

Essay

Technology Integration in Mathematics Classrooms: Impact, Challenges and Solutions

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Abstract: Mathematics education has always been a crucial aspect promoted by the Jamaican government, wherein teachers serve as one of the main sources in imparting this knowledge to students. However, since the pandemic, drastic changes in the educational system have forced teachers, if not all, to adapt to this shift. This essay discusses the need for technology integration in mathematics classroom learning, emphasizing the importance of knowledge and skills that teachers must possess to effectively integrate technology. Additionally, the essay highlights the positive impact of technology integration on students' learning in mathematical concepts. However, there are challenges faced by teachers, such as lack of digital skills and access to resources. Solutions to address these challenges are also discussed, including effective training, technical support, and increased access to devices and technological resources. Thus, the essay underscores the importance of technology integration in mathematics education and the efforts required to overcome associated challenges.

Keywords: Mathematics education; Technology integration; Jamaican government; Teachers; Pandemic; Educational system

1. Introduction

Mathematics is a crucial discipline where excelling in this area has always been promoted by the Jamaican government. With teachers being one of the main sources of imparting this science to students, emphasis has been placed on teachers cultivating and evolving their craft to develop 21st century skills in these students. Thus, enabling them to thrive in the workplace. In this technological age now more than ever the use of technology within the mathematics classrooms is highly supported by the government. Since the pandemic Jamaica's educational sector has caused a drastic change in the mode of teaching and learning and as such some teachers, if not most, were not prepared for this shift in the educational system.

The need for technology integration in Mathematics classrooms can be seen by the passes obtained by the Jamaican students during the CXC examinations in 2020. Wesley (2020) as cited in Gooding (2020) stipulated

that the government recognizes that they will have to work closer with the teachers and as such create seminars that will help to build and expand competencies of teachers in the delivery of these subjects. Research gives support to the vast benefits of integrating technology within the mathematics classroom thus teachers need to be versed in technological skills and other areas to carry out this task. Studies conducted show the use of Information and Communication Technology (ICT) specifically designed to address specific conceptual challenges in subjects such as Science or Mathematics (Eng, 2005). Despite this fact the integration technology in the classrooms is not without its challenges but these challenges have solutions. However, the positive impacts that technology integration has on students far outweighs its challenges.

2. Knowledge Teachers must Possess in Order to Effectively Integrate Technology in the Mathematics Classroom

As one of the main sources of imparting Mathematics to students, teachers need to be equipped with the essential knowledge, tools and skill set needed to effectively integrate technology in the mathematics classroom. Niess (2005) as cited in Lee and Hollebrands (2008) described four different aspects that comprise teachers' technological, pedagogical and content knowledge (TPACK): An overall idea of what it means to teach mathematics integrating technology in the learning process; Knowledge of various instructional strategies and representations for teaching different topics with technology; Knowledge of students' understandings, thinking, and learning with technology; and Knowledge of the National Standard Curriculum and the materials given that integrate technology with learning.

Teachers should be knowledgeable on how to infuse the use of technology in the learning process, whether it be at the beginning, the body or end of the lesson and be competent in manipulating these softwares. Additionally, they should be cognisant of how to effectively incorporate the students while using the technology and allowing them to manipulate the technology which will promote the construction of knowledge by the students. To do so it is very important that teachers become versed with the different instructional strategies and virtual manipulatives that correspond well with each objective, topic or concept that are being taught thus diligent preparation is key. Finally, it is only with understanding the full extent of the goals and demands of the curriculum that teachers can help the students to meet the standards set by the government for them.

The curriculum is a guide that teachers can greatly benefit from utilizing the technological materials that it provides which is aligned to a specific topic or concept. Incorporating all these skills will significantly impact students' achievement in Mathematics.

3. Impact of Technology Integration on Students' Learning of Mathematical Concepts

To improve students' performance in Mathematics, learning should be more meaningful where learners construct their own knowledge in meaningful contexts. This means that they should deal with authentic tasks that are connected to the real world, where they meet problems that they

will face in the real world (Tarmonti, 2020). It is with the intertwining of technology in the mathematics classroom that learning can be more meaningful. Thus, giving support to the meaning of technology and technology integration which is the application of scientific knowledge to the practical aims in our everyday lives and the well-coordinated use of digital devices and cloud computing as tools for problem-solving, deeper learning, and understanding (Wood, 2016; Christensen, 2019).

Utilizing educational technology in the mathematics classrooms will increase learner's conceptually understanding through timely feedback, observing patterns, seeing connections, developing visual imagery, and exploring data (Oldknow & Knights, 2011). The use of technology can provide students and their parents with access to mathematics instruction that can provide remediation and acceleration. Rather than having to wait several days for feedback in the form of right and wrong answers by a mark, students now can have access to descriptive feedback highlighting the errors made with some products even providing a re-teaching experience (Brasiel, Jeong, Lawanto, Yuan, & Martin, 2016).

The benefits of using ICT in teaching and learning are that learners have access to quality learning material; learners can improve their own knowledge and standard of work and can easily get information from the Internet. Additionally, digital technology helps students to learn mathematical concepts more quickly and accurately. It motivates children, supplies a variety of teaching and learning experiences, connect mathematical concepts to the real world, act as a visual support to allow students to construct mental images, fosters creativity and facilitate teachers' and students' representation of mathematical processes concerned in specific number operations or calculations (Mdlongwa 2012; Goos 2010; Drews 2017 as cited in Joshi 2017).

4. Challenges of Using Technology Integration in Mathematics Classrooms

Despite the many impacts of incorporating technology in the mathematics classroom many willing teachers are faced with challenges as they attempt to use technology in the classrooms. There are several factors relating to challenges regarding the use of computers in schools. These pertained to why African teachers were not able to use computers for the teaching and learning of mathematics in their schools and the lack of opportunity to acquire additional skills in the teaching and learning of mathematics (Tachie, 2019). Not surprisingly the availability of resources for mathematical learning with digital technology has been shown to vary according to the economic status of countries and regions within countries (Forgasz, Vale & Ursini, 2010). Schools in Jamaica may not be as technologically advanced as schools in Eastern Asia. Some major barriers with the implementation of ICT in Malaysian Mathematics classrooms were: the lack of time in school schedules for projects involving ICT, the lack of adequate technical support for these projects, inadequate teacher training opportunities for the use of ICT, the lack of knowledge about ways to integrate ICT to enhance the curriculum and to integrate and use different ICT tools in a single lesson (Keong, Horani & Daniel, 2006).

Teachers who lack digital skills jeopardize the effectiveness of integration of technology in their everyday lessons. Nevertheless, where teachers have a good digital literacy, they need more support on how to exploit all the learning potentials in the use of new technological tools (Tarmonti, 2018). In Jamaica several school principals have concerns about the limited knowledge of technology of some trainee teachers (Ministry of Education Youth & Information, 2021). Research has shown that major barriers that teachers encounter when trying to utilize technology in the math classrooms are lack of confidence, lack of competence and lack of access to resources (Bingimlas, 2009).

5. Solutions for the Challenges of Using Technology Integration in Mathematics Classrooms

Since confidence, competence and accessibility have been found to be the critical components of technology integration in schools, ICT resources including software and hardware, effective professional development, sufficient time, and technical support need to be provided to teachers (Bingimlas, 2009). For teachers to be able to use computers wisely for the teaching and learning of mathematics, they need to be exposed to its use frequently. The principals' refusal of allowing teachers to use school computers should be dealt with immediately by the Department of Education. This will ensure that teachers can use computers more efficiently (Tachie, 2019). Schools need to provide training courses for teachers to gain experience in dealing with the new devices, modern technologies, and new pedagogical approaches. The Ministry of Education plans to rectify the problem of beginning teachers' limited knowledge of technology by incorporating ICT in the colleges' training programmes to facilitate its use in the preparation of lesson plans, delivery of lectures and general administration (Ministry of Education Youth & Information, 2021).

It is important for schools to cooperate with teachers by providing sufficient time to implement new technologies in the classroom, technical support such as the necessary ICT resources including hardware and software. Additionally, schools can reduce the teacher's number of lessons or increase the daily lesson length. It is up to teachers to take advantage of ICT resources offered at schools. They need to be well prepared before joining the teaching profession. Where proper training is absent, teachers can prepare themselves by enrolling in workshops or by self-training. Teachers should be flexible and able to adapt to new approaches in teaching. Finally, teachers should acquire skills of self-organization which will help them a great deal in conducting their classes when using ICT (Bingimlas, 2009).

6. Conclusion

Mathematics teachers have been entrusted with the task of shaping and molding the minds of the future generation. Hence, it is imperative that this duty is met with due diligence, strategic planning, and execution. Teachers should ensure that they are up to date with the necessary technological software and applications that can be used to enhance the teaching and learning of mathematical concepts. Thus, it is their duty and that of the government to seek out and provide ample opportunities for

teachers to acquire the necessary technological, pedagogical, and content knowledge needed to impart Mathematics in an effective and authentic manner. Therefore, let teachers everywhere become cognizant of the many benefits of technology integration in the mathematics classrooms and make preparations to overcome the challenges that come with it as we continue to teach in an ever-changing society.

Conflicts of Interest: The authors declare no conflict of interest

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