Integration of Information and Communication Technology (ICT) to Enhance Mathematical Experience

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ABSTRACT: In Educational institutions, the government has made a huge investment in ICT (Information and Communication Technology) over the past few years and is committed to maintain it. The education authorities have over the last decade, taken concrete steps to encourage the use of computer to enhance teaching and learning. But the preliminary observations found that teachers are not fully utilizing these facilities in their teaching. A number of teachers report that they do not feel comfortable with the integration of ICT in subject teaching. Further, only a few teachers succeed in integrating ICT into subject teaching in a fruitful and constructive way that can promote students conceptual understanding and can stimulate higher level thinking and reasoning. Different subjects will have various styles of using ICT for example in mathematics we use hand – held devices such as graphical calculator, MATLAB software and whole class teaching tools such as interactive white board or LCD (Liquid Crystal Display) etc. There are some barriers in integration and adoption of ICT in teaching i.e. the lack of time in the school or college schedule for involving ICT, insufficient teacher training opportunities, lack of knowledge about ways to integrate ICT and unavailability of resources.
This paper is an attempt to overcome the above mentioned barriers and a survey was conducted to investigate the integration of ICT for teaching of mathematics more effective. It is concluded among the survey that the use of ICT in subject teaching can make the teaching process more effective as well as enhance the student's capabilities in understanding basic concepts.

Keywords: ICT, Interactive White Board, LCD

I. INTRODUCTION

Information and Communication Technology (ICT) has become most widely used buzzword of the computer industry. It has affected all walks of life in one-way or another. ICT is the modern science of gathering, storing, manipulating, processing and communicating desired types of information in a specific environment. IT was limited only to the textual mode of transmission of information with ease and fast. But the information not only in textual form but in audio, video or any other media is also to be transmitted to the users. The ICT brings more rich material in the classrooms and libraries for the teachers and students. It has provided opportunity for the learner to use maximum senses to get the information.

The new technological developments in information and communication technologies such as satellite radio and television broadcasting, long distance telephony, computers and telecommunications, have dramatically expanded our options for engaging in learning and teaching at the individual, community and societal levels. There are several modern communication services such as Electronic Mail, Telex, Facsimile Transmission, Bulletin Board service, Teletext, Videotext, Voice Systems, Voice Message System, Teleconferencing, Audio conferencing, Video conferencing etc. All the above services make use of the special equipments; computer based message systems and computer networks. The special equipments include: fax machine, EPBX, data networks, Optical disk storage, Word processor, TV, digital technologies such as computer and internet and so on.

When these tools of ICT used appropriately, it help to expand access to education [1], strengthen the relevance of education to the increasingly digital workplace, and raise educational quality by, among others, helping make teaching and learning into an engaging, active process connected to real life. Wider availability of best practices and best course material in education, which can be shared by means of ICT, can foster better teaching.

Thus, the participation rates of the Indian population in education, and especially in higher education are quite low. In the current Information society, there is an emergence of lifelong learners as the shelf life of knowledge and information decreases. People have to access knowledge via ICT to keep pace with the latest developments. In such a scenario, education, which always plays a critical role in any economic and social growth of a country, becomes even more important. Education not only increases the productive skills of the individual but also his earning power [2]. It gives him a sense of well being as well as capacity to absorb new ideas, increases his social interaction, gives access to improved health and provides several more intangible benefits. Today ICTs—including laptops wirelessly connected to the Internet, personal digital assistants, low cost video cameras, and cell phones have become affordable, accessible and integrated in large sections of the society throughout the world. It can restructure organizations, promote collaboration, increase democratic participation of citizens, improve the transparency and responsiveness of governmental agencies, make education and health care more widely available, foster cultural creativity, and enhance the development in social integration. It is only through education and the integration of ICT in education that one can teach students to be participants in the growth process in this era of rapid change. Use of ICT in education develops higher order skills such as collaborating across time and place and solving complex real world problems [3]. It improves the perception and understanding of the world of the student. Thus, ICT can be used to prepare the workforce for the information society and the new global economy. Institutions must promote "Learning to learn" i.e. the acquisition of knowledge and skills that make possible continuous learning over the lifetime. On internet many websites are available freely which may be utilized by teachers and students for understanding different concepts, improving vocabulary, developing Reasoning & Thinking, etc [4]. Student's ability to apply their ICT capability across the curriculum is largely dependent on the effective teaching and learning of ICT in the first place.

Student's use of ICT in other subjects may be ineffective if they do not already have an appropriate level and understanding of ICT capability. This may result in a lack of progress in both ICT and the subject area. For example, asking students to produce a presentation in a given subject will be unproductive if they have little experience of using the software or understanding of how to create meaning and impact for a given audience. Students who try to learn new areas of ICT at the same time as new subject content will often fail in both endeavors. It is crucial that students are taught the appropriate ICT capability before applying it in other subjects. Purposeful and appropriate application of ICT in subjects offers students opportunities to:

- Use their ICT capability to assist and progress their learning in subjects;
- Engage in higher-order thinking skills, for example by using ICT to undertake detailed analysis when modelling data;
- Demonstrate, apply and reinforce their understanding of ICT capability within a range of subject contexts. The transferability of ICT capability is an important aspect of progression in students' knowledge, skills and understanding.

However, existing and emerging ICT teaching tools provide further opportunities to enhance subjects and add value to teaching and learning. For example, the use of interactive whiteboards, video projection units, microscopes connected to computers, prepared spreadsheets to capture and model data, CD-ROMs, presentations with video and carefully selected resources from the internet all provide examples of how ICT can be embedded into subject teaching. When thinking about how ICT enhances teaching and learning, the challenge is to make the most purposeful use of the available resources across all teaching and learning. Opportunities to embed ICT are subject teaching need to be exploited, as appropriate. However, use of ICT as a medium of teaching can enhance and stimulate the learning experiences of students and contribute to the achievement of subject objectives. It is important to recognize the different contributions that ICT can make to teaching and learning and to acknowledge the importance of each.

II. METHODOLOGY

This research deployed a survey method to investigate the integration of ICT into the teaching of mathematics. The survey was carried out in year 2010 - 2015, before the commencement of the survey the respondents were given a briefing on the purpose of the survey [5]. A

total of 150 responses were received and they were analyzed using the mathematical package. A questionnaire was prepared and it was divided into six areas, i.e., (A) the teacher's profile (B) how teachers use ICT (C) professional development activities (D) integrate ICT into curriculum (E) the barriers faced by teachers and (F) the proposed solution.

III. RESULTS AND DISCUSSION

A. ICT applications in general

In general, a total of 71.1% of the teachers used computers on a regular basis. Table 1 depicts the percentage of usage by teachers in the various ICT applications: word processing packages (71.1%), spreadsheets (51.2%), Internet activity (44.1%), search engines (44.1%), presentation software (36.9%), drill and practice (24.3%), hypermedia/multimedia (22.5%), databases (21.6%), graphical applications (19.8%), desktop publishing (12.6%), and Java applets (6.3%).

B. Uses of Internet

The Internet was used for various purposes. 68.5% respondents used it for browsing, 44.1% used the e-mail facility, 10.8% used chat rooms, 7.2% used it in discussion forums and 1.8% for other purposes. 17.1% respondents did not use the Internet. Table 2 depicts the details.

Table 1: Common ICT Applications by Teachers.

Application	Daily (%)	Weekly (%)	Monthly (%)	1 or 2 times a year (%)	Never (%)
Computers in general	25.2	22.5	23.4	17.1	2.7
Word processing packages	21.6	27.0	22.5	9.9	5.4
Spreadsheets	9.8	22.5	18.9	22.5	11.7
Graphical applications	1.8	6.3	11.7	20.7	27.9
Presentation software	2.7	12.6	21.6	28.8	18.9
Any Internet activity	12.6	13.5	18.0	20.7	18.9

Table 2: Use of Internet by Teachers.

Activity	Browsing	e-mail	Chat rooms	Discussion	Others	None
Response (%)	68.5	44.1	10.8	7.2	1.8	17.1

C. Professional development and training needs

A total of 42.3% respondents indicated that they had received ICT training during 2010 -2015. 71.2% of the respondents demonstrated that they had found the training to be generally useful while 64.9% said that they had not received training on how to integrate ICT into mathematics teaching [6]. According to 33.3% of the respondents, mathematics teachers require training on how to integrate ICT into their teaching while 59.5% of them stated that they needed a combination of various types of training. Table 3 depicts their responses.

Table 3: ICT Training Needs.

ICT training needs	General use	Integrate ICT into teaching	Use of Internet	Combination of needs
Response (%)	9.9	33.3	4.5	59.5

From the survey, the following findings were found:
(i)   Mathematics teachers need more time to learn to use them – programmes like MATLAB, MATHEMATICA, Flash presentations, graphical applications and simulation programmes have great potential for the teaching of mathematics because they encourage explorations and higher order thinking [7].
(ii)   Courseware (49.5%) and presentation tools (40.5%) were used widely for teaching mathematics. Graphical visualization tools and online demonstrations have educational values as well. It is time when we encouraged the mathematics teachers to use them in the class.

(iii)   Internet opened the new sky for the learners. It is encouraging to learn that 68.5% of the respondents used the internet browser to gather information. It is timely that educators encourage mathematics teachers to use the Internet for online demonstrations like using Java applets on mathematics that are only available online.

(iv)   More than half of the respondents (56.8%) did not receive any professional training in ICT during 2010 - 2015. A large proportion (64.9%) did not have any training on how to integrate ICT into mathematics teaching. Such training should be an integral part of professional training. Moreover, 33.3% of the respondents requested to have training on how to integrate ICT into teaching.

IV. CONCLUSIONS

The purpose of this study was to examine teacher's beliefs and concerns regarding the expected innovation of integrating the new technology-based curriculum in mathematics. The questionnaire was prepared about the integration of the new technology-based mathematics curriculum, which shows that the great majority of teachers welcome the expected change in mathematics curriculum after the introduction of ICT and they seem to have positive beliefs in general and positive self-efficacy beliefs for teaching mathematics using ICT. The present study showed that in general teachers welcome the introduction of ICT in mathematics education. This is crucial for the successful implementation of the innovation as, according to teacher's answers, teacher role will be changed, new classroom dynamics will appear, and student learning in mathematics will be improved. The results of the study also revealed that teachers believe that this innovation is important and can positively change the way mathematics are taught and student learning can be improved, but this is not an easy task, careful planning is needed and resources like software and lesson plans will help teachers in their new different role. The integration of ICT in the teaching and learning of mathematics can assist teachers in teaching problem solving skills, an essential and core part of the mathematics curriculum. This survey underlines the importance of teacher's training and knowledge on the various aspects that are related with the integration of ICT in Mathematics [8]. Furthermore, teachers appeared to be very positive about the innovation and that they expect that the role of ICT will assist the teaching and learning of mathematics. This result is very prominent and encouraging, considering that the majority of these teachers were not well informed about the innovation from educational authorities, but were rather themselves positive and they believe that the role of technology can positively influence the role and impact of school or college mathematics on student learning and problem solving abilities. Since teachers appear to have quite strong and positive beliefs and they expressed their willingness to adopt and use the new curriculum, a study on the development of their concerns and beliefs over a long period could provide more useful information for practitioners and researchers. The Indian Ministry of Education has spent a large sum of money for the ICT project. It should not only view using ICT as a mere tool for teaching and learning as mathematics educators and teachers alike can derive more value from it. Therefore to encourage more teachers to integrate ICT into mathematics lessons, the devised programme must be user friendly. The use of ICT in teaching mathematics can make the teaching process more effective as well as enhance the student's capabilities in understanding basic concepts. The aim, therefore, is not to provide students with a new technology 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.

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