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The Effect of Interactive Flat Panel Use On Symbolic Thinking And Number Recognition In Early Children

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ABSTRACT

Symbolic thinking skills and recognition of numerical concepts are critical cognitive foundations in early childhood and require interactive learning stimulation. This study examines the impact of using an Interactive Flat Panel (IFP) on these two abilities compared with conventional teaching methods. A quasi-experimental, pretest-posttest control group design was employed, involving 60 young children divided into an experimental group (using an IFP) and a control group (using conventional methods). Data were collected via pre- and post-treatment tests to assess any changes resulting from the use of the IFP medium. Data analysis included descriptive statistics, normality testing, Levene's test for homogeneity, and an independent samples t-test. The results indicate significant differences between the two groups in both symbolic thinking skills ($t = 3.977$; Sig (2-tailed) < 0.001; MD = 9.100) and the recognition of numerical concepts ($t = -4.342$; Sig (2-tailed) < 0.001; MD = -7.833). The IFP group achieved statistically higher posttest scores than the conventional group. It is concluded that the integration of an Interactive Flat Panel (IFP) into early childhood education effectively facilitates the development of symbolic and numerical cognition, as it bridges the gap between abstract concepts (such as numerals and letters) and the visual-concrete experiences that align with the cognitive developmental stage of children during their "golden age."

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1. Introduction

Early childhood education (PAUD) is a fundamental phase for building the foundation of development, including cognitive development, symbolic thinking skills, and understanding of number concepts. Between ages 4 and 5, children enter the preoperational stage, characterised by the ability to represent objects through symbols such as numbers, pictures, and language. Symbolic thinking skills form an important foundation for early literacy and numeracy, as children begin to link symbols to abstract meanings. Early childhood education requires innovative approaches to stimulate cognitive abilities, particularly symbolic thinking and the introduction of number concepts.

Symbolic thinking lets children represent abstract ideas with concrete symbols such as numbers, images, or movements, supporting the shift from egocentric to logical thinking. At ages 4-5, children begin to associate number symbols with real quantities, but this is often hampered by a lack of multisensory stimulation. Piaget's preoperational stage highlights that young children are visual, symbolic, and kinesthetic learners who are not yet fully capable of abstract thought. When designed with these developmental principles in mind, IFP-based learning (Interactive Flat Panel-based learning) is more than an advanced technological tool; it serves as an effective mediating bridge. IFPs turn abstract concepts into concrete, visual, interactive experiences that align with how children in the preoperational stage process information, explore their surroundings, and build knowledge. Symbolic thinking is a child's ability to solve problems mentally without taking direct action (trial and error). This ability develops rapidly in preschool and becomes a foundation for understanding abstract concepts in formal learning (Brofman et al., 2023). Meanwhile, according to (Hanifa et al., 2024) symbolic thinking is a logical thought process that allows individuals to understand various symbols, such as letters, numbers, and other symbols, to represent or describe objects or things that are not

directly present in front of them. Symbolic thinking is the cognitive ability to represent objects, events, or concepts through abstract symbols (language, numbers, images), allowing individuals to understand, classify, and mentally manipulate reality without relying on direct experience.

According to (Jordan et al., 2012) introducing the number concept refers to a child's ability to understand numbers as representations of quantity, including skills such as recognising number sequences, comparing values, and performing simple operations. This understanding develops through learning experiences and interactions with the environment from an early age. Meanwhile (Alkhede & Holmqvist, 2021) describe number sense as a comprehensive understanding of numbers and operations, including the ability to grasp quantity, part-whole relationships, and apply numbers in various everyday contexts. This concept includes several key components, such as cardinality (quantity), ordinality (sequence), one-to-one correspondence, and recognising number symbols. Based on the foregoing, the number concept is defined as a child's foundational ability to understand numbers as representations of quantity, including recognising number symbols, understanding sequences and relationships between numbers, and using numbers in simple mathematical situations. Symbolic thinking skills and number concept recognition in early childhood require supportive media to stimulate them effectively. Currently, the government is actively facilitating Indonesian education to prepare it to compete in today's sophisticated world by providing *interactive flat panels* (IFPs).

This requires teachers to utilise the facilities optimally, rather than simply applying conventional learning methods. Technology in education is a key factor in stimulating symbolic thinking skills and recognising number concepts. This is in line with (Modati et al., 2024; Supriadi, 2024; Syafri et al., 2026; Tahirah et al., 2024) Technology-based media has been statistically shown to improve symbolic thinking indicators, including the ability to recognise number symbols and letters and to represent objects as images. This shows that integrating media and technology into early childhood education is crucial for building a strong foundation in numeracy and symbolic literacy before children enter elementary school.

Observations at TK Negeri Satu Atap 03 Ngabang indicate a need to strengthen cognitive stimulation, particularly in symbolic thinking and recognition of numerical concepts. Observations at TK Negeri Satu Atap 03 Ngabang indicate a need to strengthen cognitive stimulation, particularly in symbolic thinking and understanding numerical concepts. Pre-research observations of Group A (children aged 4–5 years) revealed a significant gap between the established Child Development Achievement Standards (STPPA) and actual classroom performance. Data show that 80% of the children cannot perform one-to-one correspondence, while 67% struggle to recognize and distinguish between numerical symbols—for instance, frequently confusing the digits 2 and 5. The children tend to rely on rote counting without understanding cardinality. This situation is exacerbated by conventional, static, two-dimensional learning materials—such as flashcards and worksheets—which offer minimal feedback and fail to support children's cognitive transition from concrete objects to symbolic thinking. Furthermore, the limited attention span of 4–5-year-olds causes them to lose focus quickly when using printed materials. Consequently, an educational intervention is needed to bridge this gap through multisensory stimulation. Interactive Flat Panel (IFP) use is highly relevant for research; its interactive touchscreen features, dynamic visualizations, and audio-visual feedback suit the kinesthetic and visual needs of 4–5-year-olds and may foster symbolic thinking and a deeper, more engaging understanding of numerical concepts.

Based on these observations, this study addresses the following questions: (1) Is there a significant difference in symbolic thinking skills between young children taught using the IFP approach and those taught using conventional learning methods? (2) Is there a significant difference in the recognition of numerical concepts between young children taught using the IFP approach and those taught using conventional learning methods? (3) Does the use of the IFP approach have an impact on symbolic thinking skills and the recognition of numerical concepts?

A review of previous research shows progress in studying Interactive Flat Panel (IFP) use in early childhood education; however, critical gaps remain. While (Afkarina & Nasikhah, 2026a) found a positive correlation between IFPs and general thinking skills, they did not explain the underlying cognitive mechanisms. (Wilantoro et al., 2024) highlighted the appeal of IFPs and how easily material can be grasped, but their focus was limited to perceived engagement rather than the depth of conceptual understanding. (Mailani & Ismawati, 2025) provided a comprehensive examination of the impact of IFPs on both cognitive and social domains; however, by combining these areas, their analysis lacked depth—particularly in identifying which specific cognitive indicators were affected.

Furthermore, research on other interactive media—such as interactive PowerPoint presentations and tablet-based educational games—reveals limitations in their affordances: PowerPoint is inherently linear and teacher-centered, while tablet-based games tend to be individualistic, with small screens that offer little opportunity for collaboration. To date, no study has explicitly compared the affordances of IFPs—specifically their large-scale multi-touch capabilities, real-time manipulation of digital objects, and instantaneous multisensory feedback—against these other media in the context of developing numerical concepts in young children.

Consequently, this study aims to address these gaps by offering three specific contributions: (1) narrowing the dependent variables to two crucial cognitive subcomponents—symbolic thinking and numerical concepts (specifically one-to-one correspondence and cardinality)—which are particularly prone to misconceptions among children aged 4–5 years; and (2) unpacking the mechanisms by which IFP affordances act as mediators for the cognitive transition from the concrete to the abstract. and (3) to reinforce the differentiation of IFP from

conventional interactive media through a comparative analysis of technological affordances. Thus, this research does not merely confirm the effectiveness of IFP, but also explains why and how IFP uniquely facilitates cognitive development in early childhood—a process that cannot be accommodated by other media.

2. Method

This research method is designed with a quantitative experimental approach with a quasi-experimental approach with *a pretest-posttest control group design* to test the effect of using Interactive Flat Panel (IFP) on symbolic thinking skills and number concept recognition in children aged 4-5 years in PAUD, with a sample of 60 children: 30 children in the control class and 30 children in the experimental class. Data analysis used the normality test, homogeneity test, and t-test to test the research hypothesis. The hypotheses of this study are: 1) there is a significant difference in symbolic thinking skills between early childhood using IFP and early childhood using conventional learning methods, 2) there is a significant difference in number concept recognition between early childhood using IFP and early childhood using conventional learning methods, and 3) there is an effect of using IFP on symbolic thinking skills and number concept recognition.

The observation instrument grid and questionnaire grid can be seen in the table below:

Table 1. Grid of the symbolic thinking ability observation instrument

Variable	Aspect	Indicator
Symbolic thinking ability	Recognizing number concepts	The child recognizes and names number symbols (1–10) when displayed
	Stating number concepts	The child recites the number sequence (rote counting 1–10) and counts simple objects
	Using number concepts	The child uses numbers to perform addition or matching (e.g., 2+3=5 objects on screen)
	Mengenal huruf	The child identifies vowels (A, I, U, E, O) and basic consonants (B, C, D, etc.)
	Representing objects/imagination in drawings	The child draws real objects (e.g., a house) or imaginary ones (e.g., a monster) and explains their meaning

(Kemendikbud, 2020)

The observation instrument employed a four-point Likert scale to evaluate each observed indicator. The rating scale consisted of four categories: 1 (Less), 2 (Enough, 3 (Good), and 4 (Very Good). Higher scores indicated better performance or a higher level of achievement in the observed aspects.

Table 2. Grid of the number concept introduction questionnaire

Variable	Indicators	Number of Instruments
Introduction to Number Concepts	Counting things 1-10	2
	Sort numbers 1-10 with objects	2
	Connecting the concept of numbers with random number symbols	4
	Get to know more number concepts	2
	Get to know the concept of fewer numbers	2
	Get to know the concept of the same number	2
	Get to know the concept of unequal numbers	2

(Cahyaningrum et al., 2022)

This research instrument was developed based on the Ministry of Education and Culture (Kemendikbud, 2020) guidelines for symbolic thinking skills and adapted from the indicators for recognizing number concepts proposed by (Cahyaningrum et al., 2022). To ensure the quality of the instrument, a two-stage validation process was conducted: content validity testing and empirical validity testing. Content validity was assessed through expert judgment by two specialists in the field of educational evaluation. The results indicated that all items received an average score above 3.0 on a 1–4 scale, placing them in the "Suitable" to "Highly Suitable" categories. Minor revisions were suggested for some items regarding sentence diction to improve readability; these suggestions were subsequently addressed by the researcher.

Empirical validity (construct validity) was assessed through a try-out involving 30 respondents who shared similar characteristics with the research population. The analysis was performed using the Pearson Product-Moment correlation technique with SPSS (version 25). Based on the calculations, with degrees of freedom (df) = N–2 = 28, the critical value (r-table) at the 5% significance level was 0.361. The validity test results confirmed that all 9 instrument items were valid, as their calculated correlation coefficients (r-calculated) exceeded the critical value (r-table = 0.361). The r-calculated values ranged from a minimum of 0.410 to a maximum of 0.721. Consequently, no items were discarded, and the entire instrument was deemed suitable for use in the primary data collection phase.

Furthermore, we conducted a reliability test on all items previously confirmed as valid using Cronbach's Alpha coefficient. The calculation yielded a reliability coefficient of 0.875. Based on the interpretation criteria for reliability coefficients, this value falls into the "Very High" category (> 0.80). Consequently, the research instrument meets the requirements for validity and reliability, making it suitable and trustworthy for use as a measurement tool in this study's data collection process.

Once the data collection instrument was confirmed as valid, data collection commenced with the implementation of specific treatments for each class group. The experimental group intervention was conducted over 6 weeks, with 3 sessions per week. Each session lasted 30–40 minutes, with 15–20 minutes allocated for direct interaction between the children and the Interactive Flat Panel (IFP). The intervention content focused on developing understanding of numerical concepts and symbolic thinking through leveled, interactive, game-based media. The implementation followed a validated Lesson Plan (RPP) and consisted of the following stages: (1) apperception and the establishment of rules for taking turns (queuing); (2) direct interaction with touchscreen features (such as drag-and-drop or matching tasks) accompanied by audio-visual feedback; and (3) reflection and the transfer of concepts to concrete objects within the classroom.

The control group completed learning activities for the same duration and frequency as the experimental group—30–40 minutes per session, 3 times a week, for 6 weeks. The difference in treatment was the media used: the control group did not use an Interactive Flat Panel (IFP) and instead used concrete, manipulative educational aids (such as number cards, beads, blocks, and flannel boards). The instructional framework remained play-based, in which children physically manipulated objects to match quantities with numerical symbols. In the experimental group, the IFP (Interactive Flat Panel) system provided feedback automatically, whereas in the control group, the teacher provided it directly through verbal and non-verbal reinforcement. This approach was taken to ensure equivalence in terms of content and duration, so that the independent variable being tested was solely the effect of using the IFP medium.

Data analysis involved normality tests, homogeneity tests, and t-tests to address the research hypotheses. The research hypotheses are as follows: 1) there is a significant difference in symbolic thinking skills between young children who use the IFP and those who use conventional learning methods; 2) there is a significant difference in the recognition of number concepts between young children who use the IFP and those who use conventional learning methods; and 3) the use of the IFP has an influence on symbolic thinking skills and the recognition of number concepts.

3. Result And Discussion

1. Result

The results of this study were obtained using observation instruments for symbolic thinking skills and questionnaires for number concept recognition skills. Data were collected before and after implementing the IFP. The measurement results will be presented first in the descriptive statistics table below:

Tabel 1. Descriptive Statistic of Experimental Group

	N	Min	Max	Mean	Std. Deviation
Symbolic Thinking Ability Pretest of Experimental Class	30	50	70	60.00	4.639
Posttest of Symbolic Thinking Ability of Experimental Class	30	69	100	85.33	9.732
Pretest Introduction to Number Concepts of Experimental Class	30	54	78	65.50	6.827
Posttest Introduction to Number Concepts of Experimental Class	30	65	100	87.50	7.227
Valid N (listwise)	30				

Based on the descriptive statistics presented in the table above, it can be observed that the mean pretest and posttest scores in both the experimental and control groups showed an increase. In the experimental group, the mean pretest score for symbolic thinking skills was M = 60.00, increasing to M = 85.33 after using the IFP. For recognition of number concepts, the experimental group's mean pretest score was M = 65.50, rising to M = 87.50 after using the IFP.

Tabel 2. Descriptive Statistic of Control Group

	N	Min	Max	Mean	Std. Deviation
Symbolic Thinking Ability Pretest of Control Class	30	50	70	60.00	4.639
Posttest of Symbolic Thinking Ability of Control Class	30	64	89	76.23	7.899

Pretest Introduction to Number Concepts of Control Class	30	56	78	67.17	6.259	
Posttest Introduction to Number Concepts of Control Class	30	73	100	79.67	6.740	
Valid N (listwise)	30					

Meanwhile, in the control group, the mean pretest score for symbolic thinking skills was M = 60.00, and the mean posttest score for the same skill was M = 76.23. For recognition of number concepts, the control group's mean pretest score was M = 67.17, increasing to M = 79.67 on the posttest. From the average results, it can be seen that there were changes before using and after using IFP, but these results do not answer the entire research; therefore, it will be continued with a normality test to see whether the data obtained is normally distributed or not. The results of the normality test can be seen in Table 2 below:

Table 3. Normality Test of Experimental Class

	Class Group	**Stattistic**	**df**	**Sig**
Learning Outcames	Symbolic Thinking Ability Pretest	.104	30	.200
	Posttest of Symbolic Thinking Ability	.109	30	.200
	Pretest Introduction to Number Concepts	.147	30	.095
	Posttest Introduction to Number Concepts	.098	30	.200

Based on the results of the normality test in Table 2, it is known that the sig value obtained is greater than 0.05, so the experimental class data is declared normal.

Table 4. Normality Test of Control Class

	Class Group	**Stattistic**	**df**	**Sig**
Learning Outcomes	Symbolic Thinking Ability Pretest	.134	30	.175
	Posttest of Symbolic Thinking Ability	.122	30	.200
	Pretest Introduction to Number Concepts	.128	30	.200
	Posttest Introduction to Number Concepts	.136	30	.162

Based on the results of the normality test in Table 2, it is known that the sig value obtained is greater than 0.05, so the control class data is declared normal.

The next test carried out was a homogeneity test, which can be seen in Table 4 below:

Table 5. Levene's Test of Homogeneity

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Symbolic Thinking Ability Pretest	Equal variances assumed	.000	1.000	.000	58	1.000	.000	1.198	-2.397	2.397
	Equal variances not assumed			.000	58.000	1.000	1.100	1.198	-2.397	2.397
Posttest of Symbolic Thinking Ability	Equal variances assumed	2.075	.155	3.977	58	1.000	9.100	2.288	4.519	13.681
	Equal variances not assumed			3.977	55.645	1.000	9.100	2.288	4.515	13.685
Pretest Introduction to	Equal variances assumed	.985	.325	-.986	58	.328	-1.667	1.691	-5.052	1.718

Number Concepts	Equal variances not assumed			-.986	57.569	.328	-1.667	1.691	-5.052	1.719
Posttest Introduction Number Concepts	Equal tovariances assumed	.123	.728	-4.342	58	1.000	-7.833	1.804	-11.445	-4.222
	Equal variances not assumed			-4.342	57.720	1.000	-7.833	1.804	-11.445	-4.222

From the results of the homogeneity test of Levene's Test for Equality of Variances above, it can be seen that the Sig value obtained in the four data sets is greater than 0.05, so it is concluded that the four data are **homogeneous** . The pretest of symbolic thinking ability obtained a Sig value of 1.000, which is greater than 0.05, so the data are declared homogeneous. The posttest of symbolic thinking ability obtained a Sig value of 0.155, which is greater than 0.05, so the data are declared homogeneous. The pretest of number concept introduction obtained a Sig value of 0.325, which is greater than 0.05, so the data are declared homogeneous. Furthermore, the posttest of number concept introduction obtained a Sig value of 0.728, which is greater than 0.05, so the data are declared homogeneous. Furthermore, after the homogeneity test, the results of the t-test are interpreted to determine whether the hypothesis is accepted or rejected. The t-test results are shown in the table below.

Table 6. T-test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Symbolic Thinking Ability Pretest	Equal variances assumed	.000	1.000	.000	58	1.000	.000	1.198	-2.397	2.397
	Equal variances not assumed			.000	58.000	1.000	.000	1.198	-2.397	2.397
Posttest of Symbolic Thinking Ability	Equal variances assumed	2.075	.155	3.977	58	.000	9.100	2.288	4.519	13.681
	Equal variances not assumed			3.977	55.645	.000	9.100	2.288	4.515	13.685
Pretest Introduction Number Concepts	Equal tovariances assumed	.985	.325	-.986	58	.328	-1.667	1.691	-5.052	1.718
	Equal variances not assumed			-.986	57.569	.328	-1.667	1.691	-5.052	1.719
Posttest Introduction Number Concepts	Equal tovariances assumed	.123	.728	-4.342	58	.000	-7.833	1.804	-11.445	-4.222
	Equal variances not assumed			-4.342	57.720	.000	-7.833	1.804	-11.445	-4.222

4. Discussion

There is a significant difference in symbolic thinking skills between young children who use an Interactive Flat Panel (IFP) and those who are taught using conventional learning methods.

Based on the statistical test results, the first hypothesis (H_1) of this study is accepted. This is supported by the finding that using an Interactive Flat Panel (IFP) significantly impacts the symbolic thinking skills of young children.

1) Interpretation of Initial Conditions (Pretest)
   The independent-samples t-test results at the pretest stage yielded a t-value of 0.000 and a significance level (Sig. 2-tailed) of 1.000. Since this significance value is far greater than the alpha (α) level of 0.05, it is concluded that there was no significant difference in symbolic thinking skills between the experimental group and the control group before the intervention. This statistical homogeneity is an ideal methodological prerequisite, ensuring that both groups had equivalent baseline abilities. Consequently, any changes or improvements observed during the posttest can be validly attributed to the intervention (the use of the IFP) rather than to pre-existing differences in the children's inherent capabilities.

2) Interpretation of Final Results and Effect Size (Posttest)
   Following the intervention, the posttest results revealed a dramatic shift. The t-value increased to 3.977, with a significance level (Sig. 2-tailed) of 0.000 (< 0.05). This figure confirms a highly significant difference between the two groups after the intervention. Furthermore, descriptive analysis indicates a mean difference of 9.100. Within the context of early childhood education (ECE) assessment instruments, a difference of this magnitude represents a substantial improvement. In practical terms, this demonstrates that children in the experimental group were able to recognize and apply numerical concepts, identify letters, and represent objects or imaginative ideas through drawings with a significantly higher degree of accuracy, speed, and confidence compared to children in the control group, who were taught using conventional methods.

3) Analysis of the Mechanism: Why Is IFP More Effective?
   The significant advantage observed in the experimental group can be explained by the inherent characteristics of the Interactive Flat Panel (IFP) medium. Conventional teaching methods—such as static flashcards, standard whiteboards, or lectures—tend to be one-way (teacher-centered) and offer limited stimulus variety. In contrast, IFP provides multisensory stimulation that aligns closely with young children's learning characteristics. The experimental group's superior performance stems from IFP's greater responsiveness to early childhood learning needs. (Nurhayati et al., 2026) emphasize that conventional teaching methods—such as static flashcards, standard whiteboards, or lectures—are typically one-way (teacher-centered) and lack a diverse range of stimuli, thereby restricting children's active exploration. Conversely, IFP offers a much richer multisensory learning experience. (Akyuna et al., 2026) explain that the animation, audio, and video features within interactive media create an engaging learning experience that simultaneously activates various information-processing channels. This synergy between visual, auditory, and kinesthetic stimulation allows the IFP to bridge the gap between abstract concepts and a child's concrete understanding; consequently, numerical concepts are internalized and symbolic thinking develops more effectively than through conventional approaches.

4) Alignment with Theory and Previous Research
   These findings align with Jean Piaget's theory of cognitive development, which posits that young children are in the preoperational stage—a phase in which they rely heavily on visual aids and direct experience to develop symbolic functions. In this context, Interactive Educational Game Platforms (IFP) serve as effective scaffolding.

   Empirically, these results are supported by (Rejabbilaisyah et al., 2024), who showed that interactive educational game media enhance the symbolic abilities of 5–6-year-old children by shifting their role from passive learners to active participants. These findings also align with research by (Lutfiah & Iqbal, 2026), which examined the use of IFP in early childhood education settings; the study concluded that IFP supports children's symbolic and logical thinking skills by presenting material visually and interactively, thereby fostering greater enthusiasm and improved understanding. Additionally, research by (Afkarina & Nasikhah, 2026b) indicates that the availability and use of IFP are positively correlated with children's cognitive abilities, particularly in recognizing letters and numbers through interactive quizzes.

Young children who use IFP differ significantly in their understanding of number concepts from those who use conventional learning methods.

The independent-samples t-test conducted on the pretest data regarding the understanding of number concepts yielded a t-value of 0.986, with a Sig. (2-tailed) value of 0.328. Since this significance value is greater than the alpha level ($\alpha = 0.05$), the null hypothesis (H_0) is accepted; it is concluded that there is no significant difference in the initial ability to understand number concepts between the experimental group and the control group. Unlike the pretest results for the symbolic thinking variable—which yielded a t-value of 0.000—the t-value of 0.986 for this variable indicates a very small mean difference between the groups. This difference falls

within the range of random variation and is not substantial enough to be considered statistically significant (Gravetter & Wallnau, 2017).

Following the intervention, the posttest results yielded a t-value of −4.342, with a Sig. (2-tailed) value of 0.000 (< 0.05). Consequently, H_0 is rejected, and H_2 is accepted: there is a highly significant difference in the understanding of number concepts between the experimental group and the control group after the intervention.

It should be noted that the negative sign in the t-value of −4.342 does not imply that the experimental group possesses a lower level of ability. This sign is merely a technical consequence of the group ordering used during data processing in SPSS; the control group was entered first, resulting in a calculation based on the formula (mean of control group − mean of experimental group). Because the experimental group mean was higher, the subtraction yielded a negative result. In a two-tailed test, the decision-making process is based on the absolute value $|t|. = 4.342$, along with its significance value, regardless of the sign.

A t-value of 4.342, which far exceeds the t-table value at the 5% significance level, indicates that the difference is not only statistically significant but also substantial in magnitude. The mean difference between the two groups should be explicitly reported in the manuscript as evidence of practical significance—as was done for the symbolic thinking variable, where the difference was 9.100. The analysis would be stronger if it included an effect size calculation (using eta-squared) and N-Gain scores to categorise the level of improvement (low, medium, or high) for each group.

The concept of number is an abstract and hierarchical construct. It is not enough for a child to memorise a sequence of numbers verbally (rote counting); they must simultaneously master several fundamental principles: one-to-one correspondence, cardinality (understanding that the final number stated represents the total quantity), stable order, and the ability to link a written numerical symbol with the quantity it represents. This complexity is why learning number concepts often challenges young children when taught through purely verbal and abstract methods.

The advantages of IFP in this study can be explained through the following mechanisms:

1) Concretisation of Quantity through Multiple Representations (Bruner's Theory)
   IFP enables the presentation of numerical symbols alongside simultaneous visual and auditory representations. This mechanism is highly effective in helping children connect number concepts with their corresponding numerical symbols. For instance, when the numeral "5" appears on the screen, IFP simultaneously displays an animation of five moving objects, accompanied by an audio prompt saying "five." This simultaneous presentation of symbols, images, and sounds bridges the gap between the iconic and symbolic stages, ensuring that children do not merely memorise number shapes but truly grasp the quantitative meaning behind them. This aligns with research by (Maulidia & Muthi, 2025), which suggests that interactive media—by integrating visual, verbal, and animated elements—offers a cognitive advantage; it stimulates the information-processing channels in a child's brain, enabling them to move beyond rote memorisation toward a genuine understanding of the quantitative significance underlying numerical symbols.

2) Reinforcing One-to-One Correspondence through Sensorimotor Interaction
   The touchscreen feature of an Interactive Flat Panel (IFP) provides a hands-on experience that is crucial for learning to count objects from 1 to 10. When a child touches or drags and drops an animated object on the screen, the system responds (e.g., the object enlarges or emits a sound). Each touch on an object corresponds to verbalising a single number. This process internalises the principle of one-to-one correspondence through physical (sensorimotor) experience—a method far more effective than simply pointing at static objects in conventional learning media. This aligns with findings by (Hasbi et al., 2025), which suggest that digital learning media can enhance young children's cognitive abilities and serve as an innovative solution for educators.

3) Dynamic Comparison Visualisation for Relational Concepts
   Comparing quantities is an abstract concept that can be difficult for young children to grasp. An IFP supports this through animations that can be rearranged in real time. Teachers can display two groups of objects (e.g., 3 apples and 5 oranges) and have children interact with them to determine which group has more, fewer, or an equal amount. This dynamic visualisation makes differences in quantity concrete and easy to observe, helping children build cognitive schemas about relationships between numbers. This aligns with research by (Suparmi & Nurunnisa, 2026), which indicates that such tools help children understand numerical symbols more easily and in a more engaging way.

4) Immediate Feedback for Sequencing
   When children sequence numbers from 1 to 10 using objects, an IFP provides a safe environment for trial and error. If a child places a number or object in the wrong sequence, the medium can provide a gentle visual or auditory cue, enabling the child to perform self-correction immediately. This process strengthens

the understanding of numerical sequences without instilling a fear of failure—unlike conventional worksheets, where feedback is delayed until a teacher reviews the work.

5) Increased Engagement and Meaningful Repetition
Mastering the seven indicators of number concepts mentioned above requires meaningful repetition. The dynamic, colourful interface of the Interactive Digital Platform (IDP)—presented as educational games—automatically boosts children's motivation and attention span. Consequently, children become eager to engage in repeated practice—counting, sequencing, or comparing numbers—with great enthusiasm. This is difficult to achieve through conventional drill-based methods or lectures, which often lead to boredom. This aligns with (Maulidia & Muthi, 2025), who observed that engaging learning activities enhance children's participation in the learning process.

6) The Role of Digital Scaffolding within the Zone of Proximal Development (Vygotsky)
The IDP serves as a scaffolding tool that expands a child's Zone of Proximal Development (ZPD). When a child encounters difficulty with a complex task—such as sequencing numbers 1–10 using objects or matching numerical symbols presented in a random order—the IDP can provide gradual visual cues (for example, by highlighting the correct answer slot). This technological support, combined with the guidance of a teacher acting as a facilitator, enables children to complete tasks that would otherwise be beyond their independent capabilities.

These findings align with Piaget's theory, which posits that children aged 5–6 years are in the preoperational stage—a phase in which abstract thinking skills are not yet fully developed, leaving children highly dependent on concrete objects and visual representations to grasp concepts. Because numbers are inherently abstract, children can master them only when they are first presented in a form they can observe and manipulate. Interactive Flat Panels (IFP) address this need by providing "virtual concrete objects" that can be manipulated directly, while simultaneously overcoming the limitations associated with the availability of physical materials in the classroom.

The results of this study align with findings by(Aisyah et al., 2025), who state that interactive learning media provide dynamic visual and auditory representations, making it easier for young children to internalise abstract numerical concepts. Furthermore, (Mutiningsih & Hikmatin, 2024) demonstrated that the interactivity of such media leads to significant differences in the achievement of number-recognition competencies compared to groups that do not use these media.

Additional empirical support comes from research by (Kemala, 2023), which employed an experimental design comparing two groups—one using interactive media and the other using traditional methods—and found a significant improvement in the numeracy skills of young children, including better conceptual understanding, as well as increased speed and accuracy in counting. In a more specific context, (Lutfiah & Iqbal, 2026) reported that using IFPs at KB Babus Salam supported children's ability to count objects through interactive quizzes, with children demonstrating a better grasp of the material when it was presented in a visual, interactive format.

Using an Interactive Flat Panel (IFP) influences symbolic thinking skills and recognition of numerical concepts.

Based on the results of hypothesis tests 1 and 2, conducted using an Independent Samples T-Test, there is strong statistical evidence that the use of an Interactive Flat Panel (IFP) has a significant impact on both dependent variables: for symbolic thinking skills, $t = 3.977$, Sig (2-tailed) < 0.001, with a mean difference of 9.100; and for the recognition of numerical concepts, $t = -4.342$, Sig (2-tailed) < 0.001, with a mean difference of -7.833. Since the significance values for both variables are well below the alpha level of 0.05—and given that the initial pretest conditions were equivalent (homogeneous)—Hypothesis 3 is ACCEPTED. This confirms that the intervention using an IFP does not affect only a single cognitive aspect; rather, it exerts a broad, positive influence on young children's early symbolic and mathematical development.

Dynamic & Multisensory Visualisation: The IFP presents symbols (numbers, shapes, signs) through engaging animations and colours. This visual-auditory stimulation helps children form stronger mental representations than static media (such as flashcards or traditional whiteboards), accelerating the transition from the concrete stage to the symbolic stage. Interactivity & Instant Feedback: The touchscreen feature allows children to "hold" and manipulate symbols directly. When a child touches a number or matches a symbol on the IFP and receives an immediate response (such as a sound or a correct/incorrect animation), it supports neural reinforcement and long-term memory retention. Contextualization of Abstract Concepts: The IFP can present numerical concepts and symbols within meaningful stories or digital games. Children do not merely memorise the symbol "5"; rather, they perceive it as a collection of objects that can be counted, moved, and grouped interactively.

These results align with (Lutfiah & Iqbal, 2026), who state that interactive digital platforms (IFP) can foster children's cognitive abilities, including symbolic thinking. Similarly, (Fauziyah et al., 2026) found that interactive educational games can enhance interest, concentration, and cognitive skills related to numbers and letters. This aligns with a study by (Sopianti et al., 2023), which shows that children's enthusiasm and retention

of numerical symbols increase significantly when using interactive media compared with traditional lecture-based methods.

5. Conclusion

Based on the results of data processing and analysis regarding the effect of the use of *interactive flat panels* (IFP) on symbolic thinking skills and number concept recognition in early childhood, the following conclusions can be drawn: 1) There is a significant difference between the symbolic thinking skills of children who use Interactive Flat Panel (IFP) media and children who use conventional learning methods. This is evidenced by the t-test significance value of 0.000 ($p < 0.05$) and the average difference (Mean Difference) of 9.100. IFP is statistically more effective at improving children's symbolic thinking skills than conventional methods. Visual-interactive media in IFP is strongly suspected to support children's symbolic abstraction process because the material is presented more dynamically and interestingly. 2) There is a significant difference between the number concept recognition of children who use IFP and children who use conventional methods. This is indicated by the t-test significance value of -4.342 ($p < 0.005$), with an average difference (mean difference) of -7.833. IFP is statistically proven to be more effective than conventional methods in improving children's number concept recognition. 3) There is an influence of the use of IFP on symbolic thinking skills and number concept recognition. Strong statistical evidence shows that using Interactive Flat Panel (IFP) media significantly affects both dependent variables: symbolic thinking skills ($t = 3.977$, Sig. (2-tailed) <0.001, with a mean difference of 9.100. For number concept recognition, $t = -4.342$, Sig. (2-tailed) <0.001, with a mean difference of -7.833. The significance value of both variables is far below the alpha level = 0.05 and is preceded by equal (homogeneous) pretest conditions.

Before the treatment was administered, both groups (experimental and control) had equivalent initial abilities, both in symbolic thinking and number concept recognition (pretest significance value > 0.05). This condition ensures that differences in posttest results were truly caused by the treatment variable (use of IFP), not by differences in innate abilities between the groups.

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