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The Effectiveness of Using IFP Based on The Number Line Frog Educational Game on Mathematics Learning Outcomes in Third Graders

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Abstract

Students' learning outcomes in mathematics, particularly on the topic of number lines, remain relatively low. Therefore, this study investigates the effectiveness of using an Interactive Flat Panel (IFP) integrated with educational games in improving students' mathematics learning outcomes. This research employed a quasi-experimental, nonequivalent control group design, involving two groups without full random assignment of participants. The study was conducted with third-grade elementary school students, consisting of an experimental group that received instruction using the IFP and a control group that learned through concrete learning media. Data were collected through pre-tests and post-tests and analysed using the Shapiro–Wilk normality test, homogeneity test, and independent-samples t-test with SPSS. The results revealed a significance value of 0.00, which was lower than 0.05, indicating that the alternative hypothesis (H_a) was accepted. These findings demonstrate that using an educational game-based IFP has a statistically significant positive effect on mathematics learning. Furthermore, the implementation of the IFP was founded on students' motivation, engagement, and conceptual understanding, making the learning experience more concrete and meaningful. This study supports the notion that integrating interactive game-based technology into classroom instruction can serve as an effective strategy for improving the quality of mathematics education in elementary schools and reducing students' misconceptions of mathematical concepts.

Keywords: Educational Games, Interactive Flat Panel, Mathematics Learning, Number Line

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Abstrak

Hasil belajar matematika siswa, khususnya pada materi garis bilangan, masih tergolong rendah. Oleh karena itu, penelitian ini bertujuan untuk mengetahui efektivitas penggunaan Interactive Flat Panel (IFP) yang terintegrasi dengan permainan edukatif dalam meningkatkan hasil belajar matematika siswa. Penelitian ini menggunakan metode kuasi eksperimen (quasi-experimental) dengan desain nonequivalent control group, yang melibatkan dua kelompok tanpa pembagian peserta secara acak sepenuhnya. Penelitian dilaksanakan pada siswa kelas III sekolah dasar, yang terdiri atas kelompok eksperimen yang memperoleh pembelajaran menggunakan IFP dan kelompok kontrol yang mengikuti pembelajaran menggunakan media pembelajaran konkret. Pengumpulan data dilakukan melalui tes awal (pretest) dan tes akhir (posttest). Data yang diperoleh kemudian dianalisis menggunakan uji normalitas Shapiro–Wilk, uji homogenitas, dan uji independent samples t-test dengan bantuan perangkat lunak SPSS. Hasil penelitian menunjukkan nilai signifikansi sebesar 0,00, lebih kecil dari 0,05, sehingga hipotesis alternatif (H_a) diterima. Temuan tersebut menunjukkan bahwa penggunaan IFP berbasis permainan edukatif memberikan pengaruh positif yang signifikan secara statistik terhadap hasil belajar matematika siswa. Selain itu, penerapan IFP didasarkan pada peningkatan motivasi, keterlibatan, dan pemahaman konsep siswa, sehingga pengalaman belajar menjadi lebih konkret dan bermakna. Penelitian ini mendukung pandangan bahwa integrasi teknologi interaktif berbasis permainan dalam pembelajaran di kelas dapat menjadi salah satu strategi yang efektif untuk meningkatkan kualitas pembelajaran matematika di sekolah dasar serta mengurangi miskonsepsi siswa terhadap konsep matematika.

Kata Kunci: Permainan Edukatif, Interactive Flat Panel, Pembelajaran Matematika, Garis Bilangan

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INTRODUCTION

The development of digital technology is encouraging schools to utilise interactive learning media, in line with the demands of digital literacy and 21st-century skills, which need to be developed starting in elementary school (Fatmawati, 2025). However, utilising technology is not enough to simply capture students' attention; media must be designed to help students grasp concepts that are difficult to grasp through verbal explanation alone. The number line is an important representation in elementary school mathematics learning because it is used to understand sequence, position, distance, and number operations. Although it seems simple, the number line requires students to connect numbers as discrete symbols with positions on a spatial representation in the form of a line. This transition can lead to misunderstandings when students have to determine the position of numbers, read the distance between points, or interpret the direction of motion on the number line. Maemuna et al. (2023) found conceptual and procedural errors in students' solutions to integer arithmetic operations using the number line, indicating that the relationship between arithmetic operations and their representation on the number line is not yet fully understood.

This difficulty was also apparent in grade 3B of SDN Kedung Badak 2. Based on the results of a preliminary study through an initial assessment, it was found that mathematics learning outcomes on the number line topic were still low. The pre-test results showed an average score of 46.25, with the lowest score being 35 and the highest score being 60. Compared to the Learning Objective Achievement Criteria (KKTP) of 70, all students (100%) did not reach the KKTP. This condition indicates that students' initial understanding of the number line material still needs reinforcement. Learning that relies on verbal explanations and simple media can make students less active and easily bored, so media that presents concepts more concretely and directly involves students is needed. Andika et al. (2024) reported that interactive learning media in elementary school mathematics can support motivation and learning outcomes, although implementation still requires teacher readiness and available infrastructure.

In the number line material, media that have been studied include number line teaching aids (Siregar, 2022) and number line Engklek games (Sapta et al., 2022). In elementary school mathematics learning more broadly, the effectiveness of game-based learning models and other learning media has also been tested (Paulina et al., 2023; Septiyani et al., 2024; Trisnawati et al., 2025), and a literature review on interactive educational game media in mathematics learning has been compiled by Nurhikmah et al. (2024). Educational games connect play activities with learning objectives so that students not only receive information, but also try strategies, get feedback, and improve their answers.

Interactive Flat Panel (IFP) is a large touchscreen that allows students to interact directly with the material through touch, object movement, animation, sound, and educational games. In number line material, this characteristic can be utilised to show position, direction, and distance dynamically, for example, by moving objects on the number line according to the given problem. The use of IFP has been reported at various levels and subjects (Fauzi & Hasan, 2025; Sari et al., 2026; Istiana & Prahastiwi, 2026) and is associated with learning motivation and collaboration (Indriansyah, 2025). In mathematics learning, Aulia et al. (2025) reported an increase in learning outcomes through classroom action research; Rahayu et al. (2026) tested IFP on integer arithmetic operations with a nonequivalent control group design and reported a significant difference in learning outcomes (Sig. 0.001), while Arrasid et al. (2026) analysed the use of IFP on the understanding of mathematical concepts of third-grade students.

Theoretically, the effectiveness of an educational game-based IFP can be explained through the cognitive theory of multimedia learning (Mayer, 2009), which posits that learners process information via visual and auditory channels with limited capacity; thus, learning becomes meaningful when visual elements and interactive activities reinforce one another rather than inducing cognitive overload. From a constructivist perspective, students construct mathematical understanding through direct manipulation. On a number line, physically moving objects to determine and observe numerical positions helps students bridge abstract symbols with spatial direction and distance. This representational support is crucial because students often make conceptual and procedural errors when connecting arithmetic operations to number line representations (Maemuna et al., 2023) and struggle to interpret number line models flexibly across different problem contexts (Samuntya & Ikram, 2022).

Bridging these representational difficulties requires instructional media that integrates structured visual scaffolding with active student engagement. Previous studies have shown that targeted visual aids such as number line boards support conceptual understanding (Larasati et al., 2023), while problem-based interactive multimedia enhances classroom dynamism and mathematical critical thinking—enabling students to analyse numerical relationships, justify directional choices, and self-correct based on immediate feedback (Andika et al., 2024; Kinanti & Masniladevi, 2024; Pusnawati et al., 2024). Specifically regarding IFP integration in Indonesian elementary schools, Aulia et al. (2025) reported improved student learning outcomes through classroom action research, while Rahayu et al. (2026) demonstrated a statistically significant difference ($p = .001$) in integer arithmetic outcomes using a quasi-experimental nonequivalent control group design.

Nevertheless, the mere presence of an IFP in the classroom does not automatically guarantee improved learning quality; as Umara et al. (2025) emphasised, effective IFP utilisation depends heavily on teachers' digital competence, technical readiness, and structured pedagogical planning. Consequently, IFPs must be paired with well-designed, concept-aligned educational games rather than serving solely as passive display boards. While prior studies on number line instruction have predominantly relied on static teaching aids or physical games, and existing IFP studies have largely focused on case studies, classroom action research, or general arithmetic, experimental evidence comparing game-based IFPs against concrete manipulatives specifically on the number line topic for third-grade students remains scarce. To address this gap, the present study evaluates the effectiveness of the "Number Line Frog" educational game integrated into an IFP using a quasi-experimental design.

Based on previous research, studies on number line media generally involve teaching aids or concrete games, while some studies on IFP use case study approaches, classroom action research, or media development. To the author's knowledge, experimental research testing educational game-based IFP on number line material for third-grade students by comparing it to concrete media is still limited. The formulation of the research problem is whether there is a difference in mathematics learning outcomes on the number line material between third-grade students who learn using IFP based on the educational game "Number Line Frog" and students who learn using concrete media. The purpose of this study is to determine the effectiveness of using the educational game-based IFP on the mathematics learning outcomes of third-grade elementary school students. The hypotheses tested are H_0: there is no difference in the average learning outcomes between the experimental group and the control group, and H_a: there is a difference in the average learning outcomes between the two groups. The results of the study are

expected to inform teachers and schools in designing interactive, technology-based mathematics learning and to serve as a reference for further research.

METHODS

Research Approach and Design

This study used a quantitative, quasi-experimental approach. This method was used to determine the effect of learning media on student learning outcomes. The research design used was a nonequivalent control group design, an experimental design involving an experimental group and a control group without full subject randomisation. Both groups were given a pre-test before learning and a post-test after learning to determine differences in learning outcomes.

Table 1. Nonequivalent Control Group Research Design

Group	Pre-test	Treatment	Post-test
Experiment	O_1	X: IFP based on the educational game "Number Line Frog"	O_2
Control	O_3	K: concrete media	O_4

Research Variables

This study involved two variables: an independent variable and a dependent variable. The independent variable (X) was the learning media, namely the use of IFP based on the educational game "Number Line Frog" in the experimental group and concrete media in the control group. Meanwhile, the dependent variable (Y) was the students' learning outcomes, which were measured based on pre- and post-learning test scores. The use of learning media was the main differentiator between the two groups. In contrast, the students' learning outcomes were the aspect that was compared to determine any differences in learning outcomes.

Research Subjects

The research was conducted at SDN Kedung Badak 2, Bogor City, on Tuesday, May 12, 2026. The research subjects were third-grade students from two intact classes with 20 students each (40 students total), namely class 3B as the experimental group and class 3A as the control group. The determination of the groups was based on the available classes, so that individual randomisation was not carried out. The equality of the initial abilities of the two groups was checked through a pre-test.

Research Instruments

The main instrument in this study was a mathematics learning achievement test administered in a pre-test and post-test. The instrument was designed based on learning objectives and indicators of learning achievement in the number line material. The instrument grid included indicators of the abilities measured, cognitive aspects, question formats, and item numbers. The test was used to obtain quantitative data regarding student abilities before and after learning. The pre-test was given to determine students' initial abilities, while the post-test was given to determine learning outcomes after treatment. In addition to the test, an observation sheet was used as a supporting instrument to monitor the implementation of learning.

Instrument Validity

Instrument validity was conducted to ensure that the instrument was capable of measuring learning outcomes in accordance with the research objectives. Validity testing was conducted

through content validity and empirical validity. Content validity was assessed by examining each question item's suitability to the learning objectives, competency achievement indicators, the material being measured, and the students' cognitive abilities. The review also took into account aspects of construction and language use to ensure that the questions were appropriate to the characteristics of third-grade elementary school students. Thus, each question item was expected to have a clear relationship to the abilities being measured. After review, the instrument was pilot tested to obtain data for empirical validity testing. Empirical validity testing was conducted using SPSS by analysing the relationship between each item's score and the total score. Items were declared valid if the correlation coefficient met the predetermined testing criteria. Items that met the validity criteria were used in the study, while those that did not were either not used or were revised.

Instrument Reliability

Reliability testing is conducted after the instrument validity process to determine the instrument's level of consistency in measuring student learning outcomes. Reliability testing is conducted using Cronbach's Alpha with the help of SPSS. An instrument is considered reliable if the reliability coefficient value meets the predetermined criteria. Reliability testing is conducted on test items that meet the validity criteria. The results of the reliability testing serve as the basis for ensuring that the instrument has adequate measurement consistency so it can be used in research data collection.

Data Collection Technique

In this study, data were collected from pre-test and post-test scores. Tests served as the primary data source to determine students' learning outcomes before and after the treatment. In contrast, observations were used as supporting data to see the implementation of the learning process. The study was conducted on May 12, 2026, with a time allocation of 2 JP. Measurements were carried out on the experimental and control groups under relatively similar conditions and time spans so that differences in implementation time would not be a dominant factor in the research results.

Research Procedures

The research procedure consisted of three stages. In the preparation stage, the researcher prepared learning materials, media, grids, and instruments, and validated and tested the instruments. In the implementation stage, both groups were given a pre-test, then followed the number line learning according to their groups (IFP based on educational games for the experimental group and concrete media for the control group), and ended with a post-test. The treatment was given on Tuesday, May 12, 2026, with an allocation of 2 lesson hours (2 JP). In the final stage, the data were analysed statistically. The study was conducted with the school's permission and the consent of parents/guardians. Student scores were reported as aggregate group scores.

Data Analysis Techniques

Data were analysed using IBM SPSS Statistics version 23 with a significance level of $\alpha = 0.05$. Descriptive analysis was used to obtain the minimum, maximum, average, and standard deviation of pre-test and post-test scores in each group. Prerequisite tests included the Shapiro-Wilk normality test and the homogeneity of variance (Levene) test; data were declared normally distributed or homogeneous if the significance value was > 0.05.

Hypothesis testing was conducted using an independent-samples t-test on pre-test data to check for equality of initial abilities and on post-test data to test for differences in learning outcomes. H_0 was rejected if the Sig. (2-tailed) value was <0.05. The improvement in learning outcomes was analysed using N-Gain, which is the difference between post-test and pre-test scores divided by the difference between the maximum and pre-test scores (Hake, 1998), with high ($g > 0.7$), medium ($0.3 \leq g \leq 0.7$), and low ($g < 0.3$) categories. The N-gain test was calculated from the mean of each group.

RESULTS AND DISCUSSION

Reliability Test

A reliability test is a tool used to determine how accurate, stable, or consistent a measuring instrument is in measuring what it is intended to measure. Table 2 presents the reliability criteria as follows.

Table 2. Reliability Criteria

r value	Information
≥ 0.70	High
< 0.70	Low

(Source: Sardia et al., 2021)

The following are the reliability analysis results presented in Table 3.

Table 3. Reliability Results

Question Items	Number of Subjects	Test Reliability	Interpretation of Reliability
10	20	0.82	High

Based on Table 3, the reliability value of the instrument is 0.82, and it can be interpreted that the 10 questions that the researcher will use have high reliability.

Statistical Data

This study was conducted to determine the effectiveness of using an Interactive Flat Panel (IFP)- based educational game in improving students' mathematics learning outcomes on number lines. Data were obtained through pre-test and post-test results for the experimental and control groups. The results of the descriptive analysis are presented in Table 4.

Table 4. Descriptive Statistics of Pre-Test and Post-Test Scores

Description	N	Min.	Max.	Mean	Std. Deviation
Experiment Pre-test	20	35	60	46.25	8.091
Experiment Post-test	20	75	95	84.25	6.340
Pre-test Control	20	10	70	46.75	14.534
Post-test Control	20	60	85	70.75	7.656

Based on Table 4, the experimental group of 20 students obtained pre-test scores ranging from 35 to 60. The experimental group's average pre-test score was 46.25, with a standard deviation of 8.091. After receiving treatment using an Interactive Flat Panel (IFP)- based

educational game, the post-test results showed a minimum score of 75 and a maximum score of 95, with an average score of 84.25 and a standard deviation of 6.340. This indicates an increase in the average learning outcomes in the experimental group from 46.25 to 84.25.

In the control group of 20 students, the pre-test scores ranged from 10 to 70, with an average of 46.75 and a standard deviation of 14.534. After participating in the learning activity in the control group's post-test results showed a minimum score of 60 and a maximum score of 85, with an average score of 70.75 and a standard deviation of 7.656. Thus, the control group's average learning outcomes increased from 46.75 to 70.75.

Descriptively, both groups experienced improved learning outcomes after the learning process. The experimental group experienced an average increase of 38.00 points, while the control group experienced an average increase of 24.00 points. Furthermore, the data were analysed using prerequisite tests, including normality and homogeneity tests, before conducting hypothesis testing.

Normality Test

A normality test was conducted to determine whether the learning outcome data in the experimental and control groups were normally distributed. The test was conducted on pre-test and post-test data using the Shapiro-Wilk test. The results of the normality test are presented in Table 5.

Table 5. Normality Test Result

	Shapiro Wilk		
	Statistics	df	Sig.
Experiment Pre-test	0.925	20	0.124
Experiment Post-test	0.914	20	0.077
Pre-test Control	0.953	20	0.418
Post-test Control	0.928	20	0.143

Based on Table 5, the Shapiro-Wilk normality test results show that the significance value for the pre-test in the experimental group was 0.124, and the post-test in the experimental group was 0.077. In the control group, the significance value for the pre-test was 0.418, and for the post-test, it was 0.143. All significance values are greater than 0.05.

Based on the decision-making criteria, the data are considered normally distributed if the significance value is >0.05. Therefore, the pre-test and post-test data for both the experimental and control groups are normally distributed. Furthermore, because all data are normally distributed, the analysis can proceed with a homogeneity test to assess whether the variances between the experimental and control groups are similar.

Homogeneity Test

The homogeneity test was conducted to determine whether the variance of learning outcome data in the experimental and control groups was homogeneous. The test was conducted on pre-test and post-test data using IBM SPSS Statistics version 23. The hypotheses were H_0: the variances of both populations are homogeneous, and H_a: the variances of both populations are not homogeneous. The decision was based on comparing the significance value (p-value) with a significance level of $\alpha = 0.05$; H_0 is accepted if the significance value is > 0.05, and H_a is accepted

if the significance value is ≤ 0.05. The results of the homogeneity test of mathematics learning outcome data in the experimental group and the control group are presented in the following table.

Table 6. Homogeneity Test

Data	Sig.	Interpretation
Pre-test	0.065	Homogeneous
Post-test	0.607	Homogeneous

Based on Table 6, the homogeneity test results show that the significance value of the pre-test data is 0.065 and the post-test data is 0.607. Both significance values are greater than the 0.05 significance level, so H_0 is accepted. Thus, it can be concluded that the variance of the pre-test and post-test data in the experimental and control groups is homogeneous. This indicates that the data met one of the prerequisite tests for proceeding with hypothesis testing using the independent-samples t-test.

Sample T-Test

The Independent Sample T-Test was conducted after the data met the prerequisite tests of normality and homogeneity. This test was used to determine whether there was a difference in average learning outcomes between the experimental and control groups in the pre-test and post-test data. The test was conducted using IBM SPSS Statistics version 23 with a significance level of $\alpha = 0.05$. The results of the Independent Samples t-test are presented in Table 7.

Table 7. Independent Samples T-test Result

Description	P-Value	Significance Level	Interpretation
Pre-test	0.894	0.05	H_0 is accepted
Post-test	0.000	0.05	H_a is accepted

Based on Table 7, the results of the Independent Samples t-test on the pre-test data yielded a significance value of 0.894. This value is greater than 0.05 (0.894 > 0.05), so H_0 is accepted. Thus, there is no significant difference in the average learning outcomes between the experimental group and the control group before being given treatment. Meanwhile, the results of the Independent-Samples T-Test on the post-test data yielded a significance value of 0.000. This value is less than 0.05 (0.000 < 0.05), so H_a is accepted. Thus, there is a significant difference in the average learning outcomes between the experimental group and the control group after learning. These results indicate that there is a difference in mathematics learning outcomes on the number line material between students who participated in learning using educational game-based IFP and students in the control group.

N-gain test

After conducting the normality test, homogeneity test, and Independent-Samples T-Test, the next step was to conduct the N-Gain test based on the pre-test and post-test results obtained from third-grade students. The N-Gain test was used to determine the extent of improvement in mathematics learning outcomes on the number line material after instruction. The results of the N-Gain test in the experimental and control classes are shown in Table 8.

Table 8. N-Gain Test of Experimental Class and Control Class

Class	N-Gain Score	Interpretation
Experiment	0.71	High
Control	0.44	Medium

Based on Table 8, it can be seen that the N-Gain value in the experimental class was 0.71 and is included in the high category. These results indicate a significant increase in mathematics learning outcomes in third-grade students after participating in learning using the Number Line Frog educational game-based IFP. Meanwhile, the N-Gain value in the control class was 0.44, falling into the moderate category. This indicates that the improvement in mathematics learning outcomes in the control class was moderate after participating in the learning provided.

Based on the results of the N-Gain test, the average N-Gain value of the experimental class was 0.71, higher than the control class at 0.44. Thus, the increase in mathematics learning outcomes in the experimental class using the Number Line Frog educational game-based IFP was in the high category, while the control class was in the medium category.

The results of a quasi-experimental study of third-grade elementary school students, divided into two classes: a control class and an experimental class, revealed that the use of an Interactive Flat Panel (IFP) based on educational games was highly effective in enriching students' learning experiences through engaging visual educational games. This is in line with Fauzi & Hasan's (2025) research, which states that mathematics learning using Interactive Flat Panel (IFP) media can increase student participation and creativity.

Discussion

The use of educational game-based Interactive Flat Panels (IFPs) has enormous potential for application in quasi-experimental research because this technology can create more interactive, adaptive, and student-centred learning. This is in line with Trisnawati et al. (2025), who state that educational game-based learning can encourage students to try, make mistakes, correct them, and build concepts independently. IFPs not only function as a medium for delivering material but also as a tool that can accommodate the various learning styles of all students. Students with visual learning styles can understand material through images, animations, and videos displayed directly on the screen. In contrast, students with kinesthetic learning styles can interact directly through the available touchscreen features. This condition shows that IFPs can provide a more concrete and meaningful learning experience for elementary school students. This is in line with Indriansyah's (2025) research, which states that the use of Interactive Flat Panels (IFPs) can help create a more interesting and less monotonous learning atmosphere. However, the success of using Interactive Flat Panels (IFPs) depends on the teacher's ability and mastery in using them. This is in line with Pradana's research (2026), which states that teacher competence in designing content will influence the success of using Interactive Flat Panels (IFP) in elementary schools.

Furthermore, the integration of educational games into Interactive Flat Panels (IFPs) makes the learning process more engaging and less monotonous. Educational game platforms actively engage students in playful learning activities. These activities can increase student attention, motivation, and participation. Through interactive touchscreen features, students can directly answer questions, move objects, or solve learning challenges collaboratively in front of the class. This approach encourages active, enjoyable learning so that students not only passively receive

information but also construct their own understanding through direct learning experiences. This is in line with research by Istiana and Prahastiwi (2026), who stated that the interactions that occur during the use of IFPs prove that educational technology can shift learning patterns from teacher-centred to student-centred. Students are not only recipients of information, but also process, explore, and present material through direct contact with the screen. The positive impacts on motivation, conceptual understanding, and collaborative skills indicate that using IFPs aligns with learning needs that emphasise observation, analysis, and problem-solving activities.

In the context of quasi-experimental research, using an educational game-based Interactive Flat Panel (IFP) is highly relevant for measuring the effectiveness of a treatment on student learning outcomes. Quasi-experimental research allows researchers to compare classes using an educational game-based Interactive Flat Panel (IFP) with classes using conventional learning methods. Through a pre-test and post-test design, researchers can observe improvements in student learning outcomes, motivation, and activeness after being given an educational game-based Interactive Flat Panel (IFP) learning treatment. This is in line with Sari's (2025) research, which states that the use of digital technology can increase student motivation and engagement in learning.

Before the treatment (the use of an Interactive Flat Panel (IFP) based on educational games), a pre-test was given to determine each students' initial knowledge. After the pre-test was conducted, all students were given treatment in the form of delivering material in an Interactive Flat Panel (IFP) with number lines (Hartini et al., 2026). Thus, the success of implementing the Interactive Flat Panel (IFP) can be seen in the difference in average learning outcomes between the experimental and control classes and the significance value obtained from statistical testing. If the significance value is less than 0.05, it can be concluded that using an Interactive Flat Panel (IFP) based on educational games has a significant impact on student learning outcomes.

In addition to statistically demonstrating improved learning outcomes, quasi-experimental research can also demonstrate the impact of using Interactive Flat Panels (IFPs) on student motivation, activeness, and engagement in learning. Educational games displayed through Interactive Flat Panels (IFPs) can create a more enjoyable, interactive, and less monotonous learning atmosphere, thus making students more enthusiastic in participating in learning. This is in line with Umara et al. (2025), who state that the use of IFPs has a positive effect on student motivation and collaboration, where the IFP's multi-touch feature allows students to work in groups to complete assignments, discuss, and share ideas directly on a large screen. Thus, using educational game-based IFPs not only influences cognitive aspects but also supports the development of students' affective aspects and social skills in the learning process.

Based on this, a quasi-experimental study is the right approach to show that using an Interactive Flat Panel (IFP) based on educational games can significantly improve the quality of learning. The research results, analysed using SPSS, provide a scientific basis and objective data, allowing the effectiveness of digital learning media to be academically justified. It is consistent with Hartini et al. (2026) and Nabillah and Harjunanto (2026) that interactive touchscreen games strengthen early numeracy comprehension and learning motivation, while functioning as structured digital scaffolding that bridges discrete number symbols to continuous spatial representations on a number line (Mayer, 2009; Srimuliati et al., 2023).

Ultimately, the experimental group's superior performance demonstrates that integrating the Number Line Frog educational game into an Interactive Flat Panel (IFP) offers a distinct pedagogical advantage over static concrete media in elementary mathematics. Building on the findings of Rahayu et al. (2026) and Arrasid et al. (2026), this study confirms that dynamic

touchscreen manipulation supports third-grade students' cognitive transition from discrete numerical symbols to continuous spatial representations of distance and direction on a number line. In alignment with Mayer's (2009) cognitive theory of multimedia learning, synchronising visual motion, immediate game feedback, and direct kinesthetic touch effectively scaffolds conceptual understanding without inducing extraneous cognitive load. Nevertheless, as Umara et al. (2025) note, sustained instructional effectiveness still relies on teachers' digital readiness and alignment with specific curricular goals. Furthermore, these findings should be interpreted in light of several methodological limitations, including the single-school sample ($N = 40$), the non-randomised intact group design, and the brief two-lesson-hour (2 JP) intervention window. Future studies are therefore recommended to employ multi-school randomised designs with delayed post-tests and standardised affective instruments to examine long-term conceptual retention.

CONCLUSION

Based on the research results, the use of an Interactive Flat Panel (IFP)- based educational game, "Number Line Frog", has an impact on the mathematics learning outcomes of third-grade elementary school students. This media provides a more interactive learning experience through visualisation and game activities, allowing the number line material to be presented more concretely and engagingly. The results of the independent-samples t-test showed a significance value of 0.00, which is < 0.05. These results indicate a significant difference in learning outcomes between the experimental group using educational game-based IFP and the control group using concrete media. Thus, the alternative hypothesis (H_a) is accepted, and the null hypothesis (H_o) is rejected. Thus, the "Number Line Frog" educational game-based IFP can be used as an alternative learning medium for mathematics on number lines in elementary schools. This medium not only supports visual presentation but also gives students opportunities to engage directly in learning activities. Its use still needs to be tailored to the learning objectives, teacher readiness, and school support facilities.

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