Integrating Mathematics Education with Technology

Mridula Purohit[1], Vipin Kumar[2], Dr. Vipin Kumar Solanki[3], Dr. Vinod Kumar[4]

[1] Department of Mathematics, Vivekananda Global University, Jaipur, India

[2] Department of Mathematics, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

[3] Department of Mathematics, Sanskriti University, Mathura, Uttar Pradesh, India

[4] Department of Department of Computer Science & Engineering, SGT University, Gurugram, Haryana, India

Correspondence: Mridula Purohit, Department of Mathematics, Vivekananda Global University, Jaipur, India. E-mail: mridula_purohit@vgu.ac.in

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Abstract

Technology, as well as the educational system, has evolved fast in recent decades. Today's demand is for practical as well as modern-oriented mathematics education. In today's world, modern and realistic mathematics education is critical in every country. The value of technology-based mathematics education has increased, signifying a fundamental shift in how mathematics education is seen today. Mathematics education will be simplified if students can access a virtual math classroom over the internet. As a result of the development of computer media, educators, students, and scientists are presented with a challenge: Theoretical frameworks are used in innovation studies in the field of teaching mathematics, but this research focuses on what such theoretical perspectives have to offer. The author's mathematical team's main goal is to create exercises that will enable communication. In addition, they should use technology to improve and broaden their pupils' math skills. This article discusses the approach for generating and employing chemicals for such an objective.

Keywords: computer, education, framework, Mathematics, technology

1. Introduction

1.1 The Development of Technology and Its Application in the Mathematical Community

Many mathematicians as mathematics teachers have been fascinated by variables affected by technologies since the invention of the computer server in 1942, the very first four-function calculators in 1967, the microprocessor in 1978, as well as the control algorithm in 1985. Nevertheless, wasn't until the mid-1960s that mathematicians, as well as mathematics educators, began to believe that computing might have a substantial impact on the substance and emphasis of education and college mathematicians, as per mathematicians and math instructors. Computer-aided Instruction the creation of personalized student-paced packages that were claimed to encourage a more active type of student learning was one of the first uses of modern technology to mathematics learning in the classroom. The PLATO (Programmed Logic for Automatic Teaching Operations) program is the most possibly the best (J. Garofalo, H. Drier, S. Harper, M. a. Timmerman, and T. Shockey 2000).

Coding, namely in Logo and BASIC, would be the next phase in innovation methods to classroom management. In this sense, the invention of the Logo computer language was crucial. A researcher who has been inspired by the ideas and was concerned in early children's teaching methods and also how the computer may help them (P. Drijvers 2010). A mathematician supported “putting students in a stronger position to perform math instead of study about it” inside a 1972 paper titled Teaching the kids to be mathematicians versus learning about arithmetic. Coding in BASIC too was thought to be a way to improve kids' mathematical concern ability at the period, even for pupils as early as the first-grader.

The introduction of the microprocessor inside the late 1970s sparked a surge in enthusiasm in coding, as well as the creation of increasingly software applications (P. Drijvers 2015). A few of these specialist software applications were designed with learning mathematics in mind, whilst others are modified to be used in the classrooms. The rise of functional methods to arithmetic and research in various techniques of mathematical concepts was further aided by the microprocessor and graphical calculators. However, during the early 1980s, technological instruments were still uncommon in mathematics classes, and there was a scarcity of high-quality software.

In light of the aforementioned technical landscape in mathematics instruction from the 1960s to the early nineties, we now look at the theoretical frameworks that were employed in technological advancements in math education studies over the same period. We'll start with the Findings of the 1985 ICMI (International Commission on Mathematical Instruction) Optimization Task (K. TAŞCI 2013).

1.2 The Emergence of Theory from the Integration of Technology within Mathematics Education

The inaugural ICMI Research, "Both Impact of Computers & Informatics upon Arithmetic and Its Education at the Universities and Senior Grade School Level," took held in Frankfurt, Germany, in 1985. While work on mathematical teaching and learning was not a primary focus of both the Study group's inquiries, the author felt it may be instructive to go through the Findings of the Survey to get a sense of what kind of concepts were discussed by the attendees (K. TAŞCI 2013). The editorial staff of the hearings highlighted the positions which computer systems could perform in the mathematical learning within beginning report prepared that sequenced the Study can be performed and conversations, including such "benefits to be deduced from using graphics," "the architecture of source code to motivate the finding and experimentation of notions," and "this same active participation out of their studying." Adventure & exploration pursuits were highlighted in particular (O. Viberg, Å. Grönlund, and A. Andersson 2020). However, the articles' emphasis upon pedagogical potential outcomes and capacities of edge computing, such as conceptualizing, modeling, or computing, with a confidence that would not be yet backed by data, was striking. A collection of 11 "Sponsoring Papers" was included in Reports, chosen from those given during the research conference (I. Lee, S. Grover, F. Martin, S. Pillai, and J. Malyn-Smith 2020).

Discussions on the symbiosis between mathematicians and computers, as well as assessments of the device's potential outcomes and constraints, were among the largely essay-style contributions. The only different theories that could've been found from any of the Eleven publications were about epistemological concerns affecting the foundations of mathematics and physics except on a broad level (Z. Lavicza 2020). The research meeting's goal and thus by were not conceptualizing and thinking on the impact of education in the learning and teaching process of mathematics. As a few mathematicians remarked in their paper: "This is a speculation conference." Even though it's not represented and in ICMI Research articles, technological concepts and their application in teaching mathematics were evolving mostly during the 1980s. Moreover, the early examples were more descriptive representations of technology's functions than experimental tools for building active learning and testing ideas about how to improve mathematics learning and teaching (P. E. Saal, M. A. Graham, and L. van Ryneveld 2020).

Those theoretical foundations centered on specific challenges linked to technology implementation. They had a distinct regional flavor to them, owing in large part to the peculiarities of the equipment, which encouraged certain applications and types of mathematical work. Theoretical concepts were frequently associated with specific pieces of applications but not with broader generic teaching strategies. We briefly examine the Mentor difference, the Acceptance Testing Box concept, Micro Realms and Constructivist, as well as the Amps dualism as instances of these early stages in thinking.

1.3 Instructor, Instrument, and Student

With the introduction of the microprocessor and its widespread use, a new paradigm was established that categorized educational computers activity into four mechanisms or positions: instructor, instrument, and student. "The computer gives some topic information, the student replies, the computer assesses the reaction, and, based on the outcomes of the review, chooses what to show next," says the machine (Susilahudin Putrawangsa and Uswatun Hasanah 2018). So, as per Taylor, a computer that functions as a weapon requires far less skilled coding than a machine that functions as an instructor and may be utilized in numerous different ways. Taylor's description of the third kind of instructional internet connection, training, is as obeys: "To utilize a machine as a mentee is to instruct the system; to do so, the mentoring student or instructor should learn to design and communicate with the desktop in a vocabulary it comprehends." The problem with this type of computing exercise was that explicitly taught would pick up on how she's teaching the computers, therefore, as a consequence, trainees would get fresh perspectives into their thoughts as a means of studying to program (O. Viberg, Å. Grönlund, and A. Andersson 2020).

1.4 White Box – Black Box

The Whitening Container Boxes concept proposed by a writer was indeed a theoretical theory that centered upon on connection between both the learner's education and the features of the technical instrument. As per a statistician, technology is utilized as a dashed line when pupils understand the arithmetic they are requesting the equipment to perform; alternatively, is used as a metal box (P. E. Saal, M. A. Graham, and L. van Ryneveld 2020). The Whitening Container Boxes concept proposed by a writer was indeed a theoretical theory that centered upon on connection between both the learner's education and the features of the technical instrument. As per a statistician, technology is utilized as a dashed line when pupils understand the arithmetic they are requesting the equipment to perform; alternatively, is used as a metal box (I. Lee, S. Grover, F. Martin, S. Pillai, and J. Malyn-Smith 2020). Whereas the Whitening Container Boxes concept is presented due to two opposing worldviews, others have modified it in the creation of “grayish” teaching methods.

1.5 Microworlds and Constructionism

The key concepts underpinning basic educational aims of miniature worlds were summarized by the authors in the concept of constructionism, or "acquiring knowledge." We are currently in Tutee mode in the Teaching assistant framework. Globalization is defined as follows by mathematicians: Constructionism – the N-word as opposed to the V-word – shares constructivism’s connotation of learning as “building knowledge structures” irrespective of the circumstances of the learning. It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it’s a sandcastle on the beach or a theory of the universe (Z. Lavicza 2020).

While conceding in 1991 that now the notion was still evolving, he offered instances of research that he had been engaged with during the preceding twenty years and so that nourished the ideas and theories' early growth. Turtles geometry, for example, was a fundamental part of the hypothesis: The Turtles Kingdom was a microcosm, a "region," a "region of Mathematics lands," where specific types of mathematical reasoning could emerge and flourish with relative ease. It Tortoise establishes a self-contained universe in which some questions were pertinent but others aren't... This concept may be fleshed out by creating a series of "micro universes," one with its own set of conditions and limitations. Children learn how it would be to investigate the features of a selected micro world without being interrupted by unnecessary queries (P. E. Saal, M. A. Graham, and L. van Ryneveld 2020).

Individuals learn to adapt their exploratory tendencies to the formalized arena of academic theory development in this way. Some opponents argued that now the mathematics' idea needed to be fleshed out more. Later developments of the concept of "nanoworld" did not confine the word to Brand or even computer-based settings. A few additional studies define where they used Social constructivist concepts to establish a program of knowledge construction that included the quality factors of meaning and value in a report prepared again for ICMI Research 17. We'd be negligent if we didn't mention that the promise of Logo educational spaces drew the interest, and research effort, of thousands of educational researchers mostly during the 1980s (N. Za’ba, Z. Ismail, and A. H. Abdullah 2020).

1.6 Amplifier Reorganizer

And for instance, in technologies in schools, mathematics re-elaborated a person’s perception of critical thinking. Machines can both augment and reorganize mathematical reasoning. The author, on the other hand, claimed that just one amplified viewpoint, in which tools enable users to be more proficient and learn faster, overlooks the new technologies' more significant two-way management succession capabilities. He emphasized that technologies not only impact humans but that individuals also influence machines (Both in terms of how companies decide what else are suitable methods to like them and whether they alter techniques to help match academic objectives as they refine them).

In his ICMI Research 17 submission, Meagher (2006) describes how modern technology brought into the classroom might bring to just the fore unforeseen 2 factors that really can lead to inadvertent subversion of a particular curriculum's declared goals. He suggests using a mathematician's triangle model of mathematical thinking as a technique for better comprehending the complicated relationship between students, technology, plus mathematics.

Pea's experimental literature involved the creation of a taxonomy that distinguishes between two sorts of functions that might help people improve mathematics cognitive skills: goal activities and process functionalities. Students are encouraged to analyze mathematically by the objective functions, and the patients receiving care assist them after they have done so. Responsibility, personality, and the utilization of motivating "real-world" settings and interactive teaching methods are among the components addressed by the purpose activities. As per Pea, the processing functions are classified into four categories: “Tools for improving conceptual clarity, mathematical inquiry, integrating diverse analytical models, willingness to learn, or learning real problem-solving methodologies”.

1.7 Theoretical Ideas Emanating from the Literature on Mathematical Learning

Throughout these decades, not just to do localized theories about its use of modern technology in education beginning to expand, but linkages with the recently formed concept from either the research or education of arithmetic were gradients. Due to the impossibility of providing comprehensive coverage, this year's three primary instances of philosophical constructs from the literary works on mathematics teaching demonstrate a few of the aspects in which such hypotheses and structures are being used in experiments studies applications, and technologies in the events prior up until the mid-1990s (N. Za'ba, Z. Ismail, and A. H. Abdullah 2020).

1.8 Interrelations Between Mathematics and Technology:

This up-to-date overview has been based on peer-reviewed journal articles including the Publication for Maths Teacher Training, Academic Experiments in Maths, Innovations, Teaching, and Wisdom, and ZDM Cognitive Science, but also prosecutions of professional organizations including such CERME presidencies, ICMI findings, ICTMA, and study done in this field, particularly in Romania, and very well screenplays. Interrelationships between maths and engineering are not the subject of existing investigation, although it has been a lengthy and hotly debated issue in previous works (N. S. M. Rasid, N. A. M. Nasir, P. Singh, and C. T. Han 2020). The instruction of how to recognize and comprehend mathematical relationships is a key aspect of mathematics instruction that is addressed in many curricula throughout the globe (e.g., NCTM 2000). As a result, mathematicians explain the problem of employing technology as follows:

- This necessitates teachers imagining probable interrelationships between technologically provided current architectural features and the real program (N. S. M. Rasid, N. A. M. Nasir, P. Singh, and C. T. Han 2020).
- By adhering to those criteria, (mathematical) knowledge and abilities should be transmitted, allowing Whitehead's desire to be fulfilled:
- The whole science should lose its esoteric aspect because it is provided to students. It must deal with a few broad concepts of the far importance in a clear, direct, and straightforward manner (B. M. Follong, E. Prieto-Rodriguez, A. Miller, C. E. Collins, and T. Bucher 2020).

It is undeniable that using technologies in mathematics teaching broadens the range of instruments available. Complicated and genuine difficulties can be mentioned utilizing technological media as a flight recorder. Aside from practical applications, everyday difficulties that aren't explicitly related to maths can be debated. Because the hard mathematical portion and the mathematical answer may be delegated to technologies, meaningful problems like evacuation a specific location or a sports stadium, determining the best path on a mountainside, or stance can be explored. Only the human needs of knowing and comprehending mathematical relations, as well as the application of mathematical abilities, remain. And those are the (new) computational mathematics difficulties (W. Park, J. Y. Wu, and S. Erduran 2020). As one author puts it: Whenever a new story, such as technologies, is added, the ecosystem is disrupted, and decisions must be made to restore equilibrium, decisions that may have been connected to the many interconnected parts of the educational system stated.

The mediating of communication photography change data structures, as shown in dynamic geometries: dynamic approximations of mathematical entities do not reside in the postulate of topography; instead, they were new things with new habits. In arithmetic, digital technological advances are a novel form of technology that encapsulates academic understanding (T. T. Wijaya, S. Murni, A. Purnama, and H. Tanuwijaya 2020). Figure 1 represents the relationship between mathematics and technology

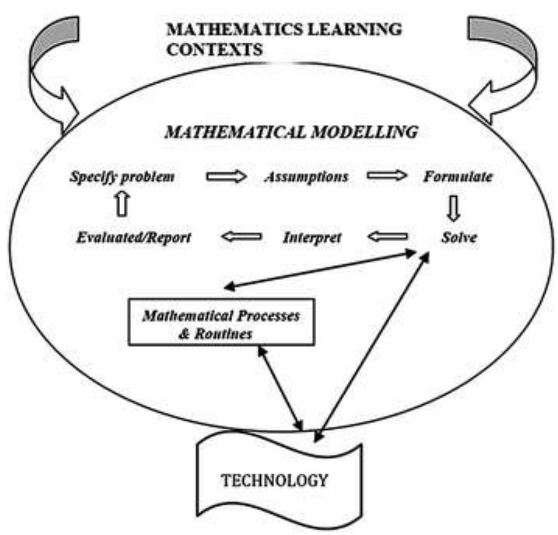

Figure 1. Relation among Mathematics and Technology (P. Drijvers. 2010)

2. Discussion

A component is thought of as a connection between x and y variables from the standpoint of the process: The algorithm has a matching value of y with each x value. A functional or connection, of any of its manifestations, are conceived of as things from the object viewpoint – for example, trigonometric functions as membership of parametric classes, or in the planar as networks that may be "collected whole" and twisted or rotated. The researchers indicated that gaining proficiency in linear connections entails understanding which viewpoints and depictions usually work in certain contexts and just being ready to migrate fluidly from one to another based on the constraints of the scenario and one's intended outcomes. The investigators decided to design a tutoring program that would speak directly to the objects and procedure orientations within the framework of linear equations using GRAPHER, a computer-based microenvironment. It's worth noting that, unlike in the preceding part, the theoretical thoughts influenced the program design instead of the opposite way around. Students struggle to acquire flexibility between any of these two views, according to mathematicians. They did highlight, though, that technology tools like the one utilized in this research allow skills to communicate with elements of functionality and build gut feelings that were previously unavailable due to the lack of this kind of tool.

Further implementations of a conceptual model (which eventually became known as the APOS concept) were created. They utilized the ISETL software package as an atmosphere in which learners could write software applications to construct mathematics as processes. Children are expected to grasp the concept of service as an object by completing programming assignments that employed functions as an entry but also generated functions as outputs. However, opponents say that, while a focus on continuous processes is useful for stressing process characteristics, it would be too tightly linked to arithmetic to allow for a full-fledged object view of procedures. Mathematicians employed the APOS concept and its feature of genetic deconstruction one of the first investigations on the educational application of computer arithmetic. Gray & Tall developed the concept of the precept as just a third category to the procedure dualism (1991). "Using a machine to perform the audit, allowing the student to focus on the outcome, greatly enhances the educational experience," their authors claim.

2.1 Visual Thinking vs. Analytical Thinking

The interaction of spatial and conceptual schema in mathematical work, as well as learners' preferences for either one, had been a theoretical concept that was used in several previous technology-related research investigations. For instance, in the setting of the eleventh and twelve-year-old working in turtles mathematics Logo settings, mathematicians discriminated between both the two such follows:

- A visible schema is a Logo structure of geometric forms in which the instructions and input are chosen determined by visual clues.

The empirical schema refers to solutions that are predicated on a search for precise simulation and programmatic relationships inside a figure's structure. The pupils did not completely establish connections among their representations and their problem solving, according to the scientists. While studies in non-technology training circumstances had revealed (older) pupils' inclinations for functioning in the Stallings instead of the graphic, the introduction of plotting technologies offered the possibility of a shift toward prioritizing block diagrams and moving average. In the coming years, these concerns will be investigated further.

2.2 Representational Issues

Theoretical frameworks of previous research using technology settings in mathematics teaching included representational concerns. Unfortunately, there used to be a lack of empirical accuracy about vision, mental images, and representational in most of this study, and also in most of the studies that did not use technologies. The need for explanation prompted by technological advances and its representational potential prompted an attempt to provide a unified theoretical framework for representation. "A few really math education scholars have created local concepts in reaction but the requirement to explain signifiers in a specific area," Kaput told delegates at a workshop on represented in 1984. "Even so, a cohesive and overarching theoretical background is sorely missing." He argued that a notion of the presentation should encompass the five important elements: the represents entity, the representative entity, the specific features of the depicted organization that are now being represented, and the representative entity's representations of the characterized entity; the characteristics of the represented entity which are conducting the reflecting, as well as the connection seen between two individuals This paradigm was used to conceptualize several "representative democratic studies" using the three types of depiction: statistical, pictorial, and symbols. Whereas the volume of knowledge on learners' linkages between the three interpretations of operations in diverse technical ecosystems would keep growing, Kaput predicted further philosophical developments of interpretations and he spoke about "the potential of typefaces in vibrant digital multimedia." That particular shift in theoretical models is one of the topics covered in a later section.

2.3 From Past to Present

Lagrange et al. compiled a fascinating inventory of technology-related research in teaching mathematics from the 1990s. Individuals note in everyone's review of the global corpus with technology and development articles published of Knowledge interoperability that “the period from 1994 to 1998 made an appearance particularly deserving of research [662 publication works], since during such years school use of tech became more feasible, and writings mellowed, often having broken with preliminary atrium approaches. Lagrange et al. discovered that if the only conceptual synchronizations in the whole corpus of publications studied would be at a broad level and included problems such as representation, representational linkage, and contextual knowledge. According to the findings, nearly two-thirds of the articles studied seemed to go far beyond explanations of the surroundings or events being observed – even though this material was supposed to indicate a particular level of expertise in the subject.

To wrap up this subsection mostly on theoretical models employed in innovation research in classroom practices from either the 1990s onwards, we see an early focus on the capacities of technologies instead of just theoretical underpinnings. Ultimately, both locally created technological advancements theories and newly generated theories from mathematical teacher education were applied to the issue of technology-assisted learning. Such an overall trend may be extended to the present predicament, which is also the topic of discussion over the next paragraph.

3. Conclusion

Recent technological improvements cannot be isolated from existing approaches addressing theory in mathematics education technology studies. On the one hand, technological equipment has reduced in size, and portable devices such as graphing and symbols computations are becoming more widespread. On the other hand, communication is becoming a more integrated component of technology use: apps may be distributed through the Internet, and learners in online education settings can interact efficiently with classmates and lecturers. On the other hand, the content of such educational systems is difficult to develop. The question of how to design a multimedia course that fully utilizes technology's possibilities and goes beyond the "newsprint" paradigm has yet to be resolved.

The discussion of recent theoretical achievements in this chapter is set in the context of such technological advancements. The segment above provided an outline of some exact theoretical perspectives that were suited from hypotheses in mathematics instruction or beyond, however with new great emphasis that indicate a shift toward customized architectures for researching arithmetical teaching and learning process in learning environments. In the part above, two specific approaches on learning using the development process to mathematical, measurement theory, or multimodal mediation, are examined in further detail.

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