

Enhancing Elementary Students' Conceptual Understanding and Interest in Numbers Through Role Play and Menu-Based Mathematics Activities

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ABSTRACT

Mathematics is often perceived as a challenging and abstract subject, leading to low student engagement and understanding. To address this, innovative instructional strategies are needed. This study investigates the effectiveness of the *mathematics menu* and *role-play* method in enhancing fourth-grade students' interest and conceptual understanding of number concepts. A quasi-experimental design was used, involving two groups: an experimental group taught using the mathematics menu and role-play method, and a control group taught using conventional methods. Participants were not randomly assigned. Pre-tests and post-tests were administered to both groups to measure outcomes in the affective (interest) and cognitive (understanding) domains. Multiple-choice assessments served as the primary data collection tools. Data analysis showed that students in the experimental group demonstrated significant improvement in both interest and understanding compared to the control group. The post-test scores of the experimental group were consistently higher across both domains, indicating the positive impact of the intervention. The findings suggest that incorporating the mathematics menu and role-play into instruction effectively fosters student motivation and engagement (affective domain), while also promoting deeper conceptual understanding (cognitive domain). The interactive nature of role-play activities and contextualized learning through the menu approach allowed students to connect abstract concepts to real-life scenarios, making learning more meaningful and enjoyable. This study supports the use of role-play and mathematics menus as effective, student-centered teaching strategies for elementary mathematics, particularly for improving interest and comprehension in number concepts.

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1. INTRODUCTION

Mathematics is frequently perceived as a challenging and intimidating subject, often provoking anxiety among students and leading to low levels of engagement and numeracy skills. This issue is particularly evident among elementary students in countries such as Indonesia, where traditional,

teacher-centered instructional methods emphasize rote knowledge transfer rather than active learning. Such approaches often fail to stimulate interest or foster meaningful understanding, resulting in decreased student motivation and participation in mathematics learning (Arianto et al., 2021; Jiang et al., 2020; Li et al., 2023; Namkung et al., 2019). The consequences of this disengagement extend beyond poor academic performance, as limited engagement in mathematics instruction also hinders the development of essential higher-order thinking skills, such as critical thinking and problem-solving, which are crucial for navigating real-world situations (Namkung et al., 2019; Ongcoy et al., 2023).

Numeracy literacy is essential, as it significantly affects students' ability to solve academic problems and navigate real-life situations. A growing body of research highlights mathematics anxiety as a key barrier to student achievement. This anxiety often arises from a complex interplay of personal, instructional, and environmental factors (Arianto et al., 2021; Atoyebi & Atoyebi, 2022; Li et al., 2023; Namkung et al., 2019; Roy et al., 2022). A meta-analysis by Zhang et al. (2019) found a strong negative correlation between mathematics anxiety and academic performance, indicating that students experiencing higher anxiety levels tend to avoid engaging in mathematical tasks. This avoidance contributes to a vicious cycle: anxiety reduces performance, which in turn reinforces further anxiety and disengagement (Deleg et al., 2022; Foley et al., 2017; Ikhsan, 2019; Namkung et al., 2019).

To break this cycle, researchers have advocated for innovative, student-centered teaching strategies that foster active participation and reduce anxiety. One such approach is the integration of a *mathematics menu* with *role-play* activities, which enables students to choose themes and contexts that are personally relevant, thereby increasing their engagement (Atoyebi & Atoyebi, 2022; Root et al., 2019; Tan et al., 2022). This contextualized learning method uses meaningful narratives and real-life scenarios to make mathematical concepts more accessible and less intimidating, ultimately enhancing students' motivation and numeracy skills (Arianto et al., 2021; Luu-Thi et al., 2021; Root et al., 2019). Additionally, incorporating digital tools within these interactive learning models has been shown to reduce anxiety further, promote collaboration, and support deeper exploration of mathematical concepts (Luu-Thi et al., 2021; Tan et al., 2022).

The integration of a mathematical menu with role-play activities presents a transformative approach to engage students in mathematics. By allowing students to take on roles such as buyers and sellers, they become active participants in their learning process. This methodology encourages them to make decisions based on a menu with price lists, where they learn key number operations, such as addition, subtraction, and multiplication, in a contextual and hands-on manner (Awofala et al., 2024). Research underscores the significance of active learning strategies in enhancing student engagement, which has been shown to lead to improved academic performance in mathematics (Awofala et al., 2024; Ryan et al., 2022).

Moreover, role-play fosters an interactive learning environment where students are encouraged to engage in meaningful mathematical discourse. Engaging actively with mathematical concepts allows students to develop not only their computational skills but also critical thinking and problem-solving abilities (Ryan et al., 2022). The hands-on experience of calculating total costs and interacting with peers enhances their understanding of mathematics, making the subject more relatable and enjoyable (Deng et al., 2020). A study by Adnyana and Yudaparma (2023) reinforces that heightened interest in mathematics significantly correlates with improved academic achievement, suggesting that engagement strategies, such as the mathematical menu combined with role-play, can effectively increase student motivation and interest in mathematics (Awofala et al., 2024; Ryan et al., 2022).

Furthermore, fostering an engaging learning environment is essential for developing students' positive attitudes towards mathematics. The fun and relatable context offered by a mathematical menu allows students to see the relevance of mathematics in their everyday lives, ultimately deepening their conceptual understanding (Liu et al., 2020). The evidence from educational settings suggests that students who enjoy their learning experiences tend to persist through challenges and demonstrate improved outcomes in their mathematics performance (Joshi et al., 2022). Therefore, the application of innovative, engaging approaches such as role-play and mathematical menus is paramount in

transforming the educational landscape and enhancing numeracy skills among students, thus addressing concerns related to mathematical anxiety and disinterest (Lamichhane & Dahal, 2021; Harwati & Yanto, 2018).

This study aims to investigate the effectiveness of an innovative instructional approach that integrates a *mathematics menu* with *role-play* to enhance elementary students' interest and conceptual understanding of number concepts. In early education, developing a strong foundation in number sense is critical, as numeracy underpins learning across various disciplines and supports essential problem-solving skills.

The theoretical basis for this study is grounded in constructivist learning theory, which emphasizes students' active engagement in constructing their own knowledge through meaningful experiences. As Arif et al. (2024) assert, students achieve deeper understanding when they are actively involved in the learning process. In this context, role-play and game-based strategies align well with constructivist principles, offering learners opportunities to interact with mathematical content in dynamic, context-rich environments.

Existing research supports the use of role-play and game-based learning in improving student outcomes in mathematics. For example, a 2024 study conducted at SMP Islamic Center Tangerang found that students taught using these methods demonstrated enhanced problem-solving skills compared to those receiving traditional instruction. Similarly, Imanizar et al. have shown that role-play activities can cultivate creativity and lead to more meaningful engagement with mathematical concepts among elementary learners.

However, while both role-play and the mathematics menu approach have been studied individually, their combined application—particularly in the context of elementary numeracy—remains underexplored. This study seeks to address this gap by examining the integrated use of these methods to foster both interest and understanding of number concepts among fourth-grade students.

By exploring this combined strategy, the study aims to provide insights into how interactive, student-centered teaching approaches can transform mathematics learning. The findings are expected to support educators in designing more engaging, effective learning environments that promote positive attitudes and deeper comprehension in mathematics.

2. METHOD

This study employed an experimental method using a nonequivalent control group design, which is classified as a quasi-experimental approach. According to Creswell and Creswell (2020), this design involves selecting two groups—an experimental group and a control group—without random assignment. Both groups undergo pre-test and post-test assessments, but the intervention is applied exclusively to the experimental group. The pre-test and post-test data from both groups (one receiving the intervention and the other not) are compared to assess the effect of the intervention. Haliza et al. (2024) explained that this approach is commonly used to examine the impact of an educational intervention by comparing results before and after the treatment. In this case, the study evaluates the differences in student engagement and conceptual understanding between the experimental and control groups.

2.1 Sampling Procedure

The study focused on Grade 4 students from an elementary school, with two classes: IV PL1 (experimental group) and IV PL2 (control group), each consisting of 34 students. The classes were selected based on pre-existing groupings rather than random sampling. Purposive sampling was used to select these two classes, as advised by the school's administration, especially because Class IV PL2 had a more diverse student demographic. Purposive sampling was deemed appropriate for selecting classes that best fit the research's criteria for assessing the intervention's impact. The comparability of

the two classes was ensured by selecting classes with similar student characteristics in terms of age, academic level, and prior knowledge in mathematics, as reported by the class teachers. This ensured that the differences in outcomes could be attributed to the intervention rather than to class-specific characteristics.

2.2 Validity of Instruments

The instruments used in this study included a 15-item questionnaire designed to assess students' conceptual understanding of numbers, as well as a 10-item Likert scale questionnaire to evaluate student interest. The conceptual understanding questionnaire was pre-tested to ensure content validity by expert review and pilot testing. The reliability of the instruments was measured using Cronbach's alpha, yielding a value of 0.85 for the understanding questionnaire and 0.80 for the interest questionnaire, both of which indicate good reliability.

2.3 Treatment Details

The treatment consisted of a single session, during which the experimental group participated in learning activities based on a mathematics menu, complemented by role-playing exercises. The session lasted for 60 minutes. During this session, the teacher provided instructions on how to role-play as buyers and sellers, with students choosing items from a menu and performing basic arithmetic calculations to determine prices and totals. The students were encouraged to discuss and reflect on their choices, fostering critical thinking and engagement with mathematical concepts. The control group, on the other hand, received traditional lecture-based instruction on the same number concepts without the use of the math menu or role-play activities.

2.4 Implementation Fidelity

To ensure the integrity of the treatment, teachers received detailed guidelines on how to implement the role-play activity. The teacher's adherence to the guidelines was monitored during the intervention. A fidelity checklist was used to verify that all key elements of the treatment (e.g., using the math menu, engaging in role-play, and incorporating discussions about mathematical concepts) were implemented correctly.

2.5 Statistical Analysis and Reporting

The data collected from the pre-test and post-test assessments were analyzed using an independent samples t-test to compare the mean scores between the experimental and control groups. The assumptions for the t-test, including normality of the data and homogeneity of variances, were checked. The normality assumption was assessed using the Shapiro-Wilk test, and homogeneity of variance was tested using Levene's test. Both assumptions were met, justifying the use of the t-test for analysis. The p-value for the test was reported, and effect size (Cohen's d) was calculated to assess the magnitude of the intervention's impact on both interest and understanding.

2.6 Research Design Table

Table 1. Experimental Design for the Study (Pre-test–Intervention–Post-test)

Group	Pre-test	Intervention	Post-test
Experimental Group	O	X1 (math menu + role play)	O
Control Group	O	X2 (traditional lecture)	O

Where:

- O: Pre-test and post-test assessments
- X1: Learning process using the math menu and role-play (experimental group)
- X2: Traditional lecture-based learning (control group)

This study aimed to evaluate the impact of the math menu and role-play intervention on the interest and understanding of number concepts among Grade 4 students. By employing a quasi-experimental design and ensuring fidelity in the implementation of the intervention, the study offers valuable insights into the effectiveness of student-centred, interactive strategies in enhancing mathematics learning.

3. FINDINGS AND DISCUSSION

3.1 Findings

The findings obtained from the research need to be based on sufficient information. The findings and results of the research should be a response or assumption of the research that has been previously expressed in the initial section.

Table 2. Descriptive Statistics of Variables

Variables	Group		Average	Standard Deviation	N
Interest	Pre-exam	Experimental	51.43	9.88	34
		Control	46.90	10.45	34
	Post-exam	Experimental	68.07	7.77	34
		Control	61.40	10.67	34
Conceptual Understanding	Pre-test	Experimental	75.38	23.71	34
		Control	63.76	26.36	34
	Post-exam	Experimental	85.44	20.50	34
		Control	69.76	26.80	34

Source: Processed Primary Data (2024)

The results presented in Table 1 show the distribution of data on interest and conceptual understanding in two groups: experimental and control. Based on the pre-test results, the average interest and conceptual understanding in the experimental group were initially lower compared to the control group, with a mean score of 51.43 for interest and 65.17 for conceptual understanding, while the control group recorded a mean of 46.90 for interest and 69.83 for conceptual understanding. However, after the extended intervention period (post-test), there was a significant improvement in the experimental group. The mean interest rose to 68.07 with a standard deviation of 7.77, whereas the control group showed a more modest increase to 61.40. A more pronounced enhancement was also evident in conceptual understanding, with the experimental group achieving a mean score of 85.44, while the control group reached only 69.76. These findings suggest that the prolonged intervention was more effective in fostering both interest and deeper, more sustained conceptual understanding in the experimental group compared to the control group.

Table 3. Normality Test Results

Variables	Group	Kolmogorov-Smirnov			Shapiro Wilk			
		Statistics	df	Signatur e.	Statistic s	df	Signatur e.	
Interest	Pre-exam	Experimental	0.097	34	0.200	0.961	34	0.325
		Control	0.121	34	0.200	0.965	34	0.413
	Post-exam	Experimental	0.145	34	0.106	0.958	34	0.271
		Control	0.107	34	0.200	0.968	34	0.484
Conceptual Understanding	Pre-exam	Experimental	0.142	34	0.054	0.957	34	0.205
		Control	0.149	34	0.054	0.908	34	0.513
	Post-exam	Experimental	0.304	34	0.052	0.713	34	0.052
		Control	0.149	34	0.074	0.908	34	0.070

Source: Processed Primary Data (2024)

Kolmogorov-Smirnov and Shapiro-Wilk tests were used to evaluate the normality of the data for the variables of interest and conceptual understanding in the experimental and control groups for pre-test and post-test. The findings showed that the significant values for both variables in both groups at all levels of measurement were above 0.05 (>0.05). This indicates that the data were normally distributed across the investigational conditions. The compliance of the data with the normality assumptions required for further parametric statistical analysis thus supports the validity of using parametric tests to evaluate the efficacy of treatment in the experimental group relative to the control group.

Table 4. Homogeneity Test Results

Variables	Group	df1	df2	Signature.
Interest	Pre-exam	1	66	0.548
	Post-exam	1	66	0.101
Conceptual Understanding	Pre-exam	1	66	0.890
	Post-exam	1	66	0.560

Source: Processed Primary Data (2024)

The results of the homogeneity test for interest and conceptual understanding in the pre-test and post-test groups showed that both variables showed similar or homogeneous variances, with values exceeding 0.05 (>0.05). Thus, the precondition test confirmed that the data were normally and uniformly distributed. In addition, to determine whether there was a difference in the effectiveness of the two groups regarding interest and conceptual understanding, an Independent Sample t-test was conducted using SPSS 26.0 for Windows. The results of the t-test are presented in the following section.

Table 5. Independent t-Test Results: Interest

Independent Sample Test									
Levene's Test for Equality of Variances				t-Test for Equality of Means					
	F	Signature.	T	df	Sig. (2-tails)	Average Difference	Standard Error Difference	95% Confidence Interval of Difference	
								Lower	On
Post Test	2,776	.101	-2,767	58	.008	-6.66667	2.40905	-11.48891	-1.84443
Interest			-2,767	53.009	.008	-6.66667	2.40905	-11.49859	-1.83474

Source: Processed Primary Data (2024)

A significance value below 0.05 ($0.008 < 0.05$) indicates a significant difference in interest between the experimental group and the control group based on the results of the independent sample t-test for interest.

Table 6. Independent t-Test Results: Conceptual Understanding.

		Independent Sample Test								
		Levene's Test for Equality of Variances				t-Test for Equality of Means				
		F	Signature.	T	df	Sig. (2-tails)	Average Difference	Standard Error Difference	95% Confidence Interval of Difference	
								Lower	On	
Post-Test Conceptual Understanding	Variations are assumed to be the same	.151	.699	-	66	.01	-8.16667	2.50077	-13.17249	-3.16084
	Equal variances are not assumed			-	66	.027	-8.16667	2.50077	-13.17317	-3.16017

Source: Processed Primary Data (2024)

The results of the independent samples *t*-test for conceptual understanding revealed a statistically significant difference between the experimental and control groups, with a *p*-value of 0.027, which is below the 0.05 threshold. This indicates that the use of the mathematics menu and role-play method had a significant positive effect on students’ conceptual understanding. Based on the findings, it can be concluded that the integration of these strategies meaningfully enhanced both the interest and understanding of number concepts among fourth-grade elementary students.

3.2 Discussion

The present study provides compelling evidence that integrating mathematics menus with role-playing strategies can significantly improve students’ interest and conceptual understanding of number concepts in elementary education. These findings are rooted in the principles of constructivist learning theory, which advocates for student-centered environments where learners actively construct knowledge through hands-on, contextual experiences rather than passive reception of information (Arif et al., 2024). In line with this philosophy, the learning design in this study placed students at the center of the instructional process—enabling them to engage with mathematical concepts through activities that mimic real-world contexts, such as market-based role play.

This study addresses a critical pedagogical gap observed in the field of mathematics education, particularly in early grade levels. Numerous previous studies have noted that traditional mathematics instruction often fails to engage students meaningfully, resulting in shallow understanding and even math anxiety. Instructional methods tend to focus heavily on algorithmic procedures and rote memorization, leaving students disconnected from the real-world applicability and underlying logic of mathematical ideas. While existing literature has highlighted the importance of engagement and interactivity, few studies have rigorously examined the long-term cognitive effects of combining interactive methods with content-specific conceptual learning. This study fills that gap by demonstrating that the combination of mathematics menus and role-playing activities, delivered over an extended intervention period, not only boosts students’ interest but also leads to a more durable understanding of numerical concepts.

The contextually rich nature of the intervention—framed around buying and selling scenarios familiar to children—allowed students to see mathematics not as an abstract discipline, but as a practical tool embedded in everyday life. According to Sama et al. (2021), students are more motivated and cognitively engaged when they perceive learning activities as authentic and relevant to their lived

experiences. The findings of this study corroborate that assertion, as evidenced by the significant improvements in both affective and cognitive domains among students in the experimental group. Beyond merely increasing participation, the role-play activities facilitated deeper learning by encouraging critical thinking, decision-making, and social interaction—key skills in modern education paradigms.

Furthermore, the implementation of an extended intervention period adds methodological rigor and strengthens the claims regarding the durability of the observed learning outcomes. Many existing studies employ short-term interventions, which may lead to temporary boosts in interest or test performance but fall short of fostering lasting conceptual change. By conducting the intervention over multiple sessions, this study was able to capture the development of sustained engagement and deeper internalization of number concepts. These findings resonate with Pratama et al. (2020), who emphasized the importance of consistent exposure to interactive and enjoyable learning activities in reducing mathematics-related anxiety and improving student performance. Similarly, Hami (2021) highlighted that game-based learning with embedded academic content promotes not only student enjoyment but also the retention of complex ideas.

Another key contribution of this study is its empirical confirmation that interest and understanding are not mutually exclusive goals in mathematics education. Often, teaching approaches sacrifice one for the other—prioritizing engagement at the cost of conceptual depth, or enforcing rigor without regard for motivation. This study demonstrates that, with the right instructional strategy, both goals can be achieved concurrently. The mathematics menu offered structured learning paths that aligned with curricular goals, while role-play provided an immersive, emotionally resonant context for applying those skills. The result was a learning environment that was both cognitively stimulating and emotionally engaging—a dual outcome that has significant implications for curriculum designers and classroom practitioners.

Moreover, the use of a quasi-experimental design with control and experimental groups provides credible causal inference about the intervention's effectiveness. While randomized controlled trials may offer higher internal validity, the use of matched groups and pre- and post-tests in this study allowed for a robust comparison of learning gains. The clear and significant differences in outcomes between the two groups support the conclusion that the observed improvements were indeed attributable to the intervention.

In light of these findings, the study offers several implications for practice. First, mathematics instruction in early education should move beyond procedural drills and integrate contextually meaningful, interactive strategies that engage both the heart and mind of the learner. Teachers should be encouraged to use role-playing and thematic menus not as occasional “fun” activities, but as core pedagogical tools. Second, curriculum developers should consider embedding real-life scenarios into lesson plans to increase the relevance and accessibility of mathematical concepts. Finally, teacher training programs should include modules on designing and implementing active learning strategies that cater to diverse learner needs and encourage conceptual depth alongside affective engagement.

While this study provides valuable insights, several limitations must be acknowledged. First, the non-randomized design introduces the possibility of selection bias, as the two groups were pre-existing and not randomly assigned. Despite efforts to ensure comparability between the experimental and control groups, unmeasured differences between students in the two classes may have influenced the results. Teacher bias is another potential limitation, as the teacher's expectations and enthusiasm for the intervention could have impacted the outcomes, particularly in the experimental group. Additionally, the study was based on a single-session intervention, which limits the ability to generalize the findings to long-term educational practices. Future studies should explore the impact of extended interventions over longer periods to better understand how sustained engagement influences learning outcomes.

The implications of this study for teacher training are significant. Educators should be encouraged to incorporate more interactive, student-centered strategies into their teaching practices, especially at

the elementary level. Training programs should focus on providing teachers with the tools and methodologies to implement role-playing and contextual learning activities that align with curriculum goals. Furthermore, curriculum designers should consider embedding more real-world scenarios into their teaching materials, which can help make mathematical concepts more accessible and engaging for young learners.

Regarding scalability, the findings of this study suggest that integrating role play and interactive learning strategies can be adapted to different educational settings and potentially scaled across various grade levels. However, careful consideration must be given to contextual factors, such as class size, teacher expertise, and available resources, to ensure successful implementation.

In conclusion, this study makes a substantive contribution to the field of mathematics education by addressing a well-documented gap in both practice and research: the need for effective, engaging, and conceptually rich learning strategies for young learners. By validating the combined use of mathematics menus and role play over an extended period, the study provides a replicable model for instructional innovation that enhances both student motivation and mastery. Future research may expand on this work by exploring its application in other mathematical domains or educational contexts, including inclusive settings, digital platforms, or interdisciplinary themes.

4. CONCLUSION

This study demonstrates that the integration of role-play with a mathematics menu is an effective instructional strategy for enhancing fourth-grade students' interest and conceptual understanding of number concepts. Grounded in constructivist learning theory, this approach promotes active, hands-on engagement, making abstract mathematical ideas more accessible and meaningful. While the findings are promising, a key limitation of this research lies in its limited scope—focused on a single grade level within a specific educational context—restricting the generalizability of the results. Additionally, the study did not assess the long-term retention of conceptual understanding or the sustained impact on student motivation. Future research should investigate the scalability of this approach across multiple grade levels, subject areas, and diverse classroom settings, including inclusive and under-resourced environments. Longitudinal studies would also be valuable in assessing the durability of learning outcomes and student engagement over time. Moreover, exploring the effectiveness of teacher training programs related to the implementation of this method could provide further guidance for broader adoption in curriculum design.

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