ROLE OF DIGITAL TECHNOLOGY IN MATHEMATICS

Ms. Sakshi[1] and Mr. Dilshad Ali[2]

[1]Assistant Professor (Mathemetics), Baba Farid College, Bathinda.

[2]Associate Professor (Geography), Baba Farid College, Bathinda.

ABSTRACT

The integration of digital technology confronts teachers, educators and researchers with many questions. What is the potential of ICT for learning and teaching, and which factors are decisive in making it work in the mathematics classroom? To investigate these questions, six cases from leading studies in the field are described, and decisive success factors are identified. This leads to the Study that crucial factors for the success of digital technology in mathematics education include the design of the digital tool and corresponding tasks exploiting the tool's pedagogical potential, the role of the teacher and the educational context.

Keywords:Digital technology; Internet , Mobile learning , MOOC , Blended learning , Digital libraries , Learning objects , Collaborative learning

INTRODUCTION

For over two decades, many stakeholders have highlighted the potential of digital technologies for mathematics education. The National Council of Teachers of Mathematics, for example, in its position statement claims that "Technology is an essential tool for learning mathematics in the 21st century, and all schools must ensure that all their students have access to technology" (National Council of Teachers of Mathematics [NCTM], 2008). ICMI devoted two studies to the integration of ICT in mathematics education, the second one expressing that "…a digital technologies were becoming ever more ubiquitous and their influence touching most, if not all, education systems"

The nature of mathematics and mathematics learning continues to be a dominant theme in current debates about reforms in mathematics teaching and curriculum. In so doing, the mathematics education community at large is focusing on issues concerning how individuals come to understand mathematics and how teachers can better scaffold deep learning. Against this background, the perceived and actual role of digital technologies in mathematical pedagogies of practitioners has received particular attention.

Quantitative change in the Internet has generated a change in quality, and expressions such as Web 2.0 and broadband Internet indicate that a new Internet has developed over the last 5–10 years. This new phase, which we are experiencing now and refer to as the fourth phase, brings us massive open online courses (MOOCs)—another trend of development, enhanced opportunities for collaborative learning, and the personalization of the Internet through personal devices. This phase also opens new opportunities for storing digital information through the massive increases in storage and computing power, and the emergence of cloud computing; it is in this context that digital libraries appear as another trend of development. Along with these developments, a move to mobile technology introduces new possibilities in the teaching of mathematics and leads to a further prominent development trend, included in our discussion.

THEORETICAL FRAMEWORK

How to decide which studies to include in this retrospective and even somewhat historical paper? Even if somewhat subjective and personal arguments cannot be completely ignored, the case selection is based on a number of criteria. A first criterion for including a study or a set of studies is that it really contributes to the field, by providing a new perspective, a new direction or is paradigmatic for a new approach to the topic. An indication for this is that the study is frequently quoted and has led to follow-up studies. A second criterion for inclusion is thatthe study under consideration contributes to theoretical development in the field of integrating technology in mathematics education, and as such promotes thought in this domain. A third and final criterion for the set of cases presented in this paper as a whole, is variation. Variation does not only apply to theoretical perspectives, but also to the mathematical topic addressed in the study, the type of technological tools used, and the pedagogical functionality of the digital technology. The use of technology when studying mathematics is not a new issue, since humankind always has been looking for solutions to avoid time consuming routine work. The use of technology has a long history in mathematics education. Starting from magic slate, book, magic lantern, Blackboard, OHP, radio, Slide rule video tape, Television, Calculator, computer, Interactive Board, Apple I pad all come under technology. Paper money and coins, beans, bears, buttons, and other small items are helpful for counting and computation skills. Straws, grouped by tens, are great for teaching Mathematics. Geo boards are useful for introducing geometric concepts. Clinometers are useful for teaching and learning of Trigonometry. An abacus allows children to conceptualize math formulas by working with tangible objects.

CASE DESCRIPTIONS

1. **Resequencing by Heid**

In first resequencing, During the first 12 weeks of an applied calculus course, two classes of college students (n=39) studied calculus concepts using graphical and symbol-manipulation computer programs to perform routine manipulations. Only the last 3 weeks were spent on skill development. Class transcripts, student interviews, field notes, and test results were analyzed for patterns of understanding. Students showed better understanding of course concepts and performed almost as well on a final exam of routine skills as a class of 100 students who had practiced the skills for the entire 15 weeks.

Next generation sequencing (NGS) , has very recently been shown to be successful in identifying novel causative mutations of rare or common Mendelian disorders. At the present time, it is expected that NGS will be increasingly important in the study of inherited and complex cardiovascular diseases (CVDs). However, the NGS approach to the genetics of CVDs represents a territory which has not been widely investigated. The identification of rare and frequent genetic variants can be very important in clinical practice to detect pathogenic mutations or to establish a profile of risk for the development of pathology. The purpose of this paper is to discuss the recent application of NGS in the study of several CVDs such as inherited cardiomyopathies, channelopathies, coronary artery disease and aortic aneurysm.

Even if nowadays we would not consider the digital technology available in 1988 as very sophisticated, I would guess that at the time the approach was new and motivating to the students, and the representations offered by the technology did indeed invite conceptual development. Decisive, however, I believe was the fact that the researcher herself designed and delivered the resequenced course. I conjecture that she was very aware of the opportunities and constraints of the digital technology, and was skilled in carefully designing activities in which the opportunities were exploited, and in teaching the course in a way that benefitted from this. Whether the course, if delivered by another teacher, would have been equally successful, is something we will never know.

2. Handheld Graphing Technology

In **mathematics**, **graph theory** is the study of graphs, which are **mathematical** structures used to model pairwise relations between objects. A **graph** in this context is made up of vertices, nodes, or points which are connected by edges, arcs, or lines.

Handheld graphing technology in the form of graphing calculators is a part of mathematics teaching and learning in most high school classrooms in the United States. According to data obtained from a national survey, as of 2000, over 80 percent of high school teachers used handheld graphing technology in their classrooms. Yet, questions such as, "What is the nature of the tasks for which the technology is used?" "How do students and teachers choose to use the technology?" "What is the impact of its use on student understanding?" and "Which students benefit from using technology?" are open questions. Research can help us understand how technology may be a positive influence on teaching and learning and how it becomes a barrier.

Functions and graphs have been the focus of numerous research studies over the past decade. The study of students' understanding of the concept of function, and their abilities to create and interpret graphical representations, was given strong impetus by the advent of computers and their ready availability in some classrooms. This led to many computer-based studies that analyzed students' reasoning with and about linked, dynamic multiple representations of functions (e.g., Confrey and Doerr, 1996; Leinhardt, Zaslavsky and Stein, 1990; Moschkovich, Schoenfeld and Arcavi, 1993; Yerushalmy, 1991). Yet despite the limitations of the graphing calculator when compared to a full-screen computer program, the calculator's low cost, portability and ease of use have resulted in its widespread use for teaching about functions and graphs in secondary schools in the United States.

3. Instrumental Genesis :

This study shows the interest of an instrumental approach to understand the influence of tools on the mathematical approach and on the building of students' knowledge: through a process - instrumental genesis - a calculator becomes a mathematical work tool; this process depends on the tool's constraints and potentialities, on students' knowledge, and on the class' work situations. To analyze the differentiation of instrumental genesis, we then have taken interest in students' behaviour and we propose a method enabling us to constitute a typology of extreme behaviour in environments of symbolic calculators. To take the variety of these genesis into account, the professor needs a particular organization of space and time of the study in the class. We suggest the notion of instrumental orchestration to name this organization. We demonstrate how this notion gives a better definition of the objectives, the configurations and the exploitation modes of different arrangements which aim at constituting coherent instrument systems for each student and for the class.

One important aspect of this approach is the process of instrumental genesis (Verillon & Rabardel, 1995). Through this process an artefact becomes an instrument for a user. An artefact is an object, material or abstract, available to the user and aimed at performing a certain type of task. For an artefact to become an instrument for a user, there need to exist a meaningful relationship between them (Drijvers & Trouche, 2008). In this way, "…the instrument consists of both the artefact and the accompanying mental schemes…" developed by the user.

4. Mobile Mathematics:

With the growing interest of people in android-based applications, it has been observed that mobile devices can be used to increase the educational skills of school going children instead of leaving them to waste their time on only playing games. Therefore, development of educational application is essentially required, especially, to improve the mathematics-related skill of children. Although many applications exist online for such purposes, however, there is a need to develop a simple, interactive and easy to use android-based application for enhancing the skill of children in basic mathematical concepts. In this work, we develop an educational application, named "Basic Math Skill Builder" by using MIT App inventor framework, which assist the beginners in math to learn basic math operations. Moreover, they can check their skill level by attempting quizzes by using visual images and audio support. The developed application is very interesting and provides with the students school like environment.

The use of mobile technologies (such as smartphones and tablets) in the teaching and learning of mathematics is gaining a growing interest among educational researchers and practitioners. The characteristics of mobile devices such as portability, availability, access to the internet, and its wide acceptance among young people and others, have made mobile devices an emerging agent capable of expanding the frontiers of mathematics instruction and learning beyond the walls of the classroom. White and Martin argue that the characteristics of mobile devices (such as capturing and collecting information, communicating and collaborating with others, consuming and critiquing media, constructing and creating personal forms of representation and expression) can be readily mapped onto mathematical, scientific, and engineering practices highlighted in the Common Core Math and Next Generation Standards.

5. Online Applications

The Mathematics Applications ATAR course is designed for students who want to extend their mathematical skills beyond Year 10 level, but whose future studies or employment pathways do not require knowledge of calculus. The course is designed for students who have a wide range of educational and employment aspirations, including continuing their studies at university .

Mathematics or particularly applied mathematics is widely used in every engineering fields. In this paper, several examples of applications of mathematics in mechanical, chemical, and electrical engineering are discussed. Applications here are the real ones found in the engineering fields, which may not be the same as discussed in many mathematics textbooks. The purpose of this paper is to relate mathematics to engineering subject. Many engineering students find it difficult to solve engineering problems which need mathematics a lot. The students have studied mathematics before (calculus, linear algebra, numerical analysis) but when they study engineering subjects which involve mathematics they often cannot relate mathematics to those subjects. It is hoped that through examples given, engineering students can be motivated to understand their engineering problems better. Also it is expected that mathematics lecturers can be encouraged to provide mathematics problems which are more related to engineering fields.

6. Teachers' Practices and Professional Development

In addressing the questions of how to prepare teachers for technology-rich teaching and how to enhance their professional development in this field, in line with the work done by Wenger (1998) on communities of practice, it is suggested that the participation in a community of teachers who co-design and use resources for teaching, can contribute to this (e.g., see Fuglestad, 2007; Jaworski 2006). Digital technology in such an enterprise acts on two levels: first, the professional development concerns its use in mathematics education, and second, digital technology may support the community's work by offering online and virtual facilities for exchange. Digital technology is both the subject at stake and the Digital Technology in Mathematics Education: Why it Works vehicle to address it. Efforts have been done to exploit digital technology's potential for teachers' professional development by designing online courses.

The learning environment is one in which teachers and students engage in ways that would help teachers share his or her understandings with the students. This engagement can be mediated by the use of DTs with the aim of getting students to build the range of connections that are present in the teacher's schema As an illustration, some students tend to develop a limited understanding of the concept of fractions particularly as these relate to making sense of real-life applications. Teachers are expected to have a wider network of fraction schemas including the prevalence of fractions in the interpretation of gradient and/slope of an inclined plane. Students could be encouraged to access this feature of fractions by examining contexts where the idea of gradient comes into play. Students could search these contexts on the Web, and teachers could ask them to engage in discussions, say about part-whole relations. The ensuing discussions could aid in the Aid in the discovery of new ways of thinking about fractions and contribute to improved connectedness, the construction of robust schemas. Here is a case of how DTs mediate thinking and active involvement of the learners. The ways tools mediate thinking and knowledge construction has been a central issue for mathematics educators (Gutierrez, Laborde, Noss & Rakov, 1999).

Teacher self-efficacy within the context of a suite of mathematics learning games, Spatial Temporal Mathematics (ST Math) to analyze the associations between teacher value for professional development and self-efficacy, and the associations of both with student achievement outcomes. We found that higher teacher valuing of ST Math professional development was associated with higher self-efficacy for teaching ST Math, and that teacher self-efficacy had a small positive association with student achievement, although the latter result was not replicated in a subdivision of the sample. These associations provide information on how teacher perceptions and self-beliefs about interventions and professional development may drive implementation and student outcomes.

CONCLUSION

Learning in science, technology and engineering in schools and colleges could be greatly enhanced if students were able to use digital technologies to perform mathematical processes, mirroring the types of applications used in STEM-based applications in the workplace. The benefit of using digital technologies relates both to the processing power afforded by the technologies and the opportunities to access real-world data, which is engaging for students. The underlying aim was to identify factors that promote or hinder the successful integration of digital technology in mathematics education. The analysis of the six cases described in this paper show that the integration of technology in mathematics education is a subtle question, and that success and failure occur at levels of learning, teaching and research. In spite of this complexity, three factors emerge as decisive and crucial: the design, the role of the teacher, and the educational context.

References

1. **https://www.researchgate.net/publication/268368816_Digital_Technology_in_Mathematics_Education_Why_It_Works_Or_Doesn't**
2. http://ims.mii.lt/ims/konferenciju_medziaga/TechnologyRevisited/c69.pdf
3. http://www.ncert.nic.in/pdf_files/use%20of%20technology%20in%20%20teaching%20-learning%20mathematics%20-pratimanayak.pdf
4. https://www.researchgate.net/publication/243776627_Resequencing_skills_and_concepts_in_applied_calculus_using_the_computer_as_tool_Journal_for_Research_in_Mathematics_Education_19_3-25
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3482622/
6. https://education.ti.com/sites/SVERIGE/downloads/Research-resources/Burrill_G_(2002).pdf
7. https://link.springer.com/article/10.1023/A:1003905929557
8. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.509.3359&rep=rep1&type=pdf
9. https://www.diva-portal.org/smash/get/diva2:861869/FULLTEXT02.pdf
10. https://www.researchgate.net/publication/309195356_ANDROID-BASED_APPLICATION_FOR_BASIC_MATH_SKILL_BUILDER
11. http://www.rc.unesp.br/gpimem/downloads/artigos/borba_et_al/icme-issue-zdm-5-2016_borba_etal.pdf
12. https://senior-secondary.scsa.wa.edu.au/syllabus-and-support-materials/mathematics/mathematics-applications
13. https://www.researchgate.net/publication/281629940_Applications_of_mathematics_in_various_engineering_fields
14. https://www.researchgate.net/publication/317283267_Teacher_Value_for_Professional_Development_Self-Efficacy_and_Student_Outcomes_within_a_Digital_Mathematics_Intervention