



## IMPACT STUDY OF TEACHING MATHEMATICS USING ICT ENABLED LEARNING

Rahul Chandra Kushwaha

DST- Centre for Interdisciplinary Mathematical Sciences,  
Banaras Hindu University,  
Varanasi, India

Achintya Singhal

Department of Computer Science,  
Banaras Hindu University,  
Varanasi, India

**Abstract:** This paper evaluates the impact of teaching mathematics to school students using ICT and computer enabled learning. The study is based on pre-test and post-test study on Control and Experimental groups. The control group was taught by traditional method, i.e. without using any extra teaching- learning tools while experimental group was received teaching by ICT and computer as teaching-learning tools. The study was done on the students of 4 different schools of elementary grade standards. The data were collected using questionnaire format on different concepts like, counting, addition, subtraction and patterns. Pre-test data has been collected initially without giving any instruction to the students and post-test data were collected after classroom teaching to both control and experimental groups. On analysis, significant differences between the scores of control and experimental groups were recorded. The study shows that experimental group has better achievement which had received instruction by ICT with computer enabled learning in comparison to control group which was instructed without any teaching learning tools.

**Keywords:** ICT; technology enabled learning; e-learning; computer assisted learning; learning technologies;

### I. INTRODUCTION

Mathematics is the study of number, quantity and space. Therefore, the basic concepts of mathematics can be easily explained by using locally available materials/commonly used materials or objects. The counting is done by fingers since very large times. Hands can be used to measure the length of any solid object. The other materials like stones can be used for counting. The different types of fruits, seeds and leaves can be used to explain different geometrical shapes. These materials also can be used to explain make different patterns. These materials are easily available everywhere without spending any cost. Thus these materials may be very popular teaching-learning tools to explain different mathematical concepts [1],[2]. The development of ICT has made a revolution in society. Education system is also affected by this Technology. Teacher uses ICT contents during their classroom teaching. Computer is becoming a teaching-learning tool to deliver the ICT contents. There are many educational software has developed to enhanced the teaching-learning process. Now a day, Teachers are not only using paper-pencil or chalk-blackboard for teaching but they implement audio-visual classes to their teaching skills. This research study describes the application of ICT to implement these materials for developing e-contents s using image, video or multimedia files to explain different mathematical concepts and their impact on learning enhancement [3].

The locally available materials can be used in image, video or multimedia form to prepare ICT contents. Teacher can demonstrate the ICT content s into their lectures to demonstrate their concepts. Teacher can prepare E-content of lecture notes on any concept and present to the students. They can play any video related to explain any concept to the student. Teacher can prepare interactive audio-visual or multimedia E-content and present to the students. There are many educational software which can be used as a teaching-learning tool. Geogebra is such software for dynamic mathematics teaching. Teachers can prepare Geogebra applet on any mathematics topic and represent to the students. These software is now becoming very

popular among teachers as well as students. Thus ICT is definitely enhancing the teaching-learning capabilities. Students also take interest on audio-visual classes or multimedia demonstration using various educational software. These e-contents also provide motivation towards interactive learning. Thus ICT may play a vital role in teaching-learning process [4].

### II. LITERATURE REVIEW

ICT has taken revolution in this era. ICT has influence all the sectors like education, banking, e-governance etc. The whole world is implementing ICT for their daily life. Whole world is implementing ICT for governance and other sectors. Education is one of the most influenced sectors influenced by the ICT. The developed country like USA, UK etc. has implemented ICT to their countries. The developing countries are also implementing ICT to their countries [5],[6],[7],[8].

ICT has emerged during Eighty decades, since then, it is growing rapidly. Now almost whole world is connected to the ICT and it is implemented in a large number of sectors. Education is one of the popular sector among them. The developing countries over the world have rich implementation of ICT infrastructure to their academic campuses. The developing countries have a large scope to implement ICT into their country. Government of India is also working on the development of ICT infrastructure into their academic campuses [5],[9],[10],[11],[12],[13].

The use of ICT has started since long time ago. Earlier computer as a tool used for accessing ICT contents. Computer is used for the presentation of images, audio, video cedio contents. Now using multimedia and animation teachers can create attractive lecture materials and present to the students. Many software like Geogebra, Mathematica, Maple etc. are used for mathematics teaching-learning [12],[13]. The development of learning management system (LMS) and massive open online courses (MOOCs) has taken revolution in education. It has provided facility to the students to access the e-contents through home in free of cost or very low cost. A person having internet connection can easily access the course

running on LMS or MOOCs. There are many popular LMS like Moodle, Blackboard etc. are running as virtual campus of academic institutions through the all over the world. The MOOCs like Coursera, Edx, Udacity etc. are popular among the learners around the world. Students can also submit online assignments, participated in online quizzes or group forums [3],[14],[15],[16].

Government of India, MHRD has initiated a project named National Mission on Education through Information and Communication Technology (NMEICT) to implement ICT into academic institutions. Through this program, MHRD, GOI, are developing ICT infrastructure to their universities campuses with Wi-Fi internet connections. The MHRD has provided internet access to all its central universities and rest are in progress. The MHRD, GOI has launched ‘Sakshat’ portal for online education; where teachers, students and administrators are connected to the portal [3],[5].

For school education National Council of Educational Research and Training (NCERT) is working on the development of ICT contents for the school education courses. The NCERT has initiated their open educational resources portal named ‘National Repository on Open Educational Resources (NROER)’, where ICT contents related to the school education are uploaded. NCERT has also developed their mobile application ‘Apps’ named ‘e-pathashala’ to access these e-contents. Students may easily connect using ‘e-pathashala’ Apps and access large educational contents and get benefited. To access these contents the GOI, are developing ICT infrastructure to all its Kendriya Vidyalaya ‘KV’ and Navodaya Vidyalaya. They are developing computer laboratories and provide internet facility to access e-contents for teaching-learning. Teachers are also getting trained to use these e-contents for teaching-learning. Many schools are using LMS to implement virtual learning to their school campus, where students and teachers virtually connected to each other and access e-contents, connect each other through LMS [3],[5],[17].

### III. METHODOLOGY

#### A. Research Model

This research work has done on early primary grade students of class 1<sup>st</sup> standards. The research work was conducted on pre-test post-test method. Two groups: control group and experimental group were taken. The study has been done on four concepts counting, addition, subtraction and pattern making. Before starting this study, pre-test of students were taken using open-ended questionnaires. After pre-test the control group was taught by the general method while experimental group were demonstrated with ICT contents using computer as a teaching-learning tool. After completion of course, post-test has taken.

#### B. Achievement test and Data Collection

The achievement test has been done on four different primary school students. To test for achievement of students 10 open ended questionnaire were prepared on these four concepts as counting, addition, subtraction and patterns. The same questionnaires were presented to both control and experimental group students. About three months time has been taken to teach these concepts to the students. After completion of course, post-tests were organized. Again 10 different questionnaires had been prepared for each concepts and same questionnaire has presented to both control and experimental group students. The data from students’ achievement test were collected.

### IV. DATA ANALYSIS

The recorded data were processed to see the impact of ICT for teaching mathematics. The recorded data and their analysis have given in following tables.

Table1- Pre- test Results of Control Group

<i>Pre-test Results of Control Group</i>					
<i>School</i>	<i>Number of Students</i>	<i>Counting Mean Score (%)</i>	<i>Addition Mean Score (%)</i>	<i>Subtraction Mean Score (%)</i>	<i>Pattern Mean Score (%)</i>
<i>Sch. 1</i>	39	26.79	24.61	42.31	41.28
<i>Sch. 2</i>	40	43.08	31.45	40.39	49.81
<b>Total</b>	<b>79</b>	<b>39.94</b>	<b>28.03</b>	<b>41.35</b>	<b>36.80</b>
<i>Average Performance on whole concepts =37.04</i>					

Table 1 shows the pre-test results of control group students. Two schools has selected for pre-test study. School 1 has 39 students and school 2 has 40 students appeared in achievement test. The mean scores for each concept in percentage of the achievements have shown in the table. Finally, the joint average score of both schools has calculated. The average performance in pre-test for jointly whole concepts is 37.04 percent.

Table2-Post-test Results of Control Group

<i>Post-test Results of Control Group</i>					
<i>School</i>	<i>Number of Students</i>	<i>Counting Mean Score (%)</i>	<i>Addition Mean Score (%)</i>	<i>Subtraction Mean Score (%)</i>	<i>Pattern Mean Score (%)</i>
<i>Sch. 1</i>	39	52.90	45.45	58.56	43.16
<i>Sch. 2</i>	42	45.14	42.74	42.76	54.48
<b>Total</b>	<b>81</b>	<b>49.02</b>	<b>44.10</b>	<b>50.66</b>	<b>48.82</b>
<i>Average Performance on whole concepts =48.15</i>					

Table 2 shows the result of post test score of control group students. Two schools were selected. School 1 has 39 students and school 2 has 42 students appeared in post test. The average score of post test has recorded. The average performance of both schools students on whole concepts are 48.15 percent.

Table 3- Pre-test Results of Experimental Group

<i>Pre-test Results of Experimental Group</i>					
<i>School</i>	<i>Number of Students</i>	<i>Counting Mean Score (%)</i>	<i>Addition Mean Score (%)</i>	<i>Subtraction Mean Score (%)</i>	<i>Pattern Mean Score (%)</i>
<i>Sch. 1</i>	32	29.86	36.79	33.54	37.64
<i>Sch. 2</i>	46	42.34	43.08	38.85	42.64
<b>Total</b>	<b>78</b>	<b>36.10</b>	<b>39.94</b>	<b>36.20</b>	<b>40.14</b>
<i>Average Performance on whole concepts =37.06</i>					

Table 3 shows the pre-test results of experimental group students. Two schools have selected for pre-test study. School 1 has 32 students and school 2 has 46 students. The mean scores for each concept in percentage of the achievements have shown in the table. The average score of total 78 students on over all whole concepts are 37.06 percent.

Table 4- Post-test Results of Experimental Group

<i>Post-test Results of Experimental Group</i>					
<i>School</i>	<i>Number of Students</i>	<i>Counting Mean Score (%)</i>	<i>Addition Mean Score (%)</i>	<i>Subtraction Mean Score (%)</i>	<i>Pattern Mean Score (%)</i>
<i>Sch. 1</i>	37	62.38	56.89	54.83	64.75

Sch. 2	48	56.96	52.86	57.87	72.93
<b>Total</b>	<b>85</b>	<b>59.67</b>	<b>54.88</b>	<b>56.35</b>	<b>68.84</b>
<i>Average Performance on whole concepts =59.93</i>					

Table 4 shows the post-test results of experimental group students. Two schools have selected. School 1 has 37 students and school 2 has 48 students. The mean scores for each concept in percentage of the achievements have shown in the table. The average score of total 85 students on over all four concepts are 59.93 percent.

In table 5, impact of traditional teaching has calculated. The learning enhancements have calculated by finding the difference between the scores of post- test and pre-test. The result shows some significant changes in all concepts. The overall changes score in post test is 11.11 percent.

Table 5- Learning Enhancement of Control Group

<i>Learning Enhancement of Control Group</i>					
School		Counting	Addition	Subtraction	Pattern
	Number of Students	Mean Score (%)	Mean Score (%)	Mean Score (%)	Mean Score (%)
Post	81	49.02	44.10	50.66	48.82
Pre	79	39.94	28.03	41.35	36.80
	Mean Diff	9.08	16.07	9.31	12.02
<i>Difference in whole concept= 48.15-37.04= 11.11</i>					

The learning enhancement after demonstration using ICT contents and computer as teaching-learning tool is given below.

Table 6- Learning Enhancement of Experimental Group

<i>Learning Enhancement of Experimental Group</i>					
School		Counting	Addition	Subtraction	Pattern
	Number of Students	Mean Score (%)	Mean Score (%)	Mean Score (%)	Mean Score (%)
Post	85	59.67	54.88	56.35	68.84
Pre	78	36.10	39.94	36.20	40.14
	Mean Diff	23.57	19.94	20.15	28.70

From the above table we can see that there are some significant enhancements in the score of post test in comparison to control group.

Table7-Treatment Impact Results of used Tool

<i>Treatment Impact Results of used Tool(Local materials)</i>					
School		Counting	Addition	Subtraction	Pattern
	Number of Students	Mean Score (%)	Mean Score (%)	Mean Score (%)	Mean Score (%)
Exp	Mean Diff	23.57	19.94	20.15	28.70
Ctrl	Mean Diff	9.08	16.07	9.31	12.02
<b>Treatment Impact</b>		<b>13.49</b>	<b>3.87</b>	<b>10.84</b>	<b>16.68</b>
<i>Treatment Impact on whole concepts = 11.22</i>					

The results of the recorded data show that students are more successful on post-experimental processes of experimental group than post-experimental process of control group. This result can be interpreted that the receiving of lectures using computer enabled learning on student is more effective on comparison to receiving lectures by traditional approach.

By examining table 7, it can be seen that the impact of teaching mathematics using computer enabled learning has some meaningful difference on achievement of students of experimental group. The learning enhancements of students using computer enabled learning are varying in different concepts. The impact of computer enabled learning on each concept is shown in above table 7. The treatment impact using

ICT on overall whole concept is 11.22 percent more than the treatment by traditional method.

**V. DISCUSSION**

The study has been done on early primary grade students. This is very beginning stage of learning. Students do not aware about any mathematical concepts. The students are aware about their own surrounding. They familiar about different natural things like trees, fruits, seeds etc. and home used concrete materials like, coins, balls, sticks etc. The ICT play an important role to implement these surrounding materials using images, video or multimedia to explain mathematics concepts effectively. Teachers easily can associate these natural things to explain basic mathematical concepts [1],[2].

There are very big changes education system, after the emergence of ICT. Earlier, the schools were isolated to the society after the emergence the school information is available to public domain. Earlier the teachers are initiator of learning, they focus on teaching whole class and very less focus on communication; Now teachers are using ICT to help students to find appropriate instructional path and guides students to self learning and evaluates their progress. Now teachers main focus on communication.

The educational software like Geogebra is effective tool to explain mathematics concepts in dynamic way. Teachers can easily explain the complex mathematical concepts using this software. Thus we can see that there is very good impact on student achievement after teaching mathematics using technology. Teaching using ICT with computer enabled learning can be considered as an useful educational technology.

**VI. CONCLUSION**

This research study shows that the ICT and computer assisted teaching may be very effective educational tools for mathematics learning. This study shows that there are significant changes in learning enhancement to the group of students to whom ICT enabled learning are used to teach mathematics. Thus ICT is now becoming backbone of the new model of education. The ICT based teaching-learning is adopted by new generation learners and there are significant importance to the pedagogy. This study shows that ICT influence the learning achievement of the students in every dimension. Students get better achievement on all the four fundamental of basic mathematics. The use of educational software is becoming very helpful for teachers and students. It enhance teaching capability and helpful for presentation of their ideas among learners. Students understand complex theory using the educational software in easy and play way. Thus ICT is very beneficial for students, teachers and administrators.

**VII. REFERENCES**

- [1] P. W. Thompson, Concrete materials and teaching for mathematical understanding, Arithmetic Teacher 41(9) (1994) 556-558.
- [2] A. K. Wazalwar, et. al., "Teacher Training Manual for early primary grade mathematics" published by National Council of Educational Research & Training (NCERT), New Delhi.
- [3] Information and Communication Technology for the School System Curricula for ICT in Education, Developed by Central Institute of Educational Technology National Council of Educational Research and Training, New Delhi, pp. 10-29, August, 2013.

- [4] Kushwaha, R. C., Chaurasia, P. K., & Singhal, A., "Impact on Students' Achievement in Teaching Mathematics Using Geogebra", IEEE Proceedings on IEEE Sixth International Conference on Technology for Education, 2014 .
- [5] Department of School Education & Literacy and Department of Higher Education, Ministry of Human Resource Development, Government of India, Annual report 2012-13, pp. 89-102.
- [6] U.S. Department of Education, Office of Educational Technology, International Experiences with Educational Technology: Final Report, Washington, D.C., (2011), pp. www.ed.gov/about/offices/list/oepd/ppss/reports.html.
- [7] Information And Communication Technology (ICT) In Education In Asia, UNESCO Institute for Statistics, Montreal, Quebec H3C 3J7 Canada 2014.
- [8] Eng. T., S., The impact of ICT on learning: A review of research, International Education Journal, vol. 6(5), pp. 635-650. ISSN 1443-1475
- [9] ICT in Schools, Inspectorate Evaluation Studies, Evaluation Support and Research Unit Inspectorate Department of Education and Science Marlborough Street Dublin 1, ISBN-0-0000-0000-X, pp.15-45, 2008
- [10] The Effectiveness Of Ict In Schools: Current Trends And Future Prospects, Organisation for Economic Co-operation and Development, OECD/Japan Seminar Tokyo, Japan, pp. 5-December, 2002
- [11] Nitika T., B. et. al., An Analysis of the Research and Impact of ICT in Education in Developing Country Contexts, Journal of Education for International Development, vol. 4(2), 2009.
- [12] Yves P., Dieter Z. and Cabrera, M., A Review of the Impact of ICT on Learning, JRC Technical Notes, European Commission Joint Research Centre Institute for Prospective Technological Studies, pp. 6-26, 2006
- [13] Olson, J. et. Al., An Analysis of e-Learning Impacts & Best Practices in Developing Countries, With Reference to Secondary School Education in Tanzania, Michigan State University. East Lansing, MI 48824 USA pp. 2-38 2011.
- [14] Emanuel, E.J. "Online Education: MOOCs Taken by Educated few". Nature, 11/2013, 503(7476):342.
- [15] King, C., Robinson, A. and Vickers, J. (2014). Online Education: Targeted MOOCs Captivates Students. Nature, 01/2014, 505(7481):26.
- [16] Jager, A.K. and Lokman, A.H., Impacts of ICT in education. The role of the teacher and teacher training, Paper Presented at the European Conference on Educational Research, Lahti, Finland 22 - 25 September 1999
- [17] <http://www.ncert.nic.in>

© Sep 2017. This work is published under  
<https://creativecommons.org/licenses/by-nc-sa/4.0/> (the "License").  
Notwithstanding the ProQuest Terms and Conditions, you may use this  
content in accordance with the terms of the License.