Empowering Students in the Digital Era: An Analysis of Interactive E-Modules' Effect on Digital Mathematical Communication

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Article Info	Abstract
	Students' mathematical digital communication abilities are paramount in the current digital era, yet many continue encountering difficulties. This study focuses on using interactive e-modules as an innovative learning medium to enhance these abilities. Adopting a quantitative experimental approach, this research involved grade 8students from SMP Negeri 1 Ciwaringin during the 2022/2023 academic year, allocating them into control and experimental groups. The study aimed to evaluate student responses to the e-module, compare students' mathematical digital communication abilities before and after the module's implementation, and determine the effectiveness of the e-module. The study's results showed a significant improvement in students' abilities, with a 75.5% positive response to the e-module and an average student score increase from 36.63 (pretest) to 72.56 (posttest). An N-Gain rise of 56.62% demonstrated the effectiveness of the e-module. These findings solidify the interactive e-module as a suitable learning medium that increases student enthusiasm and participation in mathematical learning. Thus, this research significantly contributes to mathematics education, demonstrating that interactive e-modules can effectively overcome challenges in teaching mathematical digital communication.

Introduction

Education in the present digital era has undergone significant social changes, reflected in the increasingly integrated relationship between mathematics and information and communication technology (Jeong & González-Gómez, 2020). As illustrated, using generative technology in education, such as the station rotation model of blended learning, can significantly impact school learning and performance (Larsari, Dhuli, et al., 2023). In the past decade, we have observed how technology has revolutionized how we learn and teach (Oke & Fernandes, 2020). Moreover, Larsari et al. (2023) have indicated that the integration of digital education into the education system, the use of m-learning, the customization and digitalization of teaching methods, the reassessment and redesigning of national

policies and curriculums, the improvement of institutional infrastructure, development of learning resources, and enhancement of digital technology skills and online pedagogy of students and teachers, are all potential avenues to explore.

The use of interactive e-modules holds the potential to expand the scope of content and accelerate the learning process (Nidhom et al., 2019). However, research investigating the effectiveness and efficiency of interactive e-modules in improving students' mathematical digital communication still needs to be improved (Noto et al., 2020; Pramuditya et al., 2021). Therefore, this study aims to fill this gap. The conceptualization of this research involves identifying and profoundly understanding how interactive e-modules are designed and how they influence student learning, encompassing e-module pedagogical design, content material, levels of interactivity, and how these interactive e-modules accommodate differing student learning styles.

This research aims to understand and evaluate the impact of using interactive e-modules in teaching mathematics on students' mathematical digital communication. The main objective is to evaluate the effectiveness of interactive e-modules in enhancing students' mathematical digital communication abilities. In terms of categorization, this study will measure mathematical digital communication skills before and after the implementation of interactive e-modules, explicitly considering the skills improvement achieved (Asmianto et al., 2022). Additionally, an assessment of how students respond to using e-modules in learning will be collected and analyzed (Kumar et al., 2023). This research is expected to contribute to the literature on mathematics education in the digital era and provide recommendations for education practitioners on effective ways of utilizing technology in teaching mathematics. Theoretically, it will extend our understanding of the use of digital technology in teaching mathematics (Rochsun & Agustin, 2020). Practically, this study recommends that education practitioners effectively leverage technology in teaching mathematics in the digital era (Oke & Fernandes, 2020).

Referring to the theoretical framework and previous studies (Asmianto et al., 2022; Kumar et al., 2023; Noto et al., 2020; Pramuditya et al., 2021), this study hypothesizes that the implementation of interactive e-modules in mathematics learning will result in significant improvements in students' mathematical digital communication abilities. This hypothesis directly responds to the research question and is formulated based on the cause-effect relationship between the variables examined. This study will implement an experimental design with control and experimental groups, measuring students' mathematical digital communication skills before and after implementing interactive e-modules. The falsifiability of this hypothesis is assured; if the research results do not show significant improvement or differences between the control and experimental groups, this hypothesis can be deemed 'refuted'. Whether supporting or refuting the hypothesis, the results will significantly contribute to our understanding of technology's role in mathematics learning.

Method

Employing a quantitative and experimental method (Boeren, 2018), this research aims to examine the impact of an interactive e-module on eighth-grade students' mathematical digital communication skills at SMP Negeri 1 Ciwaringin. We will apply a proportional stratified random sampling technique (Ramezan et al., 2019), selecting classes randomly to represent distinct populations. Two classes have been identified for the study: 8F as the control group and 8G as the experimental group, with distinct treatments regarding the e-module usage. The research utilizes a quasi-experimental design (Hodges et al., 2020). Herein, the experimental group will experience the learning process via the interactive e-module, while the control group follows regular learning methods. The core objective is to compare the learning outcomes between the two groups post-implementation of the interactive e-module.
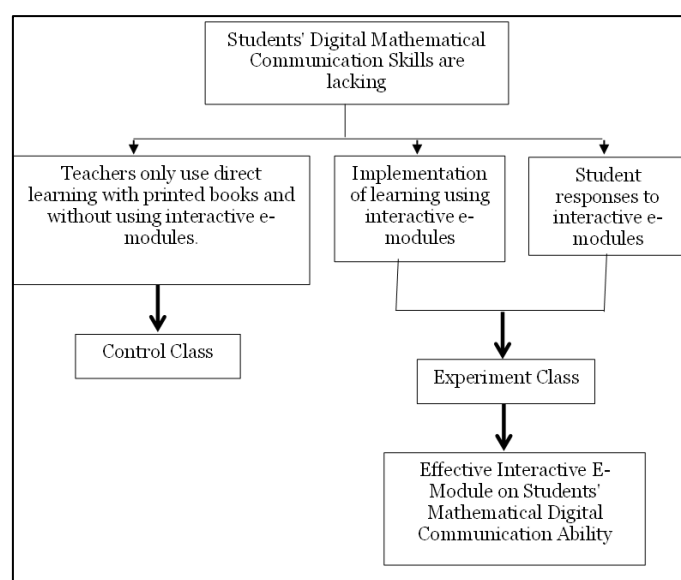

Figure 1. Research Thinking Framework

Data will be collected using two types of instruments: descriptive tests and questionnaires. The interactive e-module uses descriptive tests to measure students' mathematical digital communication skills before and after. In this study, mathematical digital communication indicators (Pramuditya et al., 2021; Pramuditya & Nurlaelah, 2021) used to measure student capabilities comprise three main components: Drawing Ability (Comp1), which includes the ability to express mathematical situations or ideas in images, diagrams, or graphs; Mathematical et al. Ability (Comp2), which involves the capacity to transform situations, images, diagrams, or actual objects into mathematical language, symbols, ideas, or models; and Writing Answers in Own Language Ability (Comp3), which includes the ability to explain mathematical ideas, situations, and relations in writing, restate a mathematical narrative or paragraph in one's language, and the skill to construct arguments or express opinions and provide written explanations for given answers.

These skills are applied to tasks concerning Linear Equations in Two Variables. Students interpret situations mathematically, solve problems, explain concepts, graph equations, and formulate problems

related to daily life scenarios. We utilize questionnaires to gauge student engagement with the interactive e-module. This instrument features 20 questions spanning various response indicators and has been validated by expert mathematic education researchers (Buteau et al., 2020). The questionnaire is given to class 8G at SMPN 1 Ciwaringin, consisting of 30 students. Evaluation employs percentage intervals, categorizing student performance into five ranges: Excellent (81%-100%), Good (61%-80%), Average (41%-60%), Below Average (21%-40%), and Poor (0%-20%).

Data analysis uses N-Gain scores (Pahlawan et al., 2021), to assess the e-module's impact on improving students' skills. The research adheres to ethical principles, ensuring respondent privacy and anonymity (Pietilä et al., 2020). This research, focusing on the use of the interactive e-module, reflects advancements in technology-based education and explores its potential within Indonesia's mathematical education context (Awaah et al., 2021; Charmaraman et al., 2022; Greenhow et al., 2020; Lewin & Charania, 2018).

Results

After an intensive journey through our methodological process, we have reached the stage in our quantitative research e-module where we can now present and examine our results (Boeren, 2018) We delve into our raw data, collected through structured questionnaires and tests, and interpret how it addresses our predefined research focus and problems (Saggi & Jain, 2018). Our research focuses on assessing students' interaction with the e-module, comparing their mathematical digital communication skills before and after using the e-module, and evaluating its effectiveness (Hamzah et al., 2022). We have reflected on our data, aligned our research with previous studies in digital mathematics education, and aimed to improve educational practices.

Now, we transition to the 'Results and Discussion' section. Here, we interpret our findings and their broader implications. This section is designed to deepen understanding of the potential of the e-module in enhancing mathematical digital communication skills (Delita et al., 2022; Greenhow et al., 2020; Pramuditya & Nurlaelah, 2021). Join us as we delve into our findings and discussions.

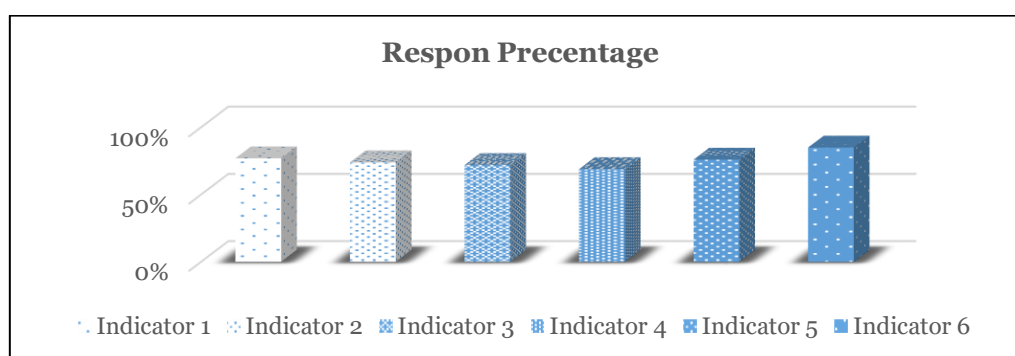**Students' Response to the E-Module**

Figure.2 Comparison of Percentage of Student Responses to Interactive E-Module for Each Indicator

To gauge students' reactions towards using the interactive e-module as a learning medium in mathematics, we employ a questionnaire. This instrument, called variable X, is explicitly designed to capture the students' experiences and responses while using the interactive e-module to learn about the system of two-variable linear equations.

The cumulative evaluation of the student response questionnaire, as depicted in Figure 2, presents an encouraging figure of 75.5%, firmly within the 'good' category, reflecting their engagement with the interactive e-module in mathematics learning. This assessment is comprehensive, comprising six distinctive indicators: interest in mathematics, discipline in learning, obedience during learning, learning activities, use of learning media, and media presentation. The first indicator assesses "Interest Related to Mathematics Subjects." It comprises four exploratory statements, including three affirmative and one critique. Capturing a predominant interest in mathematics, the students' feedback suggests an opportunity for enhancing pre-module instruction. The average score for this indicator stands at a respectable 77%, rendering a 'good' evaluation. Moving to the second indicator, "Discipline in Learning," it primarily measures adherence to task completion and active participation. It uncovers positive student responses that point towards the interactive e-module's success in fostering punctuality and engagement, subsequently attaining a 'good' rating with an average score of 74%.

The third indicator, "Obedience in Learning," comprised of a positive and a negative statement, provides an insight into the students' compliance during learning, achieving a 'good' rating with an average score of 76%. Indicator four, "Activities During Learning," evaluates student engagement during the learning process through three statements. The results, indicating an average score of 69%, denote a 'good' evaluation, confirming the e-module's efficacy in promoting active student participation. The fifth indicator, "Use of Learning Media," considers the efficacy and impact of learning media. The encouraging student response, represented by four positive and one negative statement, places this indicator within the 'good' category with an average score of 76%. Lastly, the "Media Presentation" indicator receives the highest applause, with an average score of 85%, demonstrating an 'excellent' evaluation and reflecting high student satisfaction levels regarding the quality of the interactive e-module's presentation.

Table1 Questionnaire Percentage Recapitulation

No	Indicator	Criteria
1	Interest Related to Mathematics Subjects	Good
2	Discipline in Learning	Good
3	Obedience in Learning	Good
4	Activities During Learning	Good
5	Use of Learning Media	Good
6	Media presentation	Excellent
Cumulative Average		Good

Table 2 above presents a comprehensive recapitulation comparison of the student response questionnaire results, specifically within the context of the two-variable linear equation system across

these six distinctive indicators. This detailed evaluation aids in further understanding the students' interactions and responses to the interactive e-module.

Results of the Digital Mathematical Communication Skills Test

This research was conducted at SMPN 1 Ciwaringin in the 2022/2023 academic year. The research samples were class 8F, with 30 students as the control group, and class 8G, with 30 students as the experimental group. During the research, the experimental group was given a treatment of learning using an Interactive E-module that required each student to install the e-module on their phones. In contrast, the control group received no such treatment. The following data will be discussed:
Control Group Pretest and Posttest Data

The control group for this study was class 8F, with a total of 30 students, 19 of whom were female and 11 male. The pretest and posttest results for the control group are as follows:
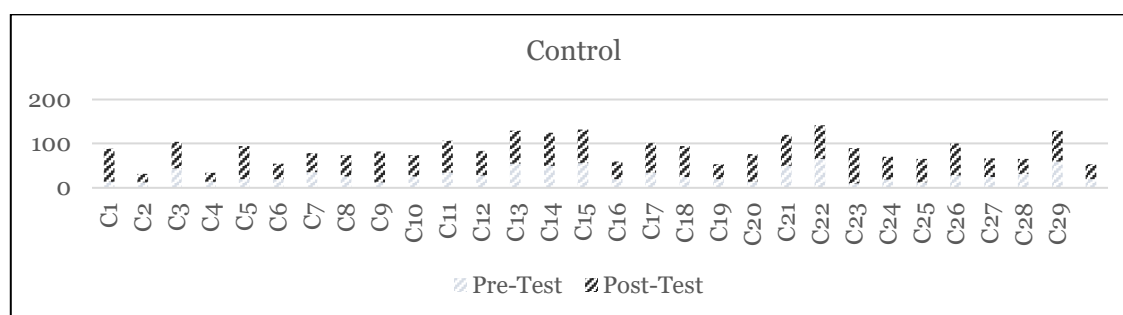

Figure 3. Pretest and Posttest Score Data of Control Class

The recapitulation of scores above shows that some students pass and fail the Minimum Completeness Criteria (KKM), with the KKM for mathematics in eighth grade set at 70. The average score for the control group suggests that the students did not achieve learning completeness as they stayed within the KKM value.

Experimental Group Pretest and Posttest Data

The experimental group in this study was class 8G, consisting of 30 students, 16 female, and 14 male. The pretest and posttest results for the experimental group are as follows:
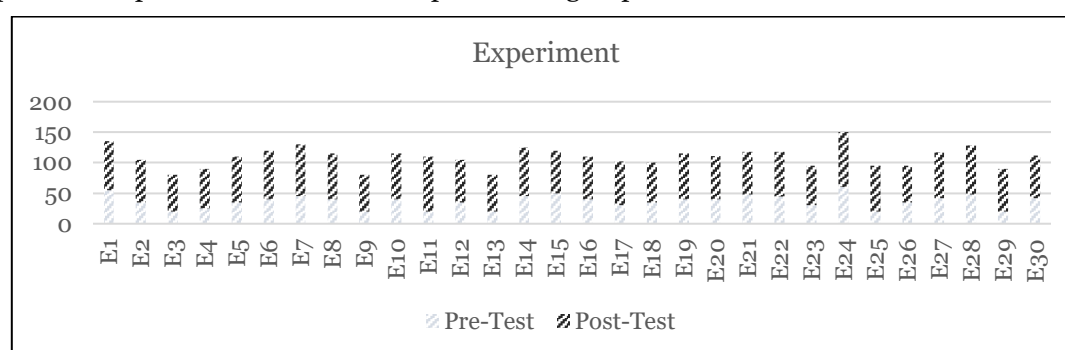

Figure 4. Pretest and Posttest Score Data of Experimental Class

Figure 4 above shows that the experimental class's post-test average is 72.56, which exceeds the established Minimum Completeness Criteria (KKM - '*Kriteria KePassedan Minimum*') set by the school at 70. This KKM implies that students achieved learning completeness after using the interactive e-module for mathematical digital communication skills. Upon obtaining the pretest and post-test scores from both classes - the experimental and control groups -, the researcher will perform tests to determine the scores obtained using analyses of normality, homogeneity, completeness tests, paired sample t-tests, independent sample t-tests, and n-gain score tests.

The research findings obtained from collecting scores via pretest and post-test will be analyzed. This score allows the researcher to determine whether there is a significant difference between the level of mathematical digital communication ability among students who use the interactive e-module versus those who do not.

The researcher analyzed the data by comparing pretest and post-test scores between the experimental and control classes. Based on the results of the normality test using the Kolmogorov-Smirnov test with the help of SPSS 22, the significance value (Sig.) for the pretest and post-test data of the experimental class was found to be 0.200 and 0.055, respectively, which means they are above the significance level ($\alpha = 0.05$), and therefore, the data of the experimental group is normally distributed both before and after the treatment.

The normality test results also show a significance value (Sig.) for the pretest and post-test data of the control class of 0.052 and 0.200, respectively, indicating that these values are above the significance level ($\alpha = 0.05$), which means the pre and post-treatment data of the control group is also normally distributed.

Homogeneity Test

The homogeneity test is an essential part of this study because it ensures that the experimental and control classes have the same variance, which is crucial for the comparison between the two classes to be valid. In the homogeneity test using SPSS 22, the significance value (Sig.) for all pretest and post-test data of the experimental group was found to be 0.146, which means the data is above the significance level ($\alpha = 0.05$), indicating the data is homogeneous or has the same variance. The same applies because the significance value of the obtained data exceeds the significance level of 0.05.

Based on the homogeneity test results, the probability value in the significance column is 0.146. Since the probability value is more significant than 0.05, it can be concluded that both classes are homogeneous.

Hypothesis Test

Individual Completeness Test of Mathematical Communication Ability The individual communication

ability completeness test is conducted by evaluating each student's score. If a student's score is equal to or greater than the established minimum completeness criterion, set at 70, the student is considered to have achieved completeness. The results of the individual mathematical communication ability completeness test can be seen in the following Figure 5.
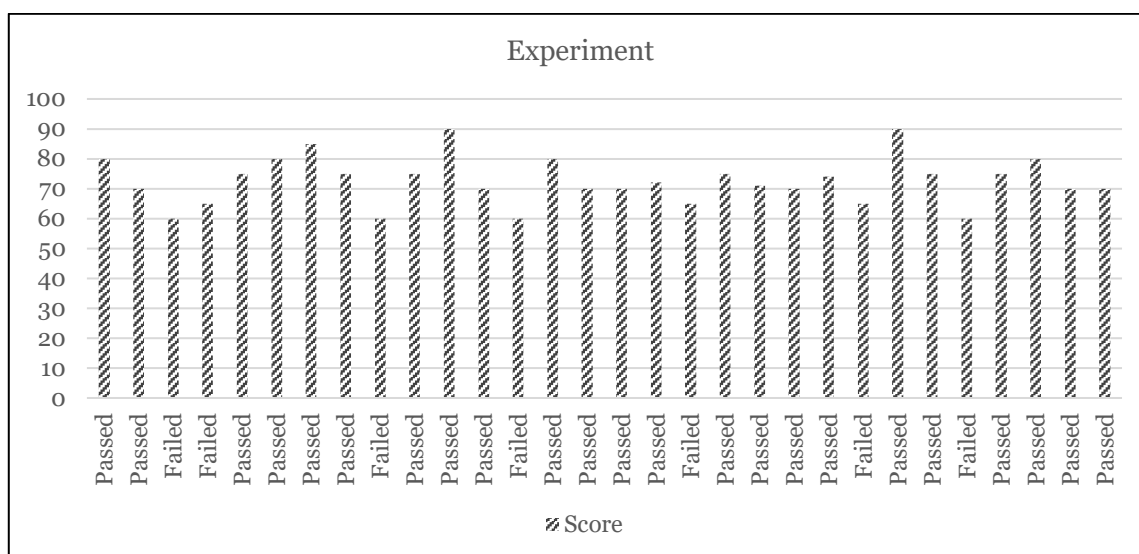

Figure 5. Experiment Class Individual Completeness Test Results

Figure 5 above shows that the experimental class's posttest average is 72.56, which exceeds the established KKM set by the school at 70. This KKM implies that students achieved learning completeness after using the interactive e-module for mathematical digital communication skills. Upon obtaining the pretest and posttest scores from both classes - the experimental and control groups -, the researcher will perform tests to determine the scores obtained using analyses of normality, homogeneity, completeness tests, paired sample t-tests, independent sample t-tests, and n-gain score tests.

The research findings obtained from collecting scores via pretest and posttest will be analyzed. This score allows the researcher to determine whether there is a significant difference between the level of mathematical digital communication ability among students who use the interactive e-module versus those who do not.

Based on the results of the normality test using the Kolmogorov-Smirnov test with the help of SPSS 22, the significance value (Sig.) for the pretest and posttest data of the experimental class was found to be 0.200 and 0.055, respectively, which means they are above the significance level ($\alpha = 0.05$). Therefore, the data of the experimental group is normally distributed both before and after the treatment.

The normality test results also show a significance value (Sig.) for the pretest and posttest data of the control class of 0.052 and 0.200, respectively, indicating that these values are above the significance level ($\alpha = 0.05$), which means the pre and post-treatment data of the control group is also normally distributed.

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Hypothesis Test

Individual Completeness Test of Mathematical Digital Communication Skill The individual communication ability completeness test is conducted by evaluating each student's score. If a student's score is equal to or greater than the established minimum completeness criterion, set at 70, the student is deemed to have achieved completeness. The results of the individual mathematical digital communication ability completeness test can be seen in the follows:

- If H_0: $\pi_0 \geq 70$ (the average value of mathematical communication ability reaches KKM)
- If H_1: $\pi_0 < 70$ (the average value of mathematical communication skills does not reach KKM)

The criteria used in this individual completeness test are $t_{count} > t_{table}$, so H_0 is accepted. The following is the result of the tcount calculation:

$$Z = \frac{\frac{x}{n} - \pi_0}{\sqrt{\frac{\pi_0(1 - \pi_0)}{n}}} = \frac{\frac{23}{30} - 0,7}{\sqrt{\frac{0,7(1 - 0,7)}{30}}} = \frac{0,604}{0,083} = 7,223$$

Because $Z_{count} > Z_{table}$ or 7.223 > 1.64, it can be concluded that students have completed it individually. This means that students' mathematical digital communication abilities in learning mathematics on the subject of SPLDV reach KKM. The number of students who achieved the KKM was 23 out of 30 students.

Mathematical Digital Communication Ability Classical Completeness Test

The results of the classical mathematical communication ability completeness test can be seen in the following Figure 6.
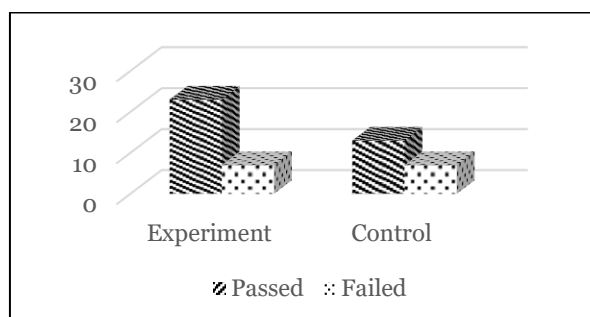

Figure 6. The Results of The Classical Mathematical Communication Ability Completeness Test

$$Z_{ij} = \frac{\frac{x_i}{n_i} - \frac{x_j}{n_j}}{\sqrt{pq(\frac{1}{n_i} + \frac{1}{n_j})}} = \frac{\frac{23}{30} - \frac{13}{30}}{\sqrt{0{,}203(\frac{1}{30} + \frac{1}{30})}} = \frac{0{,}433}{0{,}116} = 3{,}724$$

Based on the standard normal list with α = 0.05 or 5%, Z0.5-0.05 = Z0.45 and Z0.45 = 1.64. Based on the calculation of the classical test Zcount = 3.724 > 1.64 so it can be concluded that the classical passability is met. In addition to calculations with Zcount, the percentage of students who received treatment using interactive e-modules achieved KKM was 23/30 × 100 = 76.6%. It can be concluded that the percentage of students who achieve KKM in the classical experimental class is more than 70%.

Paired Sample T-Test

In this test, the decision-making basis is the paired sample test. Based on the results using SPSS 22, the Sig (2-tailed) value is 0.000, which means 0.000 < 0.05. Thus, it can be concluded that H_a is accepted, H_0 is rejected, which implies there is a difference between pretest and posttest using the interactive e-module.

Independent Sample T-Test

Given the results of the normality and homogeneity tests stating that all pretest and posttest data are normally distributed and homogeneous, a hypothesis test was conducted using the independent sample t-test with SPSS 22. The hypothesis test is used to reach a conclusion on whether or not there is a comparison. Hence, from the results, it can be inferred that the use of the interactive e-module affects students' mathematical digital communication abilities.

H0: The interactive e-module is not effective on students' mathematical digital communication abilities
Ha: The interactive e-module is effective on students' mathematical digital communication abilities
The criteria used as a guideline in hypothesis testing are:
- If the probability value is >0.05, then Ha is accepted
- If the probability value is <0.05, then H0 is rejected

Since the data is homogeneous as seen from the equal variances assumed, it shows that the t-value is larger than the t-table value. The experimental class's mean score is also greater than the control class's mean score. By using the independent sample t-test, we obtained the t-test data for the posttest mathematical learning results of the experimental and control classes with t-value 10.561 > t-table 2.045 and Sig. (2-tailed) value 0.000 ≤ 0.05. Hence, it can be concluded that there is a difference in students' mathematical digital communication abilities between the experimental class that uses the interactive e-module learning media and the control class that does not. Therefore, H0 is rejected and Ha is accepted.

Effectiveness of e-Modules on Mathematical Digital Communication Skill

As technology evolves and proliferates in this digital age, its incorporation into educational settings has become increasingly indispensable. It facilitates teaching and learning processes and equips students with the necessary skills to navigate and flourish in a technologically advanced society. One such technological tool is the interactive e-module, a sophisticated digital platform that enhances the learning experience by promoting active engagement and fostering independence among learners. However, despite its increasing prevalence in classrooms, there still needs to be more comprehensive research evaluating the impact of using interactive e-modules on specific learning outcomes, such as the development of students' mathematical digital communication skills. This increase is particularly relevant given the profound significance of these skills in the contemporary world, from their role in everyday problem-solving to their applicability in various high-demand careers in fields like engineering, data science, and finance. Thus, this study was conceived to bridge this research gap and provide empirical insights into this unexplored area.

The study deployed the N-Gain test to measure the effectiveness of the interactive e-module in enhancing students' mathematical digital communication skills, a robust method designed to assess learning outcomes in educational settings. Introduced by Hake in 1998, the N-Gain test has since garnered recognition for its reliability and effectiveness in quantifying improvements in students' abilities across a spectrum of disciplines. The test captures the change in students' scores from the pretest (before the intervention) to the posttest (after the intervention), thereby providing an objective measure of the impact of the educational intervention. In the context of this study, the 'educational intervention' refers to the use of the interactive e-module in mathematics instruction.

The N-Gain test can identify even subtle improvements in students' mathematical digital communication abilities by comparing the pretest and posttest scores. Moreover, this method helps to illustrate whether the e-module was effective and the degree of its effectiveness. Hence, the findings of this study, as gauged through the N-Gain test, could contribute significantly to the literature on digital education tools and their role in enhancing specific learning outcomes. Furthermore, such insights could prove instrumental in refining educational strategies and tailoring technological interventions to maximize student learning in the digital age.
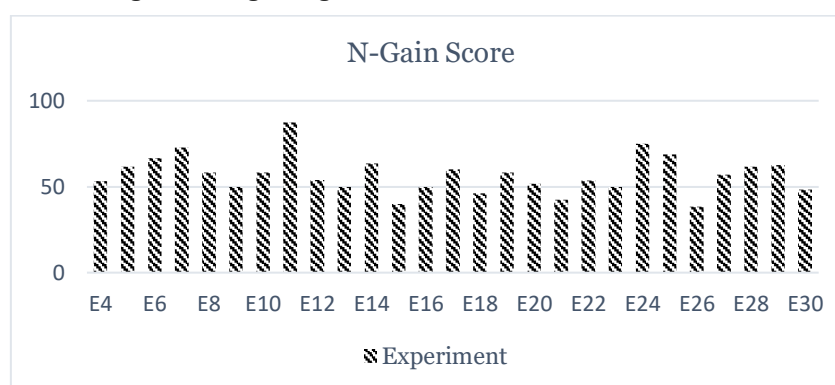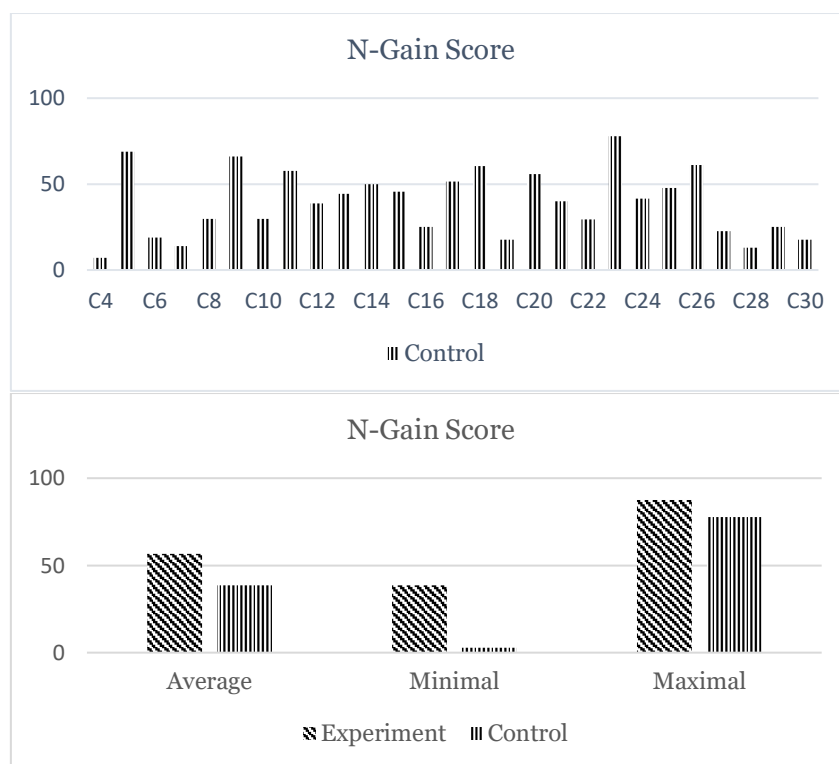
Figure 7. Results of the N-Gain Test

Results of the N-Gain Test for the Experimental and Control Classes

The N-Gain test results for the pretest and posttest in the experimental and control classes are presented in Table IV.18. Based on these results, the average N-Gain score for the experimental class was 56.62, which, according to Hake's classification (1998), falls within the "moderately effective" category. This indicates that the use of the interactive e-module was effective in enhancing the mathematical digital communication skills of 8G grade students at SMP Negeri 1 Ciwaringin. Meanwhile, the average N-Gain score for the control class was 38.44, which falls within the "less effective" category.

These results demonstrate that the interactive e-module has the potential to enhance students' mathematical digital communication skills, particularly on the topic of two-variable linear equation systems. However, this improvement does not necessarily mean that the interactive e-module will be effective in other contexts or for different mathematical topics. Therefore, further research is needed to test the effectiveness of the interactive e-module in various contexts and mathematical learning topics. Nonetheless, this study has provided promising initial evidence on the effectiveness of the interactive e-module in enhancing students' mathematical digital communication skills.

Discussion

In a careful and structured study conducted at SMP Negeri 1 Ciwaringin, two validated research instruments, namely a questionnaire and a test, were effectively used to measure two important aspects: the students' response to the implementation of the interactive e-module in the context of mathematics

learning, and the improvement in the students' mathematical communication skills (Setiyani et al., 2020).

The investigation through the student response questionnaire, which included 30 students from the experimental class, yielded valuable results. The cumulative score reaching 75.5% for response indicators such as interest, discipline, obedience, activity during learning, usage, and presentation, indicates a strong positive response to the interactive e-module (Larsari, Dhuli, et al., 2023). In other words, this is a strong indicator that the interactive e-module plays a significant role in enhancing students' attitudes towards mathematics learning (Asmianto et al., 2022; Setiyani et al., 2020; Zhou & Wu, 2022).

The subsequent analysis of the results of the mathematical digital communication skills test provided a more in-depth view of the impact of the e-module. This test was designed following the established mathematical digital communication indicators (Kom1, Kom2, Kom3a, Kom3b, Kom3c) (Pramuditya & Nurlaelah, 2021), and its results were highly encouraging (Noto et al., 2020). According to the collected data, the posttest scores of the students in the experimental class reached an average of 72.56, exceeding the minimum pass criteria of 70. This study, therefore, proves that the use of the interactive e-module can significantly improve the mathematical digital communication skills of students (Sugiharti & Maryani, 2019). The paired sample test showed a Sig (2-tailed) value of 0.000, indicating a significant difference between the pretest and posttest before and after using the interactive e-module. This means that the use of the interactive e-module has a significant positive impact on students' mathematical communication abilities.

This research demonstrates that the use of the interactive e-module effectively enhances the mathematical digital communication skills of students. This research was conducted over the past 10 years at SMP Negeri 1 Ciwaringin, a school with adequate digital facilities and students accustomed to technology (Amhag et al., 2019). In this study, students were given access to the interactive e-module, specially designed to enhance mathematical communication skills through the use of digital technology (Pramuditya et al., 2021). The study results showed an increase in posttest scores of students after using the interactive e-module, indicating an increase in their understanding and ability to communicate mathematical concepts through digital media (Noto et al., 2020). The students' response to the e-module was also very positive, showing their engagement and interest in the learning process using this technology (Delita et al., 2022)).

However, it should be noted that the school context used in this study has a high level of digital readiness (Arthur-Nyarko et al., 2020). Therefore, further research is needed to ensure whether these results can be applied to schools with different levels of digital readiness (Hong & Kim, 2018). Factors such as access to technology, students' skills in using technology, and different learning environments can influence the results in other schools. Thus, further research and adaptation of learning strategies are needed to validate and expand these findings for broader application in diverse educational contexts (Hernandez-de-Menendez et al., 2020).

Interactive E-Modules, defined as modules that use text, video, sound, and images to trigger two-way interaction between the e-module and the user, can be an effective tool in enhancing mathematical digital communication, as stated by Pramuditya and Nurlaelah (2021). The e-module helps students to understand the material more easily, makes them interested in learning, and helps them become more active in learning. Students who can use these digital media and successfully complete tasks usually gain a full understanding of the material.

As a final outcome, this study demonstrates that with the aid of the interactive e-module, students can be more active in the learning process and understand the material better (Larsari, Wildová, et al., 2023). Therefore, based on the results obtained, it can be concluded that the interactive e-module is effective in enhancing students' mathematical communication skills, marking a significant advancement in the use of technology in mathematics education.

Conclusion

In research conducted at SMP Negeri 1 Ciwaringin, it is proven that the use of interactive e-modules in learning mathematics has shown a positive and significant impact on students' mathematical communication abilities. This is based on data collected through validated questionnaires and tests, which show very positive student responses to the interactive e-modules and an increase in their scores in mathematical communication skills. however, the context of the schools in this study were schools with high levels of digital readiness, so it is important to note that these results may not directly apply to schools with different levels of digital readiness.

This research has underlined the potential of interactive e-modules as an effective tool to enhance students' mathematics learning and digital mathematical communication skills. However, as often happens in research, this study has limitations. The context of schools in Ciwaringin 1 Public Middle School has a high level of digital readiness, so further research is needed to ascertain whether the same results can be obtained in schools with different levels of digital readiness. In addition, the use of interactive e-modules needs to be adapted to the learning environment and students' abilities to use digital technology.

Recommendations

In the research conducted at SMP Negeri 1 Ciwaringin, it has been demonstrated that the use of interactive e-modules in mathematics instruction has had a positive and significant impact on students' mathematical communication skills. This is based on the data gathered from validated questionnaires and tests, which indicate a highly positive student response to the interactive e-modules and an increase in their scores in mathematical communication abilities. However, the school context in this study is one with a high level of digital readiness, and it is important to note that these results may not directly

apply to schools with varying degrees of digital readiness.

This study has underscored the potential of interactive e-modules as an effective tool for enhancing the process of mathematics learning and students' mathematical digital communication skills. However, as is often the case with research, this study has its limitations. The school context at SMP Negeri 1 Ciwaringin possesses a high level of digital readiness, warranting further research to ensure whether the same results can be achieved in schools with differing levels of digital readiness. Moreover, the use of interactive e-modules needs to be adapted according to the learning environment and the students' proficiency in utilizing digital technology.

Acknowledgements or Notes

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