Role of Technology in Teaching-learning Mathematics

Today, in many locations around the world, there is a significant gap between the knowledge and skills students learn in school and the knowledge and skills workers need in workplaces and communities.

Employers report that they need students who are better prepared in skills such as professionalism and work ethic, oral and written communication, teamwork and collaboration, critical thinking and problem solving, application of information technology, and leadership. (Sources: The Partnership for 21st Century Skills, enGauge, and SCANS Report highlight different skills and call them “21st Century Skills.”).

So the emphasis in schools is increasingly on learning how to learn, rather than just acquiring specific technical skills that keep changing anyway.

LONDON: Researchers are designing new interactive multi-touch 'smart' desk classrooms which have been found to boost pupils' mathematical skills. Using multi-user desks in the "classroom of the future" the children were able to work together in new ways to solve questions and problems using inventive solutions.

A three-year project with 400 eight to 10-year olds found that using interactive "smart" desks can have benefits over doing maths on paper, and that pupils are able to improve their fluency and flexibility in maths by working together.

Burd's team found that 45 % percent of pupils who used a maths programme on the smart desk system increased the number of unique mathematical expressions they created, compared with 16 % percent of those doing it on paper.

"We found our tables encouraged students to collaborate more effectively," said Burd. "Such collaboration just did not happen when students used paper-based approaches."

Source; Times of India dated 24/11/2012
1. Introduction

1.1
Schools today face ever-increasing demands in their attempt to ensure that students are well equipped to enter the workforce and navigate a complex world. Research indicates that computer technology can help support learning, and that it is especially useful in developing the higher order skills of critical thinking, analysis, and scientific inquiry.

1.2
Mathematics, to most, is a complex and difficult subject. The tendency for most students is to consider the subject as one that is boring, thus, creating lack of interest in the topics being discussed. This poses a great challenge for teachers and educators, especially in the primary and intermediate levels, wherein a good study habit and a firm grasp of basic concepts should be developed.

1.3
Don Knezek, the CEO of the International Society for Technology in Education, compares education without technology to the medical profession without technology. “If in 1970 you had knee surgery, you got a huge scar,” he says. “Now, if you have knee surgery you have two little dots.”

1.4
Einstein famously said that his pencil was more intelligent than he was - meaning, that he could achieve far more using his pencil as an aid to thinking than he could unaided. There is a need to recognize that mathematical digital technologies are the pencils of today and that we will only fully exploit the benefits of digital technologies in teaching, learning and doing mathematics when it becomes unthinkable for a student to solve a complex mathematical problem without ready access to digital technological tools.
2. Why to use technology?

"Our aim was to encourage far higher levels of active student engagement, where knowledge is obtained by sharing, problem-solving and creating, rather than by passive listening. This classroom enables both active engagement and equal access," by lead researcher, Liz Burd of Britain's Durham University. (2012)

2.1 Change of Scenario

Mathematics is regarded as the queen of all Sciences. For long, the role of Mathematics was limited to purely academic domain. Now, the role of Mathematics is not restricted to purely academic domain. It has entered the domain of Technology and Industry. New fields in Mathematics such as Operation Research, Control theory, Signal Processing and cryptography have been generated which need technology. Technology can reduce the effort devoted to tedious computations and increase students’ focus on more important mathematics.

2.2 Technology focuses Student’s thinking

Technology can be useful to the extent it focuses student thinking in ways that are germane, not extraneous.

In primary school, it is important to learn to do arithmetic fluently. Using technology to do this thinking for the student would be inappropriate. In secondary school, however, students have mastered arithmetic and should be focused on more advanced skills and concepts. Computational support can be very important.

2.3 Use of technology makes Ideas Tangible.

Piaget discovered that children first develop ideas concretely and later progress to abstractions (Piaget, 1970). In designing learning environments, it is often helpful to apply this principle in reverse: to help students learn an abstract idea, provide them with more tangible visualizations.

Researchers have found that when technology makes abstract ideas tangible, teachers can more easily (Bransford, Brown, & Cocking, 1999; Roschelle et al., 2001; diSessa, 2001):

- Build upon students’ prior knowledge and skills.
- Emphasize the connections among mathematical concepts.
- Connect abstractions to real-world settings.
3. What is technology?
Technology is the making, modification, usage, and knowledge of tools, machines, techniques, crafts, systems, methods of organization, in order to solve a problem, improve a preexisting solution to a problem, achieve a goal or perform a specific function. It can also refer to the collection of such tools, machinery, modifications, arrangements and procedures.

3.1 History of Use of Technology in Mathematics
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 videotape, 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.

3.2 Digital technologies / Information Communication technologies
For thousands of years, humans made presentations using only the tools they were born with: their voice and body. That was followed by tools such as chalkboards and projectors, and then by digital tools such as PowerPoint. More recently other tools have emerged, such as Sliderocket, Prezi, Glogster, Animoto, and Magic Magnify. Since the 1980’s, the importance of computer support in the teaching and learning of mathematics has been emphasized more and more.
Information and Communication Technology (ICT) is basically an umbrella term that encompasses all communication technologies such as internet, wireless networks, cell phones, satellite communications, digital television computer and network hardware and
software; as well as the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs etc. that provide access to information.

4. How to use Technology as tools of Teaching

There are various types of technologies currently used in traditional classrooms. Among these are: Radio, television, audio tape, video tape, slide projector, overhead projector are of passive learning when interaction of the learner is less.

4.1. Computer in the classroom: Having a computer in the classroom is an asset to any teacher. With a computer in the classroom, teachers are able to demonstrate a new lesson, present new material, illustrate how to use new programs, and show new websites.

Class blogs and wikis: There are a variety of Web 2.0 tools that are currently being implemented in the classroom. Blogs allow for students to maintain a running dialogue, such as a journal, thoughts, ideas, and assignments that also provide for student comment and reflection. Wikis are more group focused to allow multiple members of the group to edit a single document and create a truly collaborative and carefully edited finished product.

Wireless classroom microphones: Noisy classrooms are a daily occurrence, and with the help of microphones, students are able to hear their teachers more clearly. Children learn better when they hear the teacher clearly.

Mobile devices: Mobile devices such as clickers or smart phone can be used to enhance the experience in the classroom by providing the possibility for professors to get feedback.

Interactive Whiteboards: An interactive whiteboard that provides touch control of computer applications. These enhance the experience in the classroom by showing anything that can be on a computer screen. This not only aids in visual learning, but it is interactive so the students can draw, write, or manipulate images on the interactive whiteboard.
Digital video-on-demand: Digital video eliminates the need for in-classroom hardware (players) and allows teachers and students to access video clips immediately by not utilizing the public Internet.

Online media: Streamed video websites can be utilized to enhance a classroom lesson.

Online study tools: Tools that motivate studying by making studying more fun or individualized for the student.

Digital Games: The field of educational games and serious games has been growing significantly over the last few years. The digital games are being provided as tools for the classroom and have a lot of positive feedback including higher motivation for students. There are many other tools being utilized depending on the local school board and funds available. These may include: digital cameras, video cameras, interactive whiteboard tools, document cameras, or LCD projectors.

4.2 Software used for teaching learning Mathematics

- Graphic Calculators
- Dynamic graphing tools (GeoGebra)
- Dynamic geometry tools
- Microsoft Excel / spreadsheet
- Microsoft Mathematics
- GeoGebra
- Auto shape
- Mat lab

4.3. Learning resource centre (Indian system of Education)/Websites
Thousand websites provide e-resource for both offline and online teaching –learning.
IGNOU (http://www.ignou.ac.in/)
The Indira Gandhi National Open University (IGNOU),
http://www.ncert.nic.in/NCERTS/textbook/textbook.htm
The website is a e-resource for syllabus, online text books, other publications such as sample question papers and multimedia packages which helps both the students and teachers in teaching learning Mathematics.
http://www.ciet.nic.in
Central Institute Of Educational Technology (CIET) provides information of educational technologies viz. radio, TV, films, Satellite communications and cyber media either separately or in combinations.

www.cbse.nic.in & http://www.icbse.com provides information regarding online application for different examinations such as Mathematics Olympiad.

http://www.mathplayground.com/ASB_MeteorMultiplication.html is a very good website which allows the learner to motivate learning Mathematics through different game.

http://cbse.meritnation.com/cbse-signup2?mncid=Adwords_Banner_Test&gclid=CJnSm9yj2LMCFQV66wodpnQAQg


http://mathforum.org/library/Lesson Plan

http://illuminations.nctm.org is a very interactive website for Geometry.


There are some other useful sites provide wonderful mathematical investigations for our students and answers to the many perplexing questions that invariably arise in the classroom, for general teaching-learning mathematics.


NRICH (www.nrich.maths.org.uk)

MATH CENTRAL (mathcentral.uregina.ca)

MATH FORUM (www.mathforum.com)

PBS (www.pbs.org/teachersource/math)

DR. MATH (www.mathforum.com/dr.math)

Here the teacher as well as student will find answers to the many questions that teachers and others have posed.

http://www.ex.ac.uk/cimt & www.mathsplayground.com

this site presents a wonderful rationale for using math games in your classroom and a significant collection of easy-to-use and friendly math games.

www.discovery/education.org
5. Impact of technology on Teaching & learning Mathematics

Researchers have found that the move from traditional paper-based mathematical notations to on-screen notations (including algebraic symbols, but also graphs, tables, and geometric figures) can have a dramatic effect. In comparison to the use of paper and pencil which supports only static, isolated notations, use of computers allows for “dynamic, linked notations” with several helpful advantages.

5.1 Impacts on Student’s Learning Process

Appropriate use of ICTs allow Learnersto have the freedom of choice to decide their own time, place, pace, or path to study. Learning materials that are enhanced with various media such as sound, narration, video, animation, graphicsetc. provide learners choices to enhance their different intelligence or learning styles. If designed and implemented properly, ICT-supported education can promote the acquisition of the knowledge and 21st century skills such as Creativity, critical thinking and problem solving. Learners are able to exchange ideas more personably and directly.

The new ways of teaching and learning are underpinned by constructivist theories of learning and constitute a shift from a teacher-centered pedagogy to one that is learner-centered.

5.2 Technology helps teacher in lesson Planning

The ease and speed of obtaining information on the Internet definitely helps the teacher users to empower themselves.

1. It gives teacher the opportunity to learn current innovations in teaching from other Countries that may be utilized in his/her her class to strengthen pupils’ self-esteem.

It adds further information about the topic he/she is teaching. He/she can make the content more colourful and purposeful by integrating slide show and videos related to the topic.

He/ She can successfully impart education characterized by imparting instructions, collaborative learning, multidisciplinary problem-solving and promoting critical thinking skills as highlighted by National curriculum framework 2005 (NCF 2005)
5.3 **Technology provides evaluation tools.**

Technology provides different assessment tools such as Checklists, rating scales and rubrics to assess the 21st century skills such as creativity, problem solving, decision making and leadership skills which are criteria for project based learning. The rubrics for Research Report document, Power point presentation, Role Play helps the user. The teachers can access number of printable worksheets for Mathematics. Checklists, rating scales and rubrics are readily available in some educational websites. The students can do self evaluation through different online tools and get immediate feedback for correction. The advantages include:

1. instant feedback to students
2. greater flexibility with respect to location and timing
3. Improved reliability.
4. improved impartiality
5. greater storage efficiency

5.4 **Collaborative learning**

There are a lot of internet sites providing interactive learning tools for students. Blogs, Forums, Communities, Webcast, Pod Cast, User Groups, Picassa (Google) and Flickr (Yahoo), W3Schools.com, Wikis, Web conferencing, Video Conferencing, Chat, E-mail, Instant Messaging, Bulletin Board, Data Conferencing, Shout Box, Image Board, YouTube, Slide Share, Think quest, Schools online,e-pal and British Council Schools online.

Seeing what your friends are doing, and being able to fully participate in group activities, offers new ways of working in class, the researchers say. The findings published in the journal Learning and Instruction, show that children using these Synergy Net classrooms improve in both mathematical flexibility and fluency, while children working on traditional paper-based activities only improve in flexibility.

6. Barriers of use of Technology

- Not enough or limited access to computer hardware & computer software
- Lack of time in school schedule for projects involving ICT
- Lack of adequate technical support for ICT projects
- Not enough teacher training opportunities for ICT projects
- Lack of knowledge about ways to integrate ICT to enhance curriculum
- ICT integration is not a school priority
- Students and Teachers do not have access to the necessary technology at home

7. Curriculum

Increasingly the specification of modern laptop and e-book portable computers is such that virtually all of the major mathematical technologies now run on them. Similarly there have been significant improvements in broadband Internet connections and collaborative tools. The expansion of pupils' access to technology is less of an issue than the leadership and management of the resources at school and college level. If digital technologies are to be embedded in the mathematics curriculum then the knowledge and skills required by both teachers and learners to use them should be explicitly specified.

8. Summary

8.1 Technology provides New Ways of Learning

Technology can reduce the effort devoted to tedious computations and increase students’ focus on more important mathematics. Equally importantly, technology can represent Mathematics in ways that help students understand concepts. In combination, these features can enable teachers to integrate project based learning. Calculators and other technological tools, such as computer algebra systems, interactive geometry software, applets, spreadsheets, and interactive presentation devices, are vital components of a high-quality mathematics education. With guidance from effective mathematics teachers,
students at different levels can use these tools to construct knowledge and develop 21\textsuperscript{st} century skills such as critical thinking, problem solving and decision making.

\textbf{8.2 New Roles of the Teacher}

In the present time the teacher’s role in teaching mathematics is facilitator. The teacher has to facilitate the learning by providing students with access to instructional technology, including appropriate calculators, computers with mathematical software, Internet connectivity, handheld data-collection devices, and sensing probes. The teachers can find the means to more easily to engage students in learning and to cater to the various needs of different students. Technology provides opportunity for his /her students to collaborate with others. This case indicates that the Internet cannot replace the role of the teacher as facilitator, as she must set up the task, pose questions, provide appropriate websites, and give feedback.

\textbf{8.3 Teaching Mathematics Better and Teaching Better Mathematics}

In order to educate students to be life-long learners and successful contributors to the new global market, educators must change the way they teach and the way students learn. Curriculum and assessment in school mathematics should explicitly require that all young people become proficient in using digital technologies for mathematical purposes. High-stakes assessment needs to change in order to encourage the creative use of digital technologies in mathematics classes in schools and colleges.

What needed in schools and colleges are student-led mathematical modeling, problem solving and computer programming which makes use of the powerful Mathematical digital technologies that are widely used in society and the workplace.

\textbf{References:}

Pratima Nayak, Teacher, Kendriya Vidyalaya, Fort William, Kolkata