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Impact of Digital Modules on Math Achievement by Gender and Locality

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ABSTRACT

Digital modules typically refer to self-contained units of online learning materials designed for specific topics or learning objectives. The researcher developed digital modules for three specific math units and conducted a three-week experiment in six schools in three districts of Punjab. The purpose of the study was to find the effectiveness of digital modules. The study revealed a statistically significant difference in gain achievement scores and posttest achievement between the experimental and control groups. The t statistic for gain achievement scores was 2.41, indicating a p-value of 0.016, and 2.70 for posttest achievement. This suggests a significant difference in learning outcomes between the two groups.

Keywords: Achievement, e-content, effectiveness of e-content, e-learning, digital modules

INTRODUCTION

The term "education" refers to learning information, skills, values, and attitudes through various techniques, such as teaching, training, or research. Education is vital to human development and essential for personal, societal, and economic development. There are several types of schooling. In traditional classroom learning, as well as blended learning, the teacher supports pupils with digital

lessons. The third type is self-directed online or remote learning, in which students are given online courses or digital modules presented electronically.

E-learning refers to any sort of electronically aided or mediated learning and instruction. (Awadh et al., 2013) (Kaur, et al., 2020). Awadth stated that e-learning is "an innovative strategy for providing well-organized, student-oriented, dynamic, and assisted educational experiences to any individual, anywhere, at any time by utilizing the strengths and assets of different technological devices in conjunction with various types of instructional content appropriate for an accessible, adaptable, and dispersed learning environment." This concept incorporates pedagogical, content, and accessibility aspects. (Awadh et al., 2013)

"Digital modules" are self-contained units of online learning resources tailored for specific topics or learning goals. These programs use digital technology to provide organized and interactive instructional content. These modules are more flexible, innovative, and self-paced than conventional learning. (Astuti et al., 2022) (Awadh et al., 2013)

E-learning or digital learning is no longer a novel advancement in the learning process. It has firmly established itself during the coronavirus crisis. (Adeniyi et al., 2024) Every youngster became involved in it, from preschool to higher education. As a result, determining its effectiveness is critical whether it is something to provide to pupils or just a display.

Mathematics is a subject that is always considered tough and non-interesting among students. Therefore, we decided to make it more interesting and innovative with the help of visualization. Studies have shown that people learn better when they hear and see. (Kapoor et al., 2023) suggested that in this age of science and technology, math teachers must employ teaching resources efficiently, obtain the most from instructional innovations, and use the latest technology in their classrooms in their activities to foster the curiosity of new future generations in mathematics and to make math simpler and more accessible.

With the increased use of digital technologies in educational and instructional activities, greater emphasis has been placed on delivering material through many channels rather than a single channel, and it has been agreed that the employment of different forms is advantageous. (Zhussupbayev et al., 2023). E-learning or digital learning in mathematics teaching has characteristics such as increasing students' motivation by creating a sense of curiosity and engagement, implementing abstract concepts that can be challenging to comprehend and retrieve via algorithms and exercises, and making teaching more effective and enjoyable through digital media techniques (audio recordings, animations, footage, images, etc.). Education may be personalized owing to digital technology, and the move from instructor-focused to pupil-focused instruction is possible. As a result, children may grasp mathematical concepts and themes more quickly and develop a good attitude toward mathematics. The incorporation of ICT in the process of instruction and learning may enhance educational quality in various ways,

including increasing student motivation, collaboration, and involvement. Digital learning increases the ability of individuals to absorb concepts and information by understanding as opposed to memorization. In e-learning, the idea of self-directed education is merged with technology, and digital technology is employed in the instructional procedure as a complimentary and reinforcing aspect of the system rather than as an option. (Xiu-Yi Wu, 2024)

However, when we look at the factors influencing digital education, we see that they include a variety of aspects that involve instructional outcomes, motivation among students, advancements, conversation, individual differences in learning, the format, scope, and efficacy of the courseware, the instructor's vision, mindset, expectations, and transforming role in digital education, the incorporation of the curriculum with the instructional program, and the way digital modules are implemented in the school.(Hamadi & El-Den, 2024)

Achievement may be described as a cognitive process that occurs quickly, and mathematical achievement "seems to be in the most important markers of an individual's professional success." It is necessary to understand how society functions. A student's degree of achievement in terms of mathematical knowledge is determined via mathematics assessment. (Jayanthi, 2014) (Calvadores, 2022) (Starkey & Zhong, 2019). The word "pupil achievement" refers to an assessment examining how well a student has met two short-term and long-term educational goals. (James & Talin, 2013)

LITERATURE REVIEW

Many studies have been conducted in this area. Kaur et al. (2020) conducted a comprehensive review of e-learning, incorporating a systematic analysis of 24 studies. Their review explored various aspects of e-learning, including both student attitudes and instructor perspectives toward e-content. The study highlighted the benefits of e-learning, such as increased flexibility and accessibility, while also addressing its limitations, including technological barriers and lack of interaction. Additionally, the review examined challenges related to the deployment of e-learning, particularly the development of effective digital content and its impact on learning outcomes. The authors emphasized the importance of designing high-quality e-materials and noted the need for addressing obstacles in technology adoption to enhance the effectiveness of e-learning platforms.

Juhary (2010) discovered five obstacles to e-content production. The first difficulty, according to researchers, is the lack of a university-level digital learning policy. The subsequent focus is on digital learning initiative management. The third hurdle involves convincing instructors of the importance of e-learning. The fourth issue is the unawareness of instructional staff, and the fifth is safety and security concerns. The researcher examined the instructors' readiness for embracing and implementing e-learning and proposed that continuing training be

offered to the instructors regularly to improve their IT expertise. The paper also stated that pedagogical changes are required to generate e-content.

Awadh et al., (2013) and colleagues investigated the impact of e-learning, blended learning, and conventional learning on the achievement of students. The study included 148 students. Pre- and posttests were carried out for the two experimental and control groups. The study revealed that there was a substantial difference in pupil achievement in blended learning. However, there was no significant difference in pupil achievement between the traditional technique group and the e-learning group. Zhussupbayev et al., (2023). In line with this, determining the effectiveness of computer-assisted instructional methods for history subjects in terms of achievement revealed that computer-assisted materials and instructional methods result in noticeable differences in pupil achievement. The researcher converted the boring history lessons into interactive lessons with the help of computer-assisted material. According to the researcher, it is not easy to picture the past to the students in the present. Therefore, visualization could be a better way to do so. Bidaki et al., (2013) created a Java software program to check the effectiveness of mobile books. The results were analyzed in two distinct groups, employing a pretest and a posttest, and the conclusion was that the use of M-books increased the intensity and encouragement of students while they were idle or in action. Azhari & Ming, (2015) reviewed e-learning in Malaysia. The paper discussed the acceptance factors of teachers toward e-learning and the acceptance factors of students toward e-learning. The paper also explored the limitations and expected outcomes of e-learning. Eremias & Subash, (2013) discussed the two models for the development of e-content. The paper provides the full details of the ADDIE model and the Dick and Carey model for e-content development.

In line with this, Kaur et al., (2020) provided a detailed description of how to develop e-content in practice. The paper analyzed the instructional models used in the construction of e-content and briefly explained the different authoring tools used for the construction or development of e-learning material. This paper suggested different audio editing tools and video editing tools and explored different learning management tools, such as Moodle, Blackboard, and Google Classroom. A framework for developing e-content was created by the researcher Hamdi & Hamtini, (2016) The educational environment, interface for users, and instructional material were the dimensions. In addition, a lifecycle for the production of e-content was provided. This lifespan consists of four phases. 1. Analysis 2. Design, 3. Improvement, and 4. Evaluation. E-content was created via the cognitive theory of learning with multimedia. The students who studied under the BPF (based on the suggested framework) outperformed the students who did not study under the proposed framework by 26.7%.

Debevc, (2000) compared the usability of two learning management systems, i.e., Moodle and e-campus, and concluded that Moodle is a better LMS

than e-campus. Takin & Polat (2016) created a scale to assess instructors' readiness to generate e-content. Kapoor et al., (2023) explored Web 2.0 tools to make digital lessons more innovative and more interesting and to increase the motivation of students. The researcher suggested the use of Kahoot, ED-puzzle, Padlet, Moodle, Thinglink, Quizzes, or other tools that run through artificial intelligence in the instructional materials to keep students engaged and motivated.

RESEARCH METHOD

This study aimed to investigate the impact of digital modules on various factors in mathematical problems. To achieve this goal, an experimental model with pretest and posttest control and an experimental group design was used. The research was used in the first, second, and third units of the NCERT 8th grade high school curriculum's "mathematics chapter," "rational numbers, linear equations in one variable, and square and square roots." For this project, digital modules for the mathematics curriculum were created via e-learning principles. In addition, instructional activities were created to comply with this program. The control group received instruction via the chalk and board method" and the "lecture method". Digital lessons were provided via a projector in smart classrooms in the experimental group. Google Classroom was used to upload the e-content over three weeks, one hour per day for each group, for a total of 18 hours. During the research design process, the independent variables in the study were identified to be e-learning and traditional instruction, and achievement was determined as a dependent variable. Before these units were taught, the accomplishment exam associated with these units was administered to the two groups as a pretest, the responses gathered were put into the framework to be analyzed after the experiment, and the results were recorded. In this study, the experimental group used the e-learning approach, whereas the control group used the traditional teaching method.

After this stage achievement test was applied to the groups simultaneously as a posttest at the end of the experimental applications, three weeks after the application, the posttest test was applied to measure the effect of the digital modules on the achievement of the students. At the end of the research, the results of the pretest, posttest, and posttest scores of both groups were compared. The achievement was also compared with the gender and locale of rural and urban students.

The mean, median, standard deviation, skewness, and kurtosis were calculated for both groups. An independent sample t test was used for analysis. ANOVA and post hoc tests were conducted for comparisons between the groups in terms of sex and location.

RESEARCH DESIGN

We collected study data by administering an achievement test, which was constructed by the researcher in an earlier stage. The achievement exam included forty items, including multiple-choice questions, short answers, and long-answer questions. The scale was originally examined for validity, reliability, and dissemination; Cronbach's alpha was 0.94. Because the score is outstanding, the instrument could be used to assess the usefulness of the digital module in improving elementary school students' achievement. Awadh followed the same procedure to establish the face validity and reliability of their achievement test. (Awadh et al., 2013)

Participants

For the experiment, data from 300 students were collected. The data were gathered from six schools in the Indian state of Punjab. Three districts were chosen: Sangrur, Mohali, and Roopnagar. A total of 100 children were chosen from each district. Two schools were chosen from each district, one from the urban area and one from the rural area. A government school was chosen from an urban region, whereas a private school was chosen from a rural location. Each school was given 50 pupils. There were 25 patients in the experimental group and 25 in the traditional group. There were 150 students from cities and 150 from rural regions. There were 150 boys and 150 girls.

From urban and rural areas, 150 students were taken from government schools, and 150 students were from private schools. A pretest and a posttest were conducted on 300 students to check the effectiveness of the digital modules.

Hypotheses

The following hypotheses were proposed:

H_1: There is no significant difference between the effectiveness of digital modules on the mathematics achievement of students in the pretest and posttest.

H_2: There is no significant difference between the posttest scores of the achievement tests in the traditional group and the experimental group.

H_3: There is no significant difference between the posttest scores of the achievement test in the traditional group and the experimental group concerning locale, i.e., urban and rural areas.

H_4: There is no significant difference between the posttest scores of achievement tests in the traditional group and the experimental group concerning gender.

RESULTS

Table 1: Descriptive Analysis of Achievement Test (*N* =300)

Descriptives											
	Group	N	Mean	Median	SD	Minimum	Maximum	Skewness	SE	Kurtosis	SE
Pre scores Achievement	Experimental	150	9.13	9	4.17	1	18	0.0158	0.198	-0.924	0.394
	Control	150	8.43	9	3.69	1	17	0.1703	0.198	-0.695	0.394
Post scores Achievement	Experimental	150	16.15	15	5.82	4	30	0.3174	0.198	-0.468	0.394
	Control	150	14.37	15	5.59	3	25	-0.0338	0.198	-1.109	0.394
Gain Achievement scores	Experimental	150	7.03	6	4.05	0	18	0.7456	0.198	-0.135	0.394
	Control	150	5.95	6	3.69	1	13	0.1952	0.198	-1.271	0.394

The table displays descriptive data for pre, post, and gain-of-achievement scores in two groups: experimental and control.

The experimental group had a mean of 9.13, a median of 9, a standard deviation (SD) of 4.17, a skewness of 0.0158, and a kurtosis of -0.92a 4 for the prescores. The control group had a mean of 8.43, a median of 9, a standard deviation of 3.69, a skewness of 0.1703, and a kurtosis of -0.695.

Figure 1: Histogram presentation of the pretest scores for both groups.

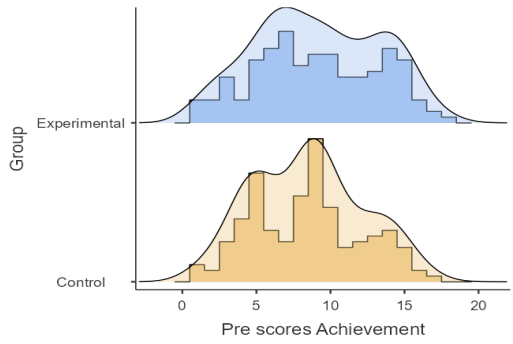
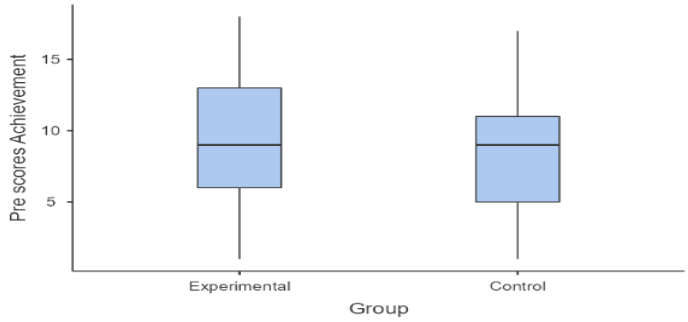


Figure 2: Box Plot presentation of the pretest scores for groups.



In terms of postscore, the experimental group had a mean of 16.15, a median of 15, a standard deviation of 5.82, a skewness of 0.3174, and a kurtosis of -0.468. The postscore values for the control group were 14.37 and 15, the standard deviation (SD) was 5.59, the skewness was -0.0338, and the kurtosis was -1.109.

The tails are shorter than those in a normal distribution. Overall, these data reveal the distribution and central tendency of achievement scores in the experimental and control groups.

Figure 3: Presents histogram representations of the scores for both groups.

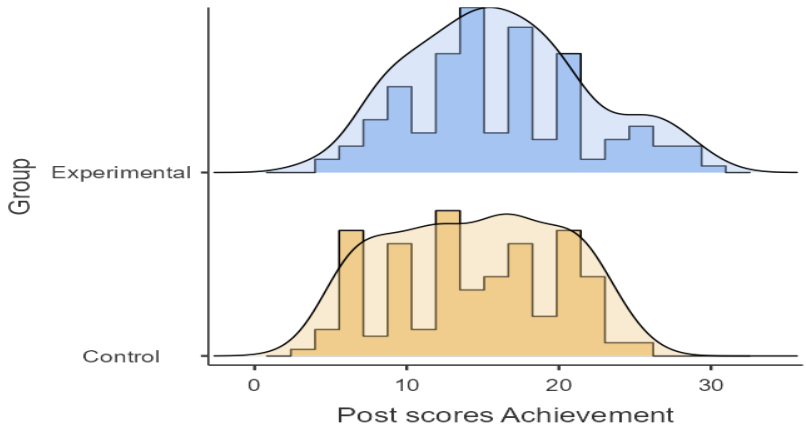
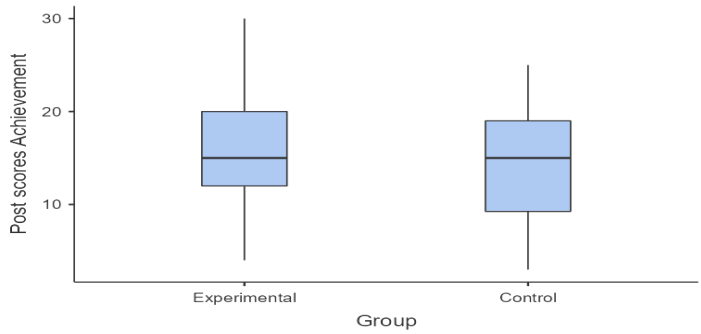
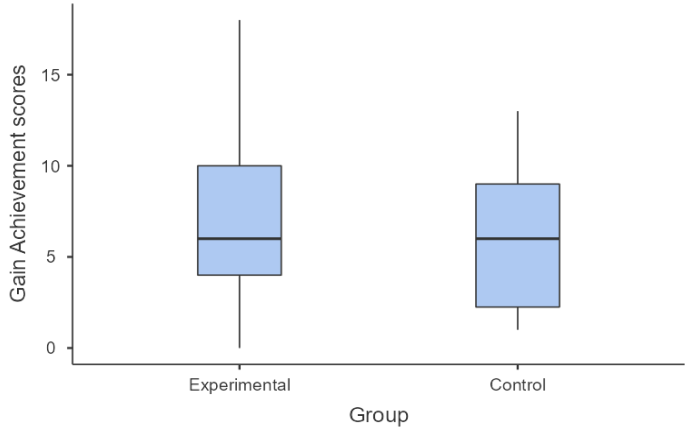


Figure 4: Presents box plot representations of the scores for both groups.



The experimental group had a mean of 7.03, a median of 6, a standard deviation of 4.05, a skewness of 0.7456, and a kurtosis of -0.135 for increased achievement scores (post minus increase in the control group had a mean of 5.95, a median of 6, a standard deviation of 3.69, a skewness of 0.1952, and a kurtosis of -1.271). Skewness assesses the distribution's asymmetry, with a value near 0 indicating a normal distribution.

Figure 5: Box plot presentation of gain achievement scores for both groups.



The above findings show that there is a significant difference in the pre and posttest scores of two groups and posttest scores of both groups i.e. experimental and control indicating that the null hypothesis one and two is rejected at 0.05 level of significance.

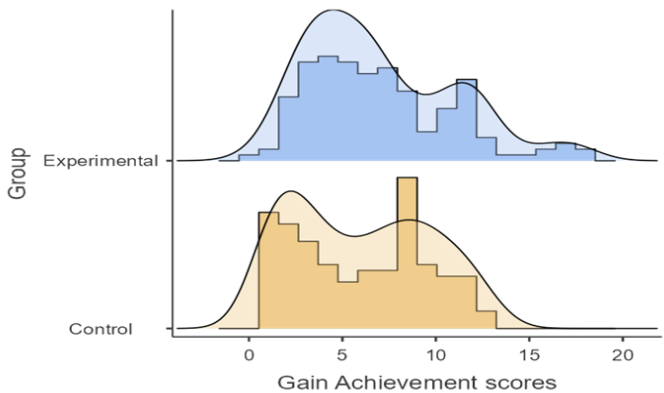
Table 2: Descriptive analyses of Achievement scores based on the Locale score

	Locale	N	Mean	Median	SD	Skewness	SE	Kurtosis	SE
Pre scores Achievement	Urban	150	8.66	9.00	3.83	0.1186	0.198	-0.702	0.394
	Rural	150	8.89	9.00	4.06	0.0952	0.198	-0.916	0.394
Post scores Achievement	Urban	150	14.77	15.00	5.16	-0.0206	0.198	-0.832	0.394
	Rural	150	15.75	15.00	6.30	0.1900	0.198	-0.720	0.394
Gain Achievement scores	Urban	150	6.11	6.00	3.66	0.5397	0.198	-0.175	0.394
	Rural	150	6.86	6.00	4.12	0.4808	0.198	-0.592	0.394

The table shows descriptive data for prescores, postscores, and gain accomplishment scores across different localities (urban and rural).
In terms of prescores, there is modest variation between urban and rural areas, with urban respondents having a mean score of 8.66 and rural respondents having an average score of 8.89. The skewness values are both positive, indicating a somewhat right-skewed distribution, whereas the kurtosis values indicate a generally flat dispersion for both locations.

In terms of postscore, urban individuals had a greater average score (14.77) than did rural participants (15.75). The skewness and kurtosis values of both distributions suggest that they are roughly typical.

Figure 6: histogram presentation of gain achievement scores for both groups.



In terms of gain accomplishment scores, urban individuals had a slightly higher average (6.11) than did rural individuals (6.86). The skewness values

suggest a fairly right-skewed distribution for both locations, but the kurtosis values indicate a distribution with slightly larger tails.

Overall, the descriptive statistics shed light on the central tendency, dispersion, and form of the distribution for prescores and postscores and increase accomplishment scores in rural settings.

Table 3 shows the descriptive analyses of achievement scored on the basis of gender.

	Gender	N	Mean	Median	SD	Skewness	SE	Kurtosis	SE
Pre scores Achievement	Girl	150	8.98	9.00	3.89	0.25199	0.198	-1.073	0.394
	Boy	150	8.57	9.00	4.00	-0.00835	0.198	-0.643	0.394
Post scores Achievement	Girl	150	15.13	15.00	5.71	0.21915	0.198	-0.713	0.394
	Boy	150	15.39	15.50	5.84	0.11414	0.198	-0.509	0.394
Gain Achievement scores	Girl	150	6.15	6.00	3.62	0.50198	0.198	-0.331	0.394
	Boy	150	6.82	6.00	4.15	0.50236	0.198	-0.525	0.394

Examining the gain achievement scores, girls have a mean gain of 6.15, while boys have a mean gain of 6.82. Both skewness and kurtosis values are close to zero, indicating relatively symmetrical and moderately peaked distributions for both genders. In summary, the descriptive statistics suggest that girls tend to have slightly higher prescores in the Achievement group, both genders show improvement in postscores, and boys exhibit a slightly higher mean gain in achievement scores.

Table 4. represents the Descriptive Analysis for Gain Achievement Scores and Post-Scores Achievement.

	Group	N	Mean	Median	SD	SE
Gain Achievement scores	Experimental	150	7.03	6.00	4.05	0.331
	Control	150	5.95	6.00	3.69	0.301
Post scores Achievement	Experimental	150	16.15	15.00	5.82	0.476
	Control	150	14.37	15.00	5.59	0.456

Table 5 represents the independent sample t test between gain achievement scores and postscore achievement.

Independent Samples T-Test								
		Statistic	**df**	**p**	**Mean difference**	**SE difference**		**Effect Size**
Gain Achievement scores	Student's t	2.41	298	0.016	1.08	0.447	Cohen's d	0.279
Post scores Achievement	Student's t	2.70	298	0.007	1.78	0.659	Cohen's d	0.312

Note. H_a $\mu_{Experimental} \neq \mu_{Control}$

The table presents the results of an independent samples t test comparing the gain achievement scores and postscore achievement scores between the experimental and control groups. The statistical analysis revealed several important findings.

The t statistic for the gain achievement score is 2.41, with 298 degrees of freedom, resulting in a p value of 0.016. This finding indicates a statistically significant difference in the gain achievement scores between the experimental and control groups. The standard error (SE) is 0.447, whereas the mean difference is 1.08. The Cohen's d effect size is 0.279, indicating a medium influence.

Table 6: ANOVA scores achievement about the locality that is rural or urban

ANOVA - Post scores Achievement						
	Sum of Squares	df	Mean Square	**F**	**p**	**η^2**
Group	237.6	1	237.6	7.59	0.006	0.024
Locale	72.0	1	72.0	2.30	0.130	0.007
Group ✻ Locale	365.2	1	365.2	11.66	< .001	0.037
Residuals	9271.3	296	31.3			

Similarly, the t statistic for Post Scores with 298 degrees of freedom produces a p value of 0.007. This finding indicates a statistically significant difference in posttest performance between the two groups. The mean difference is 1.78, the standard deviation is 0.659, and the effect size (Cohen's d) is 0.312, indicating a moderate influence. Overall, these findings indicated significant

differences in both Gain Achievement and Post score achievement between the experimental and control groups, indicating that the experimental intervention was beneficial.

Table 7 represents the post hoc comparison between the two groups.

Post Hoc Comparisons – Group						
Comparison						
Group	Group	Mean Difference	SE	df	t	p_{tukey}
Experimental	Control	1.78	0.646	296	2.75	0.006

Table 8: Post hoc comparison of postscore achievement in rural and urban localities

Post Hoc Comparisons - Locale						
Comparison						
Locale	Locale	Mean Difference	SE	df	t	p_{tukey}
Urban	Rural	-0.980	0.646	296	-1.52	0.130

Table 9: Post hoc comparison of postscore achievement in group and localities

Post Hoc Comparisons - Group ✻ Locale								
Comparison								
Group	Locale	Group	Locale	Mean Difference	SE	Df	t	p_{tukey}
Experimental	Urban	Experimental	Rural	-3.187	0.914	296	-3.487	0.003
		Control	Urban	-0.427	0.914	296	-0.467	0.966
		Control	Rural	0.800	0.914	296	0.875	0.818
	Rural	Control	Urban	2.760	0.914	296	3.020	0.015
		Control	Rural	3.987	0.914	296	4.362	< .001
Control	Urban	Control	Rural	1.227	0.914	296	1.342	0.537

$H_0$3, there is a significant difference between the posttest scores of the achievement test in the traditional group and the experimental group concerning locale, i.e., urban and rural areas," is rejected at the 0.05 significance level. There was a statistically significant difference in the post scores of rural and urban students concerning location. Similarly, the post hoc comparison for group and gender was analyzed, and the results revealed that there was no significant difference in the post hoc scores of the achievement tests for either group. Therefore, the results indicate that H_0 4, i.e., null hypothesis four, is accepted.

Table 10: ANOVA scores for achievement between group and gender

	Sum of Squares	Df	Mean Square	F	P	η^2
Group	237.63	1	237.63	7.293	0.007	0.024
Gender	5.07	1	5.07	0.156	0.694	0.001
Group ✻ Gender	58.96	1	58.96	1.810	0.180	0.006
Residuals	9644.53	296	32.58			

Table 11 presents the post hoc comparisons between groups.

Post Hoc Comparisons – Group						
Comparison						
Group	Group	Mean Difference	SE	df	t	p_{tukey}
Experimental	Control	1.78	0.659	296	2.70	0.007

Table 12 presents the post hoc comparisons between gender.

Post Hoc Comparisons – Gender						
Comparison						
Gender	Gender	Mean Difference	SE	df	t	p_{tukey}
Girl	Boy	0.260	0.659	296	0.394	0.694

Table 13 presents the post hoc comparisons between group and gender.

Post Hoc Comparisons - Group ✻ Gender								
Comparison								
Group	Gender	Group	Gender	Mean Difference	SE	df	T	p_{tukey}
Experimental	Girl	Experimental	Boy	0.627	0.932	296	0.672	0.908
		Control	Girl	2.667	0.932	296	2.861	0.023
		Control	Boy	1.520	0.932	296	1.631	0.363
	Boy	control	Girl	2.040	0.932	296	2.189	0.129

		Control	Boy	0.893	0.932	296	0.958	0.773
Control	Girl	Control	Boy	-1.147	0.932	296	-1.230	0.608

DISCUSSION AND CONCLUSIONS

The production of this digital module is divided into five stages: analysis, design, development, implementation, and evaluation. This digital module was created via various tools, including Google Slides, Kinemaster, Audacity, Google Classroom, and Microsoft Word. This product's published results are digital module files in .exe and .apk formats, and users no longer need to install a reader program to open the digital module. This digital module's components include numerous types of media, such as text, photographs, and video content, as well as interactive quizzes that allow users to take out various tasks and receive feedback from the program. (Kapoor et al., 2023) (Kaur et al., 2020) (Zhussupbayev et al., 2023)

Overall, the statistical findings revealed significant differences in both gain achievement and postscore achievement between the experimental and control groups, indicating that the experimental intervention was beneficial.

This means that null hypothesis 1, which is H_0 1, "There is no significant difference between the effectiveness of digital modules on the achievement of mathematics of students in pretest and posttest," is rejected at the 0.05 significance level.

Similarly, null hypothesis 2, which is $H_0$2, "There is no significant difference between the post test scores of achievement tests in the traditional group and the experimental group," is rejected at the 0.05 significance level.

$H_0$3, "There is a significant difference between the posttest scores of the achievement test in the traditional group and the experimental group concerning locale, i.e., urban and rural areas," is rejected at the 0.05 significance level. There was a statistically significant difference in the post scores of rural and urban students concerning location.

H_0 4, "There is no significant difference between the posttest scores of achievement tests in the traditional group and the experimental group concerning gender," is accepted at a significance level of 0.05. We did not find a statistically significant difference in the posttest scores of boys and girls concerning gender.

These results seem to be in line with those of other studies (Awadh et al., 2013) (Zhussupbayev, 2023) (Pio Albina, 2018) (Komalavalli & Amsayal, 2022). Through statistical analyses, Trakru concludes that there is no significant difference in e-learning effectiveness among boys and girls and two different cities, Delhi and Ahmedabad, i.e., concerning gender and locality. Aziz and Kumar Jha (2019) concluded that ICT positively affects the effectiveness of e-learning;

these results support the findings that digital modules positively affect the achievement of students. (Aziz et al., 2019)

A three-week experiment was conducted with 300 eighth-grade students to assess the effects of e-content/digital modules on math achievement. We examined the pretest and posttest gain scores of the students in both the experimental and control groups. The t statistic for increased accomplishment scores after statistical analysis is 2.41 with 298 degrees of freedom, producing a p value of 0.016. These findings suggest that the experimental and control groups had statistically significant differences in gain-achievement scores.

We also compared the posttest results of the two groups. Similarly, with 298 degrees of freedom, the t statistic for post score achievement is 2.70, producing a p value of 0.007. This suggests that there is a statistically significant difference in posttest performance between the two groups.

In terms of gender, the results revealed that there was no significant difference in posttest scores between the experimental and control groups.

The same is not true for the comparison of rural and urban locales. T tests, ANOVA, and post hoc tests revealed that there was a significant difference in the posttest scores of the experimental and control groups from context to location.

The findings of this study might be incorporated into future educational strategies. The outcomes of digital education should be considered when new educational policies are developed. This study adds to the recent literature on e-learning, digital learning, and online learning.

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