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ICT in Mathematics

Abstract

Information and communication technology (ICT) refers to the use of educational technology in the teaching learning process. ICT is used as an enabler for teaching all subjects ranging from art to mathematics. Information and Communication Technology (ICT) has spread in almost every facet of lives including in educational institutes. The use of technology can facilitate a move from didactic classroom teaching to participatory, decentralized and interactive group learning. This paper mainly focuses on the various domains of ICT which including certain generalized software which can be instrumental to develop pedagogical tool apart from the 'chalk and talk' method. The selection of the most suitable software for the subject is very critical and hence teachers of the subject must understand and appreciate various criteria for the selection of the same. Here the merits and demerits of the use of ICT has also been emphasized which mainly includes certain specific and miscellaneous issues related to the students and teachers. In this paper several emerging concepts and technologies related to mathematics teaching also have been outlined.

Introduction

Information and Communication Technology (ICT) refers to the integration of computing technology and communication. It can be defined as 'anything which allows us to get information to communicate with each other or to have an effect on environment using electronic or digital equipment'. The early computers were designed to aid just computation (for e.g. simple calculator), however today their use has become diverse and computation is just one among the many functions a computer is used for. These coupled with telecommunications (broad band) have become a major driver of change all over the world. It has brought unprecedented changes in many walks of life and education system.

In India ICT has taken a long stride in the field of education especially in schools. Government of India's CLASS (Computer Literacy and Awareness in Secondary Schools) could be marked as the genesis of this movement.

Role of ICT in schools

It is felt that the aim should be to engage students at three levels: technical, practical, and critical. Student should not only learn to use technology but they should also be able to use it in other activities referred to as its practical aspects (for e.g. in research analysis, note-making, assignment completion, publication and prediction) as also at the critical level, where student must learn to evaluate appropriateness of the information and the method used. These strategies will lead to shift in the educational goals towards;

- Exploration and problem solving rather than memorizing and learning the status quo.
- Processing of information rather than the collection of information.
- Search for patterns and connections rather than linear sequential reasoning.

ICT and Subject teachers

The daily routine of the subject teacher was more or less monotonous and comfortable until IT hit them in a big way. With the introduction of ICT they not only have to continue to expert in their own subjects but also have to learn how to use IT in their teaching. Teachers can inculcate this technology in five different steps:

- Entry
- Adoption
- Adaption
- Appropriation
- Invention

ICT and Mathematics Teaching

Ittigson & Zewe (2003) cited that technology is essential in teaching and learning mathematics. ICT improves the way mathematics should be taught and enhances student understanding of basic concepts. Many researchers have carried out studies to evaluate the benefits of using ICT in mathematics. Becta (2003) summarised the key benefits ICT promotes greater collaboration among students and encourages communication and the sharing of knowledge. ICT gives rapid and accurate feedbacks to students and this contributes towards positive motivation. It also allows them to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations. ICT also supports constructivist pedagogy, wherein students use technology to explore and reach an understanding of mathematical concepts. This approach promotes higher order thinking and better problem solving strategies which are in line with the recommendations forwarded by the National Council of Teachers of Mathematics (NCTM); students would then use technology to concentrate on problem-solving processes rather than on calculations related to the problems (Ittigson & Zewe, 2003). For a successful integration of ICT into the mathematics curriculum, it is essential to have knowledge of the existing software that is used by mathematics teachers.

Teaching and Learning Mathematics through ICT

There are various types of soft- wares available in the market while some of them are freely available on the internet as a freeware or shareware. These soft- wares can be categorized in to Standard soft-wares like Windows, Front Page, PageMaker, Photoshop, CorelDraw etc. and specialized soft-wares, like Microsoft Excel, Mathematica, MapInfo(GIS software), SPSS (Statistical software), ANNOVA(Analysis Of Variance), Design Expert, simulation soft-wares and Expert System in Mathematics, hand held graphic computers can be employed.

With Mathematica one can solve mathematical equations, draw graphs for equation and perform many advance activities.

Graphing software can help students to solve differential equations easier than analytic method. The use of Excel is better for the purpose of dispelling "near miss (a permutation of the same 4 digits)" myths in teaching because traditional equipment is incapable of producing quick and random generation of numbers afforded by the software. Features of software can help stimulate data and demonstrate it using stastical graph, like a bar chart, table or diagram mode.

The use of hand-held graphing calculators in teaching the transformation of graphs and the sketching of polar curves. This can help students focus on the gestalt changes and features of the graphs.

ANNOVA can be used for the statistical analysis of the experimental data and to find out the authenticity of the data comparing actual and predicted data.

Features of software can help stimulate data and demonstrate it using stastical graph, like a bar chart, table or diagram mode.

Design soft- wares can be used when more than one parameter in the system are varied and their response on the outcome can be calculated by monitoring probability values.

Simulation soft-wares are the special category of educational soft ware and can simulate research or teaching techniques that produce actual events and processes under the test conditions. It has the advantages of safety, simplicity and economy.

Expert system are designed using artificial intelligence construct which can learn from the earlier experience and develop new rules and strategies which can make tutorial packages more effective than human teachers.

Wolfram/Alpha is the first step in ambitious, long-term project to make all systematic knowledge immediately computable by anyone. Enter your question or calculation and Wolfram/Alpha uses its built-in algorithms and a growing collection of data to compute the answer. Based on a new kind of knowledge-based computing. (Case study on Wolfram/Alpha ICT.ppt)

Uses of Interactive Whiteboards make mathematics teaching richer, and mathematics learning more effective.

Sketchpad helps students see the underlying geometrical relationships, moreover when conventional static drawing is difficult to be applied. Sketchpad is also used in the animation function.

Courseware and presentation tools are used widely for teaching mathematics. Graphical Visualization tools and online demonstrations have essential values as well. There are many Flash presentations and Java applets found in the Internet which can be readily and effectively used in mathematics lessons.

There are some sites catering for specific areas of Mathematics at Advanced Level, particularly Statistics. Four excellent examples are

- Inferential Stats at <http://faculty.vassar.edu/~lowry/webtext.htm>
- Rice Virtual Lab in Statistics at <http://www.ruf.rice.edu/~lane/rvls.html>
- CAST at <http://cast.massey.ac.nz/>
- Calc101 at <http://www.calc101.com>

Benefits of ICT by Teacher's Perspective

- Elimination of physical limits imposed by the classrooms: Teachers can connect students to resource available in different parts of the world who in turn, can work with peers from other schools.
- Greater access to information and knowledge: information on any topic is now just a mouse click away.
- Increased motivation to learn for future teachers: The concept of lifelong learning is become easier and possible.
- More effective and custom based teaching: teacher can modify their material at the last moment and customize it for the intended students.
- More efficient learning management: helps in evaluation and other administrative works.
- Improved and more frequent communication among educators and students: e-mail, online chat, and video conferencing make frequent communication possible.
- Enhance critical thinking: instead of collecting information analysis of information is emphasized.
- Greater autonomy: teachers can have greater control over their resources, student data and less dependent on the supporting staff.

Issues of Concern

The sheer enormity of ICT is that it makes it powerful tool and also a Pandora's box of problems. Some of the major concerns related to this are listed below:

- Individual differences in exposure to use of computers among students
- Not enough or limited access to computer hardware
- The lack of knowledge among teachers about ways to integrate ICT
- The lack of adequate technical support for ICT projects
- Internet addiction
- Copying and Copyright
- Questionable Content
- Pornographic sites
- Hacking
- Privacy and Safety

Emerging Concepts in ICT

Virtual School:

Virtual school is an educational organization that offers k-12 course through Internet or Web-based method. A virtual school can operate under a time frame or can be self-paced. A virtual school requires better technology infrastructure that supports two way communication and storage and retrieval of large volume of text etc. There are some virtual schools in USA and Canada where students do not need to go to school at all their schooling through the Net.

Smart Schools:

Those schools which support learning and thinking schools with programs, infrastructure, tools, teachers and management aided information and communication technologies. Students learn by asking questions, reading exploring, day dreaming, formulating and testing hypothesis and communicating what they learnt by participating skills using technologies such as computers, internet and video conferencing.

OHP pads:

There are a number of devices using Liquid Crystals Displays (LCDs) designed for use with an overhead projector.

These include:

- transparent four-function and scientific calculators which sit on the OHP
- monochrome LCD displays which echo the output from graphical calculators
- colour LCD displays which echo the output from a PC or laptop

Dynamic geometry software:

This software has evolved from a package written for the Apple II computer over 20 years ago called the Geometric Supposer, written by Judah Schwarz and others at MIT. Essentially it provides a range of tools for you to construct geometric objects from a range of 'primitive' objects (points, segments, lines, circles etc.) using both "classical" constructions (midpoint, perpendicular, parallel etc.) and transformations (reflect, rotate, translate etc.)

E-learning:

The facility of internet and intranet enables e-learning that allows learning anytime and anywhere. E-learning is a student centred approach and can complement classroom teaching. In India, companies like classteacher.com and e-gurucool.com are offering internet based e-learning, modules like Blackboard (<http://www.blackboard.com>), Intralearn (<http://www.intralearn.com>) and WebCT (<http://www.Webct.com>).

Conclusion

Growing of local researches on the use of ICT in the classroom also make growing of the use of ICT in mathematical education that have yet to be explored. The emergence of the knowledge society and need for enhanced competency building among the knowledge workers as a continuous process has necessitated not only the introduction of ICT as teaching learning strategy in schools, but as an empowerment tool to the teachers and students. The use of ICT in the classroom needs initiative of teachers themselves to discover what is appropriate for their students. The aim, therefore, is not to provide students with a new "technology toy", but rather to create opportunity for active learning that enable the development of a wide variety of content knowledge, skills, processes, and attitudes that they may bring with them into the real world. Hence they should not only acquire the current knowledge about the advancements in the field, but become active users of the technology in all domains of the school environment.

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