievements Test (MAT) was used to gauge academic achievement, and its results were analyzed using mean, standard deviation, paired t-tests. It was found that students who received a digital educational intervention improved significantly in their mathematical scores. Digital technology such as Multimedia, laptop, tablets and smartphone has the potential to enhance mathematics learning for primary school students, digital technology allowing them to practice problem-solving, focus on key concepts, and improve their mastery. Therefore, based on the study findings, digital technology should be incorporated into the teaching of mathematics in primary schools.

Key Words; Digital technologies, Mathematics learning, Primary School students, academic achievement

INTRODUCTION

Digital technology is increasingly becoming an integral part of education. This technology has transformed the way students learn, enabling them to access information, collaborate with peers, and stay engaged with their studies. According to the Organization for Economic Co-operation and Development (2020), "digital technologies can be used to enhance student engagement and motivation, personalize learning, and make teaching more effective". As digital technologies in education are the use of digital tools, such as computers, tablets, and smart phones, for learning and teaching. These tools can be used to enhance students' learning outcomes by providing access to educational resources, enabling collaboration between teachers and students, and allowing them for personalized learning experiences (Fischer & Loveless, 2016).

According to Dikson (2021), the role of digital technology in education is the ability to extend learning beyond the classroom and provide students with greater options for engagement and support. She further states that digital technology allows teachers to use adaptive learning tools to tailor instruction to the individual needs of each student, and to provide real-time feedback and support. She also emphasizes that technology can be used to help teachers create a more inclusive learning environment, by providing options for differentiated instruction and providing access to resources that may not be available in a traditional classroom. She further added that, Digital

technology in education is the use of digital technology and its applications to facilitate enhance and extend teaching, learning and assessment (Dikson, 2018). Similar to this, digital technology has the potential to modernize education by making learning more engaging and interactive, as well as providing access to a wide range of resources and materials (Kumar et al., 2016).

Digital technology has the potential to create powerful learning experiences by providing learners with access to a range of digital resources, from text and video to interactive activities and virtual learning environments. It can provide opportunities for learners to engage in learning through experimentation, exploration and collaboration. Digital technology can also help to improve assessment practices, providing learners with more meaningful and personalized feedback. Studies have shown that digital technologies can promote student engagement and learning outcomes. For example, in a study by Schmidt et al. (2020), the authors concluded that using digital technologies in the classroom led to increased student engagement, improved student motivation, and improved academic performance. In addition, digital technologies can be used to enable personalized learning experiences. For example, in a study by Zollman and Miller (2016), they stated that students who used personalized digital learning experienced improved learning outcomes. Overall, digital technology is playing an increasingly important role in education. It can be used to enhance student engagement and motivation, personalize learning, and make teaching more effective.

Teachers' of mathematics across the world used a variety of teaching strategies to improve and enhance teaching mathematics more productive and interesting in primary education. Therefore, digital technology has been shown to improve student learning in mathematics by providing students with access to educational resources, enhancing collaboration, and facilitating personalized instruction. According to a study conducted by the Organization for Economic Cooperation and Development (OECD), "students who regularly use digital technologies for schoolwork score higher in mathematics than those who do not" (OECD, 2016). Additionally, research by the National Education Association (NEA) found that "students who engage in mathematics activities on computers score higher on standardized tests than those who do not" (NEA, 2019). Digital technology can also help bridge the gaps in mathematics achievement between students from different backgrounds. For example, a study by the National Center for Education Statistics found that "students who used computers for mathematics scored significantly higher than those who did not" (NCES, 2019). Furthermore, research by the American Educational Research Association (AERA) has shown that technology can help students learn mathematics more effectively by providing them with visual, interactive, and personalized instruction (AERA, 2021).

Mathematics plays a vital role in promoting logical thinking intensify critical thinking and also expand problems solving abilities in students (Ma, 2009). During mathematics classes, students learn mathematics sequentially; previous knowledge is used as a foundation for acquiring new skills (Mulligan, Mitchelmore, &Crevensten, 2013). Therefore, before learning how to multiply, one must master the addition of two integers. In the same way that subtraction teaches how to add, the division does the same. The study of mathematics has long been regarded as a way to develop the mind, particularly the ability to think logically, precisely, and systematically. In the early years of the 21st century, math experts discovered that it was an essential component of human life. In the opinion of renowned educationalists Frobel and Montessori, a person's ability to develop mentally and culturally depends on her ability to learn arithmetic (Yasoda, 2009).

Many scholars have studied the impact of digital technology on mathematics learning at the primary level. For example, a study by Ozkan et al. (2017) found that the use of digital technology improved student engagement and performance in mathematics lessons, promoting logical thinking and cognitive abilities. Similarly, a study by Hwang et al. (2019) found that the use of digital technology increased student engagement, motivation, and learning in mathematics. Additionally, a study by Leong et al. (2020) found that the use of digital technology improved student learning in mathematics, and that it was particularly beneficial for students with learning disabilities. These studies demonstrate the potential of digital technology to improve student learning in mathematics at the primary level.

Digital technologies are becoming increasingly important in the field of education, particularly with regards to the teaching of mathematics. These technologies can offer students a range of new and enhanced learning opportunities and allow them to engage with mathematics in a more interactive and engaging way. Research has demonstrated that digital technologies can help to improve students' mathematical understanding, particularly at the primary level (Kafai, 2009; Kalyuga, 2011; Shanahan, 2016). Digital technologies can provide students with visual representations of mathematical concepts, encouraging them to explore and experiment with ideas in ways that are not possible with traditional methods of teaching. Additionally, digital technologies can offer students more personalized learning experiences and allow teachers to tailor their teaching to suit the individual needs of each student (Korat and Tatar, 2018).

OBJECTIVE OF THE STUDY

1. To investigate the impact of digital technology on the mathematical achievement of primary school students.
2. To investigate the extent to which digital technology improves or hinders students' mathematical learning.
3. To examine the relationship between digital educational technology and mathematical achievements of primary school students.

RESEARCH QUESTIONS

RQ1. What is the impact of digital technology on the mathematical achievement of primary school students?

RQ2. How digital technology improves or hinders students' mathematical learning in primary education?

RQ3. What is the relationship between digital educational technology and mathematical achievements of primary school students?

METHODOLOGY

The study intends to look into how emerging digital technology enhance students' mathematics learning at primary level. The study was for seven weeks at government primary school lilownai Shangla, Pakistan. In this experiment a total of 65 students' (50 male and 15 female) students of grade 5th were participated. All those students' belongs to different family background and aged between 10 to 11 years. The study was truly experimental in nature, to examine the impact of digital of technology on mathematics. Its design include two groups- control and experimental. The study was conducted by the principal author and two volunteer Math's teachers from the sample school. Permission was taken form District Education officer of District Shangla and from students' parents as well. The researcher explains objectives of the study and course contents in details to students and teachers.

Pre-test was developed to measure students' ability in the selected topics. Pre-test was designed according to Grade 5th Mathematics, text books oh Khyber Pakhtunkhwa. The test consisted of 25 questions, 8 MCQs from Least Common Multiple (LCM), 8 MCQs from Highest Common Factor (HCF) and 9 MCQs from Friction. Pre-test was validated by the math's experts and concerned math's teachers from different schools.

Both the groups control and experimental were instructed separately. The experimental group was taught by the Math's teacher using digital technology application whereas another math teacher taught the control group using traditional methods.

The population of the study consisted of students studying in Grade 5th in Government school of district Shangla, Pakistan. There were 61 students studying in class 5th, in experimental group there were 31 participants and 30 participants were in control group. Pre-test were administer, after evaluation of pre-test groups (Control and Experimental) were formed on the basis of their performance. The experimental group was treated with using digital technology (Multi-media, Laptops, and Tablets) and the control group was taught in traditional method. A total of 07 week session of mathematics was delivered to students using digital technology.

RESULT

Table 1

Groups	Pre Test	Mean (x)	Post Test	Mean(x)
Control	30	12.57	30	20.37
Experimental	30	15.65	30	31.645

Table 2

Group/Test	Mean	SD	MD	Df	t	Sig
Posttest Control Group	20.37	8.783	7.8	58	11.32	.000
Pre Test Control Group	12.57	7.491				

The mean score 20.37 on Posttest and 12.97 on pretest performance of the control group illustrates improvements also shown by the mean score 7.8. This difference is highly significant as the *t* value is 11.324 which are significant at .000. This results showed that the performance of control group students were significantly improved from pretest to posttest, where they were taught by traditional teaching approach

Table 3

Group/Test	Mean	SD	MD	Df	t	Sig
Post Test Experimental Group	61.645	8.7237	16.00	58	18.44	.000
Pre Test Experimental Group	15.65	9.358				

The mean score 61.645 on posttest and 15.65 on pretest shown that the achievements of the experimental changed significantly, and also shown by the mean score 16.000. Therefore, it shows that digital technology had significantly improved the academic performance of students in subject Math's.

Table 4

Group/Test	Mean	SD	MD	Df	t	Sig
Post Test Experimental	15.97	9.342	3.400	29	6.725	.045
Pre Test Control	12.57	7.491				

Table 4 clearly demonstrates that the experimental group's performance was significantly higher than the control groups. With a mean difference of 3.400, the average of the experimental groups' mean score was 15.97 and its standard deviation was 9.342. The t value was 6.725, which is statistically significant at.000, thus indicating a real difference between the two groups. This result was expected, since the experimental group had been instructed with the use of digital educational technology, compared to the traditional teaching used for the control group.

Table 5

Group/Test	Mean	SD	MD	Df	t	Sig
Posttest Experimental group	31.733	8.8588	11.3667	29	6.400	.000
Posttest Control Group	20.37	8.783				

Table 5 shows that the experimental group exhibits improvement, as evidenced by the mean difference of 11.3667 and the mean score of 31.733 with a standard deviation of 8.8588. This difference is highly significant, as the t value is 6.400, which is significant at.000. Thus, the result showed that the performances of the experimental group students were significantly better than those of the control group. The experimental group was taught using digital educational technology, and the control group was taught using the traditional method.

RESULTS AND DISCUSSIONS

This study examines the effects of digital technology on mathematical achievements of Grade 5th mathematics students. The main findings of the study were that those students who were taught mathematics through digital technology showed better performance than that those taught by traditional teaching strategies. It was also found that those students who were taught mathematics through digital technology showed that their knowledge and comprehension abilities improved significantly that those taught by traditional teaching strategies. However, the study found significant difference in control and experimental groups.

Analysis revealed that using digital technology to teach mathematics to elementary school students is a more effective teaching strategy. The applications of digital technologies in the field of education are also

developing, particularly when it comes to teaching mathematics. These educational opportunities are more interactive and engaging than ever before, providing students with special and improved learning opportunities. Studies have demonstrated their value in improving students' mathematical understanding, particularly at the elementary school level (Kafai, 2009; Kalyuga, 2011; Shanahan, 2016). Similar to this, according to Dickson (2020) in the field of education, digital technology is invaluable. Students are given numerous opportunities for involvement and assistance, and learning is extended far beyond what is merely taught in the classroom. Digital technology also gives teachers the ability to design an inclusive learning environment and deliver resources and instruction that are specifically tailored to each student. Thus, digital technology has the potential to completely transform education by enabling interactive learning and facilitating easy access to a wealth of resources and materials (Kumar et al., 2016). By providing students with visual representations of mathematical concepts, digital technologies open up a variety of learning opportunities. Students are encouraged to explore and experiment with mathematical concepts in ways that were previously impractical using traditional teaching techniques thanks to these visual representations. Digital technologies also enable teachers to adapt their instruction to meet the needs of particular students by giving them the opportunity for a more personalized learning experience (Korat and Tatar, 2018).

Researchers have extensively researched the effect of digital technology on mathematics learning at the primary level. For instance, Ozkan et al., (2017) conducted a study that revealed that students who utilized digital technology in mathematics lessons were more engaged and performed better, enhancing their analytical and cognitive skills. The potential benefits of digital technology on student learning in mathematics at the primary level have been highlighted in recent studies. Specifically, Hwang et al., (2019) observed that the use of digital technology enhanced student engagement, motivation, and learning in mathematics. Meanwhile, Leong et al. (2020) reported that the use of digital technology promoted student learning in mathematics, particularly for those with learning disabilities. Collectively, these studies demonstrate the potential of digital technology to improve student learning in mathematics.

In primary schools, mathematical instruction is often taught without any sense of purpose or application, leaving students disoriented about the concept of mathematics. Primary level teachers often persist on textbooks and whiteboards rather than using examples from everyday life, which further fails to provide students with meaningful content. Furthermore, students are taught to solve mathematics equations with formulas versus understanding the implications. As a result of this traditional approach, students struggle to gain an adequate grasp of the material and ultimately perform poorly. Not only does this traditional method of teaching yield unsatisfying results, it also fails to accurately reflect the abilities and knowledge of mathematics graduates. Traditional mathematics instruction revolves around the concept of the teacher providing knowledge while the student passively receives it.

CONCLUSIONS

The study concludes that the effects of emerging digital technology in mathematical achievements were more effective than traditional lecture method. The results of this study suggest that digital technology can be used as an effective tool to enhance mathematical achievement in primary school students. At the same time, it is important to consider the use of this technology as part of broader teaching strategies, in order to ensure that students are receiving meaningful and appropriate educational experiences. Further research is needed to evaluate the effectiveness of specific digital technologies and to understand how to best leverage technology to improve learning outcomes.

RECOMMENDATION

Based on the findings the study it was recommended that;

- The emerging digital Technology may be used for teaching mathematics at various levels to improve students' academic achievement and to encourage students to avoid rote memorization in their learning. This would not be possible without the capacity building of the school teachers in

teaching methodologies through trainings and workshops or refreshing courses.

- Digital technology such as Multimedia, laptop, tablets and smartphone has the potential to enhance mathematics learning for primary school students, digital technology allowing them to practice problem-solving, focus on key concepts, and improve their mastery.
- Digital technologies also make it simple for teachers to keep track of their students' progress and give them individualized lessons, which help students perform at higher levels in math.
- Therefore, it is recommended that primary school students incorporate digital technologies as part of their mathematics education to foster better mathematical achievement
- Likewise, it was recommended that the emerging digital technology may be prioritized in pre-service teaching programs especially in pedagogy of science subjects. Government may provide basic materials like laptop, multimedia and train primary school teachers in order to encourage the use of emerging digital educational technology in their schools.

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