



## Integration of Technology in Mathematics Education

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**ABSTRACT**

The present paper focuses on perception of teachers on the use of technology in Mathematics teaching and learning. Mathematics education is one of the domains where one can see prominent and growing effect of technology. It is believed and studied widely that use of technology can have positive effect on Mathematics teaching and learning, yet there seem to be some apprehension on the part of the teachers in the use of technology. This paper has attempted to study perception of teachers in detail on the use of technology in their Mathematics teaching and learning. The perception is studied with respect to the factors - experience of teachers and level of education. The relation between the perception and each factor is studied statistically and inferences are drawn. The sample of given study consisted of the teachers teaching in schools with convenient access to technology.

### KEYWORDS

Mathematics Education, Technology, Teacher's perception

### Introduction:

Technology has infiltrated all the domains of our existence. The rapid changes in technology have also become major part of our classrooms and have levied an expectation on teachers to not only adapt to these changes but also integrate technological changes in their pedagogy and classrooms. For the teachers to be able to effectively implementing these changes there is an underlying requirement for the teacher to have good hold of technology, pedagogy and content knowledge. TPACK framework clearly elaborates this underlying idea. 'In this model, it is clear that content-based educational technologies must be pedagogically sound' (Ferdig, 2008 as cited in Sahin, 2011).

Mathematics education is one of the domains where one can see prominent and growing effect of technology. Nature of Mathematics classrooms has changed with the emergence of the technology. Mathematics teaching learning is no more restricted to pen and paper only. The NCTM's Technology principle highlights the undeniable importance of technology in teaching-learning of Mathematics; 'The technology is essential in teaching and learning Mathematics; it influences the Mathematics that is taught and enhances students' learning' (NCTM, 2000 as cited in Walle, Karp and Bay-Williams, 2013). The shift from use of pen and paper only in Mathematics classes to include elements of technology requires a marked change in the behavior of practicing teacher who have been teaching in the traditional way and also have been taught using the traditional methodologies. The transition in the role of teacher also brings out the repositioning of the role of the students. The Mathematics classes move from being teacher centric to student centric (Pierce & Ball, 2009). 'When technology is used as a tool then the teacher becomes a facilitator and students take on a proactive role in learning' (Sugar, Crawley & Fine, 2004, p. 202). 'Technology can develop students' critical thinking and allowing them to organize, analyze, interpret, develop, and evaluate their own work' (Al-Zaidiyeen, Mei & Fook 2010, p. 212).

The above discussion stresses on the role of Mathematics teacher in implementing and integrating technology

in Mathematics classroom. The teachers not only require sound understanding of technology which can be implemented in Mathematics classroom, but also need to have positive attitude towards integrating and using technology in Mathematics classrooms. 'Research also reveals that before teachers use technology for instruction they must be personally convinced of its benefits and must see the utility of using particular technology' (Lam, 2000 as cited in Sugar, Crawley & Fine, 2004, p. 202). The researcher in this article attempts to understand the aforementioned issues. The following research questions shed more light on it and guide the researcher for the next step:

### Research Questions:

This study has attempted to answer the following questions:

What is the frequency of usage of the various components of technology by the sample of teachers?

What is the perception of teachers towards technology usage in Mathematics classrooms?

Is there a relationship between teachers perception on technology usage based on the teaching experience?

Is there a relationship between teachers perception on technology usage based on the educational qualifications?

### Methodology:

Data was collected from teachers through a questionnaire consisting of three sections through e-mail. Following discussion elaborates further on the sample considered and development of tool for data collection for this study.

### Sample of the Study:

40 teachers teaching Mathematics across primary to senior secondary grades with convenient access to technology in schools were selected. Questionnaires were mailed to more number of participants and responses of 40 teachers were received. Details and purpose of the study was explained through mail to the participants. Confidentiality was assured to all the participants.

**Details of the sample taken-**

**Table 1: Categorization of teachers on the basis of teaching experience and educational qualifications:**

Categories	Number of Teachers	% of Teachers
Teaching Experience		
0-5 years	24	60
5-10 years	16	40
Educational Qualifications		
Graduate	22	55
<b>Post Graduate</b>	<b>18</b>	<b>45</b>

**Data Collection Tool:**

A Questionnaire was used as data collection tool which was emailed to Mathematics teachers. It comprised of three sections. Section I of the tool consisted of various teaching materials and technology, such as using blackboard, calculator, television, laptop, graphing calculator, Geogebra software etc, used by teachers in their classrooms. For each specific material and technology, the teachers were supposed to select one option out of four options ranging from never used, sometime used, often used and always used depending on the frequency of the usage of that particular material or technology in class. The purpose of including this section was to understand the trend of integrating manipulative and various technologies by teachers in Mathematics teaching- learning and usage of technology in their daily life. Demographic data about the participants was also collected in section I of the questionnaire. Information was sought about the number of years of experience, grade level taught by them and their educational qualifications.

Section II of the tool focussed on the Mathematics teacher's perception on the usage of technology in the classrooms. This section of the tool was adapted from Pierce & Ball, 2009. There were 12 items in this section. The items in section II primarily dealt with the three domains affecting perceptions of teachers on usage of technology:

- 'An attitude towards teaching Mathematics with technology' (AT) – 5 items
- A possible social factor say for instance the perception of the school principal, in-charge etc on the relevance and importance of using technology in Mathematics classroom (SN) - 4 items
- 'A condition which the teacher may perceive as behavioural control' like using technology is time consuming, may require extra planning which does not motivate teacher to use technology in Mathematics classroom (BC) – 3 items (Pierce & Ball, 2009, p. 307)

**Sample of section II items:**

- If I use more technology, my students will be more motivated to work on their Math (Belonged to AT)
- Students don't understand Math unless they first do it by hand (Belonged to AT)
- If there are unexpected problems caused by technology this will be very difficult for me (Belonged to BC)
- Technology can be used to help students gain a deeper understanding of Math than is possible in a by-hand classroom (Belonged to AT)
- The Math coordinator (or principal) expects me to use technology in my Math classes (Belonged to SN)

For each of the item, the participant teacher was supposed to select one option from five categories – Strongly disagree, Disagree, Neutral, Agree and Strongly agree.

Section III of the tool contained some open ended questions to help the researcher's gain insight into the experiences of the teachers which have promoted them to use technology in their classrooms. Also if teacher's need any support system to enable them to use technology in meaningful way in their class was explored in this section.

**Analysis of Data:**

Analysis of Section I: For each material and technology, percentage of their responses was calculated for category of responses and reported in table below:

**Table 2: Frequency (in %) of usage of different components of technology by Mathematics teachers in their classroom**

Used in their classes	Never used	Sometimes used	Often used	Always used
Blackboard	0.0	13.3	13.3	66.7
Charts	33.3	20.0	40.0	6.7
Book(s)	0.0	26.7	40.0	33.3
Bulletin Boards	26.7	26.7	40.0	6.7
Question book	33.3	20.0	40.0	6.7
Measurement instrument	6.7	73.3	20.0	0.0
Drawing instrument	13.3	46.7	33.3	6.7
3D model	6.7	53.3	33.3	6.7
Internet	26.7	26.7	40.0	6.7
Web page	40.0	26.7	26.7	6.7
Camera	46.7	40.0	13.3	0.0
Teleconference System	80.0	13.3	6.7	0.0
AV Labs	40.0	13.3	46.7	0.0
Virtual Classrooms	46.7	26.7	26.7	0.0
Search engines	46.7	33.3	13.3	6.7
Google Groups	80.0	6.7	13.3	0.0
Calculator	53.3	26.7	13.3	6.7
Television	53.3	33.3	6.7	6.7
Video	20.0	33.3	33.3	13.3
CD	26.7	26.7	33.3	13.3
Film	60.0	6.7	26.7	6.7
Video camera	66.7	13.3	20.0	0.0
Radio	33.3	26.7	40.0	0.0
Video tape	73.3	13.3	13.3	0.0
Overhead projector	80.0	6.7	13.3	0.0
Computer program	46.7	13.3	26.7	13.3
Practice programs	80.0	0.0	20.0	0.0
Dia diagram editor	33.3	20.0	40.0	6.7
Windows	26.7	20.0	53.3	0.0
Word	46.7	33.3	20.0	0.0
PowerPoint	40.0	26.7	33.3	0.0
Excel	20.0	33.3	33.3	13.3
Scanner	26.7	26.7	33.3	13.3
Digital camera	26.7	26.7	40.0	6.7
CD-ROM	13.3	40.0	46.7	0.0
Data projector	20.0	20.0	53.3	6.7
Multi media	73.3	13.3	13.3	0.0
Printer	73.3	26.7	0.0	0.0
Laptop	86.7	13.3	0.0	0.0
Graphing Calculator	93.3	6.7	0.0	0.0
Geogebra Software	93.3	6.7	0.0	0.0
Geometer's Sketchpad	46.7	53.3	0.0	0.0
Cabri Software	46.7	6.7	33.3	13.3
Maxima Software	86.7	6.7	0.0	6.7
Mathematica Software	26.7	26.7	40.0	6.7
Smart boards	13.3	40.0	46.7	0.0
Any other	20.0	20.0	53.3	6.7

Analysis of Section II: Percentage of respondents in domain wise items (AT/ SN/ BC) of the section II by Mathematics teachers is as follows-

**Table 3: Percentage of respondents each domain of items (AT/ SN/ BC)**

% of respondents	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
AT	0.0	6.7	20.0	46.7	28.0
SN	8.3	25.0	40.0	21.7	6.7
BC	6.7	24.4	33.3	24.4	11.1

Analysis of the relationship between number of years of experience of teachers or educational qualifications and perception of teachers towards usage of technology in the Mathematics classroom was studied through t-value-

- Based on their teaching experience, resulted in t- value = 2.078 at p 0.05 level.
- Based on their educational qualifications, resulted in t- value = 1.12 at p 0.05 level.

### Conclusions and Implications:

Based on the analysis of the data presented above following conclusions can be drawn:

- Blackboard is still considered integral part of a Mathematics classroom (Always used by 66.7%). Same can be said about the book(s) too (always/ often used by 73.3%). Thus, highlighting the importance of blackboard and books in Mathematics teaching.
- Basic technology which is commonly available to all like Word, Power point, Excel is being used in the classrooms usually. Thus, many participants show that they are comfortable with use of basic technology.
- With many schools moving towards infrastructural change of installing smart boards in classrooms has resulted in 46.7% of teachers using it often. This percentage may have arisen from schools making it compulsory for teachers to integrate in their lessons. Also some already available videos, audios etc can be used through these smart boards.
- Internet is being used in the Mathematics classrooms but it has almost equal probability of not being used in classrooms.
- AV labs is part of our school setup from long time but still 40% of the teachers have never used it.
- Teachers are still not using Math specific software such as 'Geogebra' hence the general trend towards their usage is sometimes or never. This unease with using specific Math software can stem from unfamiliarity with the software. It also stresses the need to arrange training for teachers for using these software.

Teachers have shown positive attitude towards usage of technology in Mathematics teaching - learning as 75% teachers agree or strongly agree with usage of technology. There was a neutral response towards subjective norms (SN) stressing value which others give to use of technology has neutral effect on teacher's perception towards use of technology. There was neutral response towards behavioural control (BC) too stressing there may or may not be influence of factors acting as behavioural control. Thus 'technology adoption is a personal decision, uninfluenced by other people and the presence of resources or impediments in local school/district'(Sugar, Crawley & Fine, 2004, p. 211).

Significant relationship between teachers' perception and their teaching experience was found. It was found that teachers with 0-5 years of experience showed more positive perception towards use of technology than teachers with 5-10 yrs of experience. Probably the teachers who have recently passed out of teacher education courses have more experiences with technology thus are more comfortable towards use of technology in their Mathematics classroom. No significant relationship between perception of teachers and their educational qualifications was seen establishing that type of teacher education training does not have any affect on the attitude of teacher towards technology usage.

There is no doubt in concluding that teachers have positive attitude towards usage of technology and mostly teachers feel that technology is beneficial for students as it provides platform to students to explore and learn with understanding and prepare for better future. On the contrary there is also group of teachers who feel that technology should be used with care as overdependence on it is harmful for students and so the role of blackboard and books have become the default part of Mathematics classrooms. Also systemic support and explicit support from concerned authorities along with in-service and pre-service training is needed by the teachers to successfully integrate technology in Mathematics classrooms (Sugar, Crawley & Fine, 2004; Al-Zaidiyeen, Mei & Fook 2010).

### Further Suggestions for Research:

- The given study can be extended to consider relationship between teacher's perception with respect to age groups, gender etc.
- The given study can be extended further by interviewing teachers to probe into the reasons behind their perceptions related to technology usage.

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