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EFFECTIVENESS OF ICT INTEGRATED PEDAGOGY FOR MATHEMATICS IN TERMS OF ACHIEVEMENT IN MATHEMATICS CLASS IX STUDENTS OF MADHYA PRADESH

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ABSTRACT

The status and future of any country largely depends on its education policy. The education policy lays special emphasis on the development of the creative and skill potential of each individual in India. To build a developed India, on the ground, continuous efforts are on to bring education to the highest level of quality in the global scenario. For quality education, the New Education Policy 2020 talks about integrating ICT into teaching, learning and assessment in school education. ICT can be integrated with different subjects or with teaching methods. This paper is based on an experimental survey and study focused on ICT integrated pedagogy for mathematics of class IX in Madhya Pradesh. Study was conducted at Govt. High School, Nayakheda, Datia, Madhya Pradesh. Total 90 students of class IX of this school were involved as sample. Purposive sampling method was used for the select of school and simple random sampling method was used for select the treatment group for the experiment. A true experimental pre-test post-test control group design was employed for the study. Study findings revealed specific features of a quality education scenario that matters for ICT integrated pedagogy for mathematics teaching in Madhya Pradesh.

KEYWORDS: ICT integrated pedagogy, Mathematics, Achievement

1. INTRODUCTION

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. Technology, particularly Information and Communication Technology (ICT), is playing a crucial role in enhancing quality education and learning. As the world becomes increasingly reliant on ICT in daily life, educational institutions must also adapt their roles, methodologies, and vision. The rise of a technology-driven, information-fuelled, and knowledge-based global economy necessitates a shift in educational focus from simply transmitting information to fostering "Learning to Learn"—the ability to acquire knowledge and skills for lifelong learning (Transforming American Education: NETP, 2010). Every subject area, including mathematics, has seen specialized technologies developed to enhance pedagogical aspects of learning. 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. 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. ICT integration in mathematics learning offers significant potential for improvement. This study, therefore, explores mathematics learning through the lens of ICT-integrated pedagogy.

2. RATIONALE OF THE STUDY

The digital age, driven by pervasive and user-friendly technology, has transformed education. ICT is crucial role for bridging the gap between pedagogy, research, and policy, as emphasized by India's New Education Policy 2020. ICT empowers teachers and learners, significantly impacting learning and achievement, particularly in subjects like mathematics. The assumption is that ICT-integrated pedagogy directly improves mathematical outcomes. Recognizing diverse learning styles, ICT offers varied learning environments, while also providing consistent, error-minimizing instruction that enhances learning beyond traditional methods. This study aims to develop and evaluate an ICT-integrated learning pedagogy for ninth-grade mathematics, using an experimental design to assess its effectiveness.

3. OBJECTIVES

The objectives were formulated for the study are as follows:

- **i.** To study the effectiveness of ICT Integrated Pedagogy for Mathematics in terms of Achievement in Mathematics.
- **ii.** To compare the mean score of Achievement in Mathematics of the students of Experimental and Control group by taking their pre-test scores of achievement in Mathematics as covariate.
- **iii.** To study the effect of Treatment, Gender and their Interaction on Achievement in Mathematics by taking their pre-test scores of achievement in Mathematics as covariate.

4. HYPOTHESIS

The hypotheses were formulated for the study are as follows:

i. There is no significant difference in adjusted mean score of Achievement in Mathematics of students taught with ICT Integrated Pedagogy and those taught through other method.
ii. There is no significant effect of Treatment on Achievement in Mathematics of the students when their pre-test scores of Achievement in Mathematics are as covariates.
iii. There is no significant effect of Gender on Achievement in Mathematics of the students when their pre-test scores of Achievement in Mathematics are as covariates.
iv. There is no significant effect of Interaction on Achievement in Mathematics of the students when their pre-test scores of Achievement in Mathematics are as covariates.

5. METHODOLOGY

The present study falls under the experimental. A true-experimental pre-test post-test equivalent control group design is employed. One group called the experimental group is exposed to the ICT integrated pedagogy for mathematics teaching and another group called the control group is exposed to the traditional approach of teaching Mathematics.

SAMPLE:

In the present study, the simple random sampling technique is used for the selection of the sample. In this research work, 90 students are taken from class IX of Govt. High School, Nayakheda, Datia, Madhya Pradesh. Number of students is 45 in the Experimental group and same in the Control group.

TOOLS USED:

Mathematics Achievement Test was developed by investigator to study the effect of ICT Integrated Pedagogy and traditional approach on achievement of class IX students.

PROCEDURE:

This experimental study compared ICT-integrated pedagogy with traditional teaching methods for mathematics. Students were randomly assigned to experimental (ICT) and control (traditional) groups. Both groups were pre- and post-tested using a mathematics achievement test. The experimental group received ICT-based instruction, while the control group received traditional instruction on the same mathematical concepts. Post-test scores were then compared to assess the effectiveness of each method.

6. ANALYSIS AND INTERPRETATION OF THE RESULT

Effectiveness of ICT Integrated Pedagogy in terms of Achievement in Mathematics

The data were analyzed and these are presented below.

Table - 6.1: Post-test Achievement Scores of Experimental Group

Experimental (treatment) Group		Statistic	Std. Error
	N	45	
	Mean	21.24	.873
	Variance	45.216	
	Std. Deviation	6.735	
	Minimum	12	
	Maximum	35	
	Range	23	
	Skewness	.950	.329
	Kurtosis	-.239	.625
Percentiles	**5**	11	
	10	14	
	25	16	
	50	18	
	75	26	
	90	34	
	95	37	

Above table shows, the mean score was 21.24, approximately a first division, with a SD of 6.735 and, a coefficient of variation of 45.216. Notably, over 50% of students scored above 18, and a substantial portion achieved higher scores: 25% above 26, 10% above 34, and 5% above 37. Only 5% scored below 11. This level of performance, unusual with traditional teaching methods, strongly suggests that ICT-integrated pedagogy effectively enhances students' mathematics achievement.

Compare the mean score of Achievement in Mathematics of the students of Experimental (treatment) and Control group by taking their pre-test scores of Achievement in Mathematics as covariate

Data analysis was performed using one way ANCOVA, with results detailed in Table 6.2.

Table - 6.2: Summary of ANCOVA for Achievement in Mathematics of Students by taking their Pre-test Score of Achievement in Mathematics as Covariate

Sources of Variance	df	SSy.x	MSSy.x	F-Value
Among	1	1421.36	1421.36	413.32**
Within	87	354.65	3.45	
Total	88	1776.01		

***significant at 0.01 level*

Table - 6.3: Mean, SD for Students Achievement in Mathematics

Group	Mean	Std. Deviation	N
Control Group	12.42	4.533	45
Experimental Group	21.24	6.735	45
Total	16.83	5.634	90

From the table 6.2, it is evident that the adjusted F-value for the effect of treatment on the achievement in Mathematics is 413.32 which is significant at 0.01 level. It shows that the adjusted mean score of achievement in Mathematics of students taught through ICT integrated pedagogy and those taught the same topics through traditional approach differ significantly. Thus, the null hypothesis that

Based on Table 6.2, the adjusted F-value of 413.32 demonstrates a statistically significant effect ($p < 0.01$) of the treatment on mathematics achievement. This indicates a significant difference in the adjusted mean mathematics scores between students taught using ICT-integrated pedagogy and those taught using traditional methods. Consequently, the null hypothesis that "*there is no significant difference in adjusted mean scores of achievement in Mathematics of experimental and control group when their pre-test scores of achievement in Mathematics are taken as covariate*" is rejected. When controlling for pre achievement, ICT integrated pedagogy for mathematics teaching significantly improved student performance compared to traditional methods.

Effect of Treatment, Gender and their Interaction on Achievement in Mathematics

Independent variables included treatment and gender, and achievement in mathematics was the dependent variable. Two treatment levels were implemented: teaching through ICT integrated pedagogy and Traditional method. Gender has two levels, such as, Female and Male. Pre-test scores of achievement in mathematics were taken as Covariate. Data were analyzed using a 2X2 factorial ANCOVA (equal cell sizes). The results and interpretations related to each of these indicators are presented below.

Table - 6.4: Summary of 2X2 Factorial Design ANCOVA of equal Cell Size for Achievement in Mathematics of Students by taking their Pre-test Score of Achievement in Mathematics as Covariate

Sources of Variance	df	SSy.x	MSSy.x	F-Values
Group	1	1369.45	1369.45	365.83**
Gender	1	5.63	5.63	1.52
Group X Gender	1	1.45	1.45	0.438
Error	85	351.71	3.45	
Total	88	1728.24		

significant at 0.01 level

Table - 6.5: Mean, SD for Students Achievement in Mathematics

Group	Gender	Mean	Std. Deviation	N
Control Group	Female	11.32	4.789	20
	Male	13.52	4.414	25
	Total	**12.42**	**4.533**	**45**
Experimental Group	Female	20.05	5.640	18
	Male	22.43	7.621	27
	Total	**21.24**	**6.735**	**45**
Total	Female	15.89	5.838	38
	Male	17.77	7.476	52
	Total	**16.83**	**5.634**	**90**

Effect of Treatment on Achievement in Mathematics

Table 6.4 reveals a highly significant F-value of 365.83 (df=1/88, $p<0.01$) for the treatment effect on mathematics achievement. This demonstrates a significant difference in the adjusted mean mathematics achievement scores between students instructed with ICT-integrated pedagogy and those who were not, even when controlling for students' pre achievement. Essentially, the treatment had a significant effect on mathematics achievement, independent of students' previous performance. Thus, the null hypothesis, namely, *"there is no significant effect of Treatment on students' achievement in Mathematics when their Pre-test scores of achievement in Mathematics are taken as covariate"*, is rejected. It demonstrates that the treatment had a significant differential effect on the achievement in Mathematics of students when their Pre-test scores of achievement in Mathematics were taken as covariate. Therefore, it can be said that the achievement in Mathematics of students is dependent on the methods of teaching. So, it can be inferred that ICT integrated pedagogy produced a significant differential effect on Achievement in Mathematics.

Further, Table 6.5, also demonstrates that the mean and SD of Achievement in Mathematics of students taught through ICT integrated pedagogy 21.24 and 6.735, respectively. Further, Table 6.5, also demonstrates that the mean and SD in mathematics achievement among students receiving traditional instruction is 12.42 and 4.533, respectively. The data demonstrates that the students instructed using ICT-integrated pedagogy compared to those taught with traditional methods, as evidenced by significantly greater mean scores in mathematics achievement. While SD for the experimental group was slightly higher, indicating a wider spread of scores and thus greater heterogeneity within that group, this variability does not diminish the overall effectiveness of the ICT integrated pedagogy. Despite some variation in individual outcomes, the ICT integrated pedagogy demonstrably led to superior mathematics achievement compared to the traditional approach.

Finding: There is a significant effect of Treatment provided through ICT integrated pedagogy on students' achievement in Mathematics in comparison to the student taught through the traditional method.

Effect of Gender on Achievement in Mathematics

Table 6.4 evidences that the F-value of Gender for the Achievement in Mathematics is 1.52, not statistically significant ($p > 0.05$, df = 1/88).. Therefore, the null hypotheses, namely, *"there is no significant effect of Gender on achievement in Mathematics of the students when their pre-test scores of achievement in Mathematics are taken as covariate"*, is not rejected. The analysis revealed no significant gender-based difference in mathematics achievement when controlling for pre-test scores, indicating that gender does not predict math achievement in this context.

Table 6.5, also, demonstrates the arithmetic mean of Mathematics performance of girls and boys are 20.05 and 22.43, respectively. It is evident from the table that the arithmetic mean of Mathematics performance of boys is approximately higher same in comparison to the marks secured by the girls. But, the SD of achievement in Mathematics of boys students is slightly higher (7.621) than the girls students (5.640). It evidences that the achievement in Mathematics of girls is more homogeneous in comparison to the achievement in Mathematics of boys.

Finding: There is no significant effect of Gender on achievement in Mathematics of the students when their pre-test scores of achievement in Mathematics are taken as covariate.

Interaction of Treatment and Gender on Achievement in Mathematics

Table 6.4 evidences, the interaction between Treatment and Gender yielded an F-value of 0.438, which is statistically insignificant at the 0.05 significance level, given degrees of freedom of 1/ 88. Therefore, the null hypotheses, namely, *"there is no significant effect of interaction of treatment and Gender on achievement in Mathematics of students when their pre-test scores of achievement in Mathematics are taken as covariate"*, is not rejected. It demonstrates that the interaction between neither treatment nor gender significantly affected achievement in mathematics of the students.

Table 6.5, also, demonstrates that the arithmetic mean of achievement scores in Mathematics of girls and boys belonging to experimental group is 20.05 and 22.43, respectively. It is evident from the table that the arithmetic mean of achievement scores in Mathematics of girls belonging to experimental group is lower than their counterparts of boys belonging to the same group. Table 6.5 shows that the SD of achievement in Mathematics of girls and boys belonging to Experimental group is 5.640 and 7.621, respectively. It indicates that there is more heterogeneity among the boys of Experimental (treatment) group than the girls of the same group.

Table 6.5, also, demonstrates that The arithmetic mean of achievement scores in Mathematics of girls and boys belonging to Control group is 11.32 and, 13.52, respectively. It is evident from the table that the mean score of achievement in Mathematics of girls belonging to control group is higher than their counterparts of boys belonging to the same group. Table 4.7 shows that the SD of male and female students' mathematics achievement belonging to Control group is 4.414 and 4.789, respectively. It

indicates that there is more heterogeneity among the boys of Control group than the girls of the same group.

Finding: There is no significant effect of interaction of treatment and Gender on achievement in Mathematics of students when their pre-test scores of achievement in Mathematics are taken as covariate.

7. FINDINGS OF THE STUDY

Findings of the present study are presented, below.

1. ICT Integrated Pedagogy was significantly increased achievement in Mathematics of the students.
2. The treatment produced a statistically significant effect provided through ICT integrated pedagogy on students' achievement in Mathematics in comparison to the student taught through the traditional method.
3. There is no significant effect of Gender on achievement in Mathematics of the students when their pre-test scores of achievement in Mathematics are taken as covariate.
4. There is no significant effect of interaction of treatment and Gender on achievement in Mathematics of students when their pre-test scores of achievement in Mathematics are taken as covariate.

8. CONCLUSION

In conclusion, this study reaffirms the effectiveness of ICT-integrated pedagogy in improving students' achievement in mathematics. The significant positive effect of this pedagogical approach underscores its superiority over traditional teaching methods. Importantly, the results indicate that gender does not affect students' performance in mathematics when pre test scores were controlled as covariates. Additionally, there is no significant interaction between treatment and gender, suggests that ICT-integrated pedagogy is equally beneficial for all students, regardless of gender. Overall, the ICT integration in education represents a promising avenue for improving student outcomes in mathematics and related cognitive skills.

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