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Exploration of Creative Problem-Solving Learning Based on Design Thinking with HOTS Questions to Improve Students' Numeracy

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Abstract. *The study aims to examine the effectiveness of Creative Problem Solving (CPS) learning based on Design Thinking using HOTS (Higher Order Thinking Skills) questions to improve junior high school students' numeracy skills. This research employed a quasi-experimental method with a multiple-group pretest-posttest design, involving an experimental and a control class. Data were collected through numeracy tests, classroom activity observations, and student response questionnaires. The results indicated that students in the experimental class experienced a significant improvement in numeracy, with an average N-Gain score of 0.72, categorized as high. This learning approach also facilitated active student participation, increased interest in mathematics, and promoted independence in problem-solving. Students' attitudes toward numeracy tasks shifted from frustration to more adaptive strategies. Mastery learning was achieved classically, with posttest scores exceeding the Minimum Mastery Criteria (KKM). In addition to cognitive gains, students expressed positive perceptions of the learning approach, especially due to its contextual, challenging, and exploratory nature. Thus, design Thinking-based learning integrated with HOTS-CPS questions has been proven effective in enhancing students' numeracy and is recommended as an innovative strategy in support of the Merdeka Curriculum.*

Keywords: *Design Thinking, HOTS, Numeracy*

INTRODUCTION

Mathematics learning in the 21st century emphasizes the importance of developing high-level thinking skills, one of which is through the application of the Design Thinking approach. This approach is designed to encourage students to actively explore, investigate, and construct concepts, both individually and collaboratively. (Widodo & Wahyuni, 2016). Design Thinking is in line with the principles of Realistic Mathematics Education (RME) that emphasizes contextual and participatory learning (Muhtarom et al., 2019). Sukestiyarno et al. (2024) proved that the RME approach can significantly improve students' mathematical understanding.

In order for the implementation of Design Thinking to be more optimal, supporting instruments in the form of HOTS-based questions are needed. Creative Problem Solving (CPS) serves not only as an exploration guide but also as a tool for evaluating students' understanding (Hidayat & Dimpudus, 2025; Y. P. Putra, 2018). A number of studies have shown that this approach has a positive impact on improving numeracy skills and high-level thinking, both through learning-based learning Design Thinking (Bernardez & Alenton-Oracion, 2023; Sulistyowarno et al., 2025). Furthermore, the use of educational building block-based projects is effective in developing students' mathematical creative thinking (Agustina et al., 2025). In line with that, the application of the CPS model also has a significant effect on improving students' critical thinking skills (Pamungkas et al., 2019; Wahyuni et al., 2018).

Within the framework of the Merdeka Learning policy, teachers are required to present innovative and contextual learning (Amidi, 2024; Ramadhan et al., 2023). The success of numeracy development is largely determined by the learning model used and the active involvement of teachers. (Winata et al., 2021). PMRI's approach has been proven to have a positive influence on students' numeracy through an emphasis on understanding concepts and their application in daily life (D. O. P. Putra & Purnomo, 2023).

Several previous studies have shown that CPS-based HOTS questions are effective in improving numeracy, both through the flipped classroom (Rohmatulloh et al., 2022) and contextual solutions (Sukaesih et al., 2020; Ramadhanti et al., 2022). This research is a follow-up to the study by Septiana et al. (2023) and Taufik & Suryani (2024), which aims to increase student numeracy according to the 2023 PISA indicators. This research is also relevant to the Independent Curriculum, which emphasizes project- and problem-based learning to improve critical, creative, and collaborative thinking skills (Lestari & Siswono, 2022; Rahmah et al., 2019; Setyaningsih & Kustiana, 2023).

Mathematical creative thinking ability is positively correlated with student learning outcomes (Arif et al., 2019; Dianastiti et al., 2024), while cognitive styles such as reflective and impulsive also influence problem-solving strategies (Sabika

et al., 2017; Wahyuni et al., 2018; Juliansa et al., 2019; Zahrah, 2024). Although approaches such as PMRI have been used to improve numeracy (D. O. P. Putra & Purnomo, 2023), and SLR studies were also carried out by Sukaryo & Sari (2024), there have not been many studies that have specifically developed learning models such as CPS-based learning Design Thinking. Approach Design Thinking*:* It is a human-centered approach, emphasizing a deep understanding of user needs, and encouraging collaboration and experimentation for innovative solutions (Walker et al., 2019). More than just a method, Design Thinking is a framework of thinking that can change the way students learn and solve problems (Shodiqin & Wardani, 2024).

Numeracy as an essential competency of the 21st century includes skills in understanding and applying various mathematical representations in real-world contexts (Taufik & Suryani, 2024). However, the results of the National Assessment show that the numeracy ability of Indonesian students is still low, especially in context-based and problem-solving problems. This result shows the need for a more meaningful and contextual approach to learning (Zahwa & Nabilah, 2022; Nuringtyas & Setyaningsih, 2023).

The main problem in this study lies in the low ability of students to transform contextual problems into mathematical representations. Therefore, the researcher developed CPS-based HOTS questions with the Design Thinking stage (empathize, define, ideate, prototype, test) as developed by QMC Binus (2023). The focus of this research is to explore the effectiveness of this approach in improving the numeracy of junior high school students.

The formulation of the problem in this study is: 1) How is the exploration of learning Creative Problem Solving (CPS) based on Design thinking with HOTS questions to improve students' numeracy, reviewed from activities, interests, reactions, and factors that make students happy with mathematics? 2) Does the numeracy ability of junior high school students improve after learning Creative Problem Solving (CPS) based Design Thinking with the HOTS question? 3) What are the learning outcomes of students with learning Creative Problem Solving (CPS) based Design Thinking with the HOTS question reaching completion?

RESEARCH METHODS

This study uses *a* mixed methods approach with an explanatory sequential design. Quantitative data were obtained through pretest and posttest to measure the increase in students' numeracy, while qualitative data were obtained through observation and questionnaires to support and explain quantitative results. Quantitative data analysis was carried out by descriptive and inferential statistical tests, while qualitative data was analyzed using thematic analysis techniques based on the categories of activities, interests, and student responses.

The implementation of Design Thinking in learning is carried out through five stages, namely: empathize (exploring students' learning difficulties through observation and interviews), define (formulate the main problems in numeracy), ideate (designing context-based HOTS questions), prototype (testing questions in learning activities), and testing (evaluating the effectiveness of questions on improving numeracy and student involvement).

This study uses a multiple-group pretest-posttest design for quantitative data. As for qualitative data, the researcher processed data in the form of observations on response, involvement, and dynamics of the learning process. The multiple group pretest-posttest Design can be seen in Table 1 below.

Table 1. Pretest-posttest research design in experimental and control classes

Class	Pretest (O1)	Treatment	Posttest (O2)
Experiment (Class 7G)	O1	X	O2
Control (Class 7I)	O1	X	O2

The population in this study is grade 7 students at SMP Negeri 1 Bantarkawung, which consists of 9 classes of 287 students. Next, class 7G was selected randomly as the experimental class and 7I as the control class. Class selection was carried out by cluster random sampling. Before being selected as an experimental and control class, the population had been tested for normality and homogeneity.

The instruments used in this study include:

a. Observation Sheet

It is used to explore student responses, involvement in learning activities, and the dynamics of the learning process in the classroom. This observation focuses on active response to problems (understanding the problem, participation in discussions and group work (generating ideas and planning actions), the ability to convey opinions and alternative solutions (evaluating solutions), and students' consistency in participating in the learning stages based on CPS and Design Thinking.

b. Student Questionnaire

It aims to find out students' interest in learning, students' reactions to the learning methods applied, and factors that make students feel happy learning mathematics. In addition, the questionnaire also explored how students face challenges in learning. The indicators measured included interest and motivation in mathematics, confidence in solving contextual problems, attitude to challenges with the CPS indicator, namely perseverance in problem solving, and preference for collaborative and exploratory work with the CPS indicator, openness to new ideas.

c. Numeracy Test (Pretest and Posttest)

It is used to measure students' numeracy skills before and after learning. The questions are designed based on real context and contain numeracy indicators and CPS stages. The numeracy indicators measured include understanding numbers, solving mathematical problems, interpreting and representing data, using mathematics in a real-life context, and communicating the results of mathematical thinking in writing or visually. The CPS indicators in numeracy questions include understanding the problem (the ability to understand the purpose and situation of the problem), generating ideas (developing more than one solution approach), planning and taking action (choosing the most suitable strategy and applying it), and evaluating (reflecting on solutions and thinking processes to improve results).

For qualitative data, the observation sheets were analyzed descriptively to see the pattern of student activities. The student response questionnaire was analyzed thematically to identify common responses and challenges faced.

Quantitative data were analyzed in two stages, namely the initial stage using the normality test and the second stage using the homogeneity test, which was carried out on nine classes. For the final stage, N-Gain was used against two classes, with one experimental class and one control class, and the average values of the experimental and control classes. Pretest and posttest scores are analyzed using the N-Gain test:

$$\text{N-Gain} = \frac{Posttest - Pretest}{Skor\ Maksimum - Pretest}$$

N-Gain category summary:
Height: > 0.7
Medium: 0.3 ≤ N-Gain < 0.7
Low: < 0.3

This study aims to explore Design Thinking-based learning using HOTS Creative Problem Solving questions in improving the numeracy skills of junior high school students. To measure this increase, a quantitative method of pretest-posttest with N-Gain test analysis was used. The use of this Design allowed researchers to assess the extent of changes in students' numeracy abilities before and after the implementation of learning interventions. It is hoped that the results of this research can contribute to the practice of mathematics learning in the classroom and become a reference for teachers in developing learning strategies based on exploratory and contextual activities with Design Thinking.

RESULTS AND DISCUSSION

Creative Problem Solving learning based on Design Thinking, using *HOTS* questions, which was carried out in two classes with 7G as the experimental class and class 7I as the control class, had a significant impact on increasing student numeracy. Before being given treatment, students tend to be passive and lack focus when the teacher explains on the board. Therefore, in this lesson, students are asked to directly solve the HOTS Creative Problem Solving problem by modifying the example of the problem in the HOTS Creative Problem Solving without the teacher's explanation first. This strategy encourages students to explore solutions independently, discuss, and ask active questions.

The results of the numeracy test before (pretest) and after treatment (posttest) were analyzed using the N-Gain formula. Table 2 presents the results of the average score analysis in each class.

Table 2. Average results of pretest, posttest, and N-Gain numeracy skills of junior high school students

Class	Number of Students	Average Pretest	Average Post	N-Gain	Category
VII G	31	69,03	91,61	0,72	Tall
VII I	32	59,38	89,94	0,63	Keep

The significant increase in numeracy in the experimental class can be explained through the integration mechanism of Design Thinking (DT) and Creative Problem Solving (CPS). The empathize and define stages allow teachers to understand students' difficulties and formulate contextual numeracy problems. This process makes students feel that the challenges given are relevant to real life, thereby increasing intrinsic motivation. Furthermore, the ideate and prototype stages encourage students to explore various completion strategies, both through discussion and independent experimentation. This activity strengthens divergent (looking for many alternative solutions) and convergent (choosing the most appropriate solution) thinking skills. Meanwhile, the test stage provides an opportunity for reflection that strengthens conceptual understanding. Thus, the increase in N-Gain is not just the result of practice questions, but the effect of a design-based learning cycle that places students as active problem solvers.

The experimental class (7G) achieved an N-Gain of 0.72 (high category), while the control class (7I) was only 0.63 (medium category). This difference confirms that exploratory and collaborative strategies are more effective than conventional learning. This result is in line with Osborn-Parnes' theory of CPS and the Design Thinking approach, which both emphasize the cycle of exploration, testing, and reflection as the foundation of meaningful learning.

The results of student observation show that the improvement in student learning outcomes occurs during learning activities in the five classes presented in Table 3 below:

Table 3. Results of observation of student activities in Design Thinking-based learning and HOTS-CPS questions

Observation Aspect	Key Findings	Percentage of Responses Agree & Strongly Agree
Student Engagement	Students are enthusiastic at the beginning of learning, active in discussions, and interested in contextual problems.	85–90%
Social Interaction	Work together in groups, and students perform as peer tutors,	>80%
Problem-Solving Strategies	Reread the problem, discuss with friends, and understand the steps to solve	70-90%

During the process, students seemed more focused and enthusiastic when directly working on HOTS questions based on Creative Problem Solving in the worksheet, compared to when listening to the teacher's explanation on the board. Students tend to discuss actively, try to solve problems with their friends, and some students even appear as peer tutors who help their friends understand the steps to completion. Most students also show initiative and independence, both when working individually and during group presentations. More than 80% of students were actively involved in reading and solving HOTS questions based on *Creative* Problem Solving on the worksheet. In comparison, around 70% followed the problem-solving flow independently without waiting for the teacher's direction. In class 7G, 2–3 students were found to volunteer to mentor their friends, reflecting the growing spirit of collaboration and leadership.

These findings are in line with the principle of Creative Problem Solving developed by Osborn and Parnes, who emphasized the importance of divergent and convergent thinking processes in solving problems creatively and systematically (Osborn, 1953; Parnes, 1967). The CPS approach includes exploratory stages such as fact-finding, problem-finding, and idea-finding, which in this context is realized through the exploration of modified problems that encourage students to find relevant solutions on their own. Thus, the use of CPS-based HOTS questions in worksheets has effectively facilitated an active, collaborative, and meaningful learning process.

The results of this study reinforce the findings of Setyaningsih & Kustiana (2023) and Agustina et al. (2025), which show that the learning strategy is based on exploration through questions. Higher Order Thinking Skills (HOTS) with the Creative Problem Solving (CPS) can improve students' numeracy skills. This model places students in an active, critical, and creative thinking process that is highly relevant to the needs of mathematics learning in the era of the Independent Curriculum.

Thus, the use of modified questions based on HOTS Creative Problem Solving without initial explanation from the teacher has been proven to not only improve student learning outcomes but also encourage the creation of an active, collaborative, and independent learning environment. This strategy is a practical and effective alternative to be applied in contextual mathematics learning at the junior high school level.

The results of the student questionnaire include:

a. Students' interest in math lessons

Most students show a positive interest in mathematics. As many as 34.4% felt enthusiastic, 16.3% were interested if the topic was in line with their interests, 22.3% felt anxious, and 20.1% were neutral. This data indicates that although the majority of students are enthusiastic, there are still some students who experience emotional barriers, such as anxiety when dealing with numeracy materials. These findings are closely related to the level of empathy in Design Thinking, where teachers need to understand the background of students' feelings as the basis for designing more inclusive and supportive learning. The define stage then helps formulate the core problem, namely, the low confidence of some students in facing math problems. Thus, this information on students' interests becomes an important reference for learning strategies that encourage more even motivation and reduce learning anxiety.

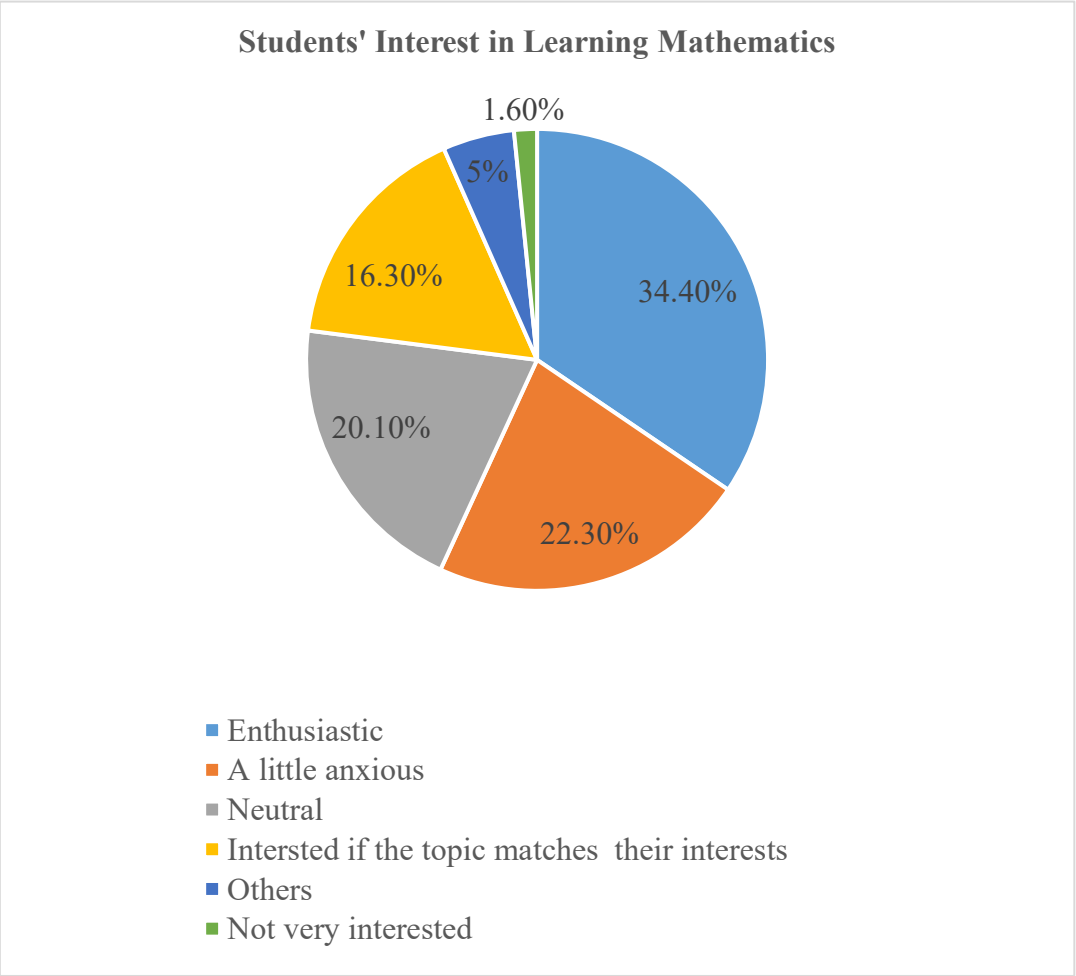


Figure 1. Students' Interest in Learning Mathematics

b. Students' Reactions to Difficult Questions

As many as 45% of students feel frustrated when faced with difficult problems. However, 15% tried to solve it on their own, 15% looked for other ways, 13% took a break, 10% asked a friend/teacher, and 2% chose another way. This pattern shows that although frustration is still dominant, there are some students who are starting to develop adaptive strategies, indicating the potential for developing learning resilience through a supportive learning approach.

The high frustration rate indicates the emotional and cognitive barriers experienced by students when dealing with challenging numeracy problems. In the framework of Design Thinking, this condition becomes an important ingredient in the empathize stage, where teachers need to understand students' experiences,

feelings, and difficulties in depth. Student frustration is not just a weakness, but a signal of the need for support for a more structured problem-solving strategy and a more supportive learning atmosphere.

The definition stage then plays an important role in formulating the core problem of the findings. From the data in Figure 2, it can be defined that the main problem is not only low numeracy skills, but also the lack of emotion regulation strategies and independence in dealing with difficult problems. With the right problem formulation, teachers can design more relevant interventions, such as providing scaffolding in the form of a first-step guide, providing difficulty-level contextual questions, or providing space for collaborative discussion.

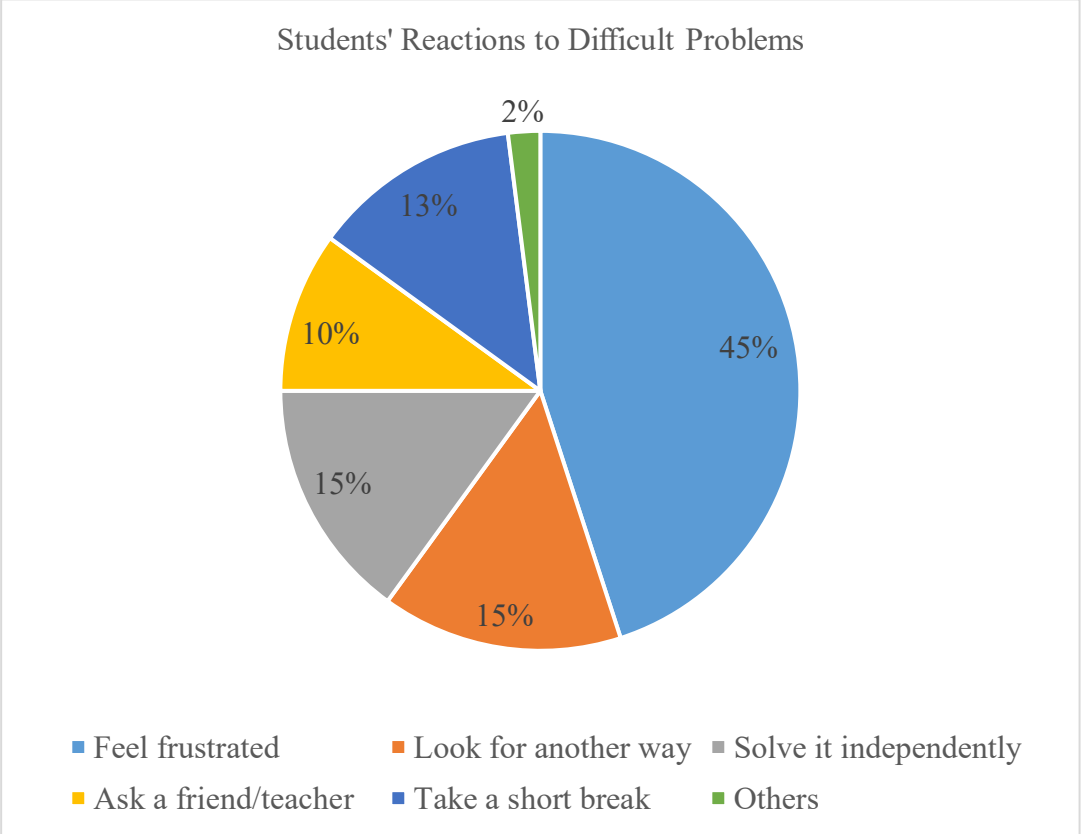


Figure 2. Students' Reactions to Difficult Problems

Thus, the frustration that arises is actually the entrance to understand the real needs of students (empathize) and formulate learning problems more appropriately (define). The integration of these findings with the Design Thinking stage helps teachers develop a learning strategy that not only emphasizes the outcome but also

pays attention to students' thinking processes and emotional experiences, so that numeracy improvements can be achieved more sustainably.

c. Factors That Make Students Happy to Learn Mathematics

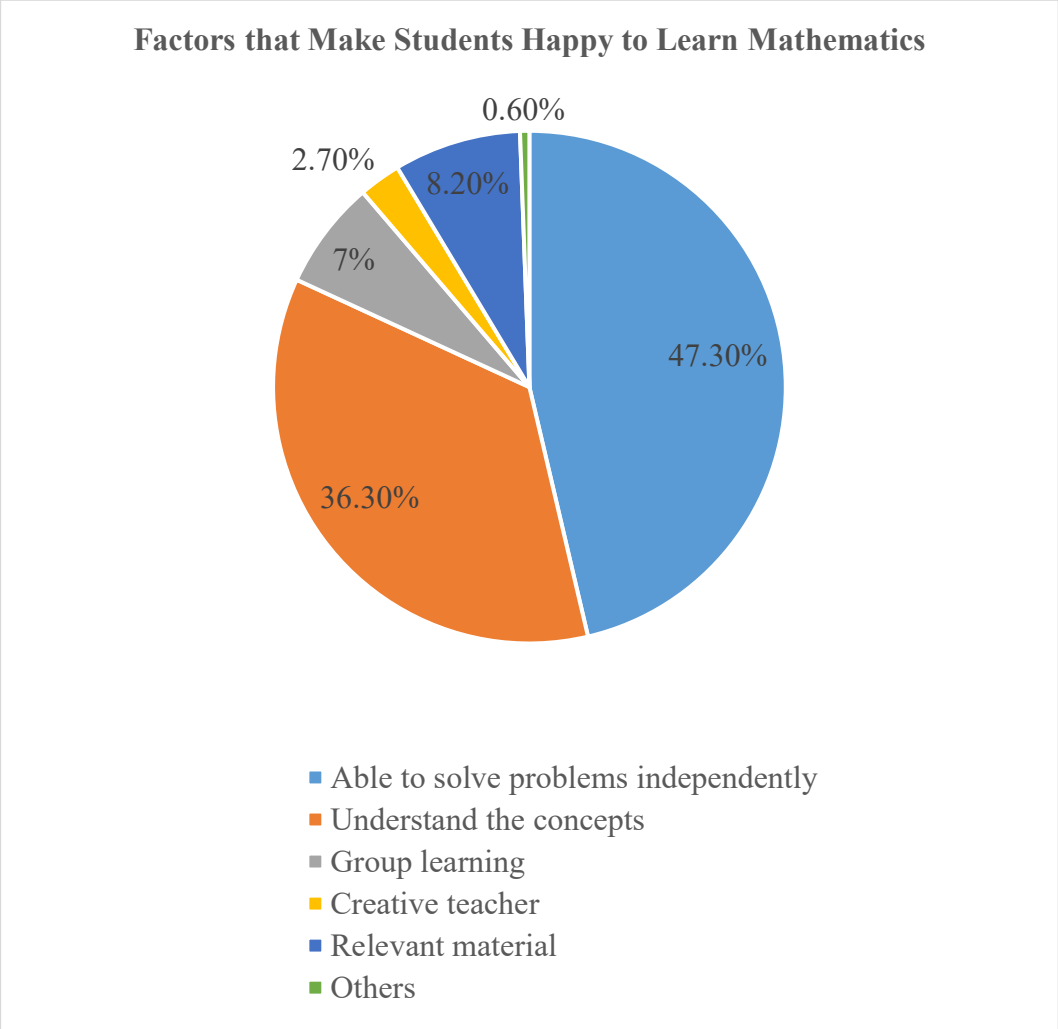


Figure 3. Factors That Make Students Happy to Learn Mathematics

The results of the survey shown in Figure 3 show that the ability to solve problems independently (47.3%) is the main factor that makes students feel happy in learning mathematics. This result shows that independence in thinking and finding solutions is a strong source of learning satisfaction for most students. The second dominant factor is the ability to understand concepts (36.3%), which shows the importance of clarity and comprehension of the material in building interest and comfort in learning. In addition, creative teachers (8.2%) were also considered influential in creating a pleasant learning experience, followed by group learning

(7%), and relevant material (2.7%), which showed that social and contextual aspects also supported students' enjoyment of mathematics lessons. The other factor was only 0.6%, which shows that most respondents chose the factors that were already available in the main choice.

These findings confirm the importance of learning strategies that provide space for students to think independently, understand concepts in depth, and feel the relevance of the material to real life. Learning approaches such as Creative Problem Solving and contextual learning can be an effective means of creating a more meaningful and enjoyable learning experience.

d. Students' Perception of Learning

After the treatment, a questionnaire was filled out by all students to find out their perception of the learning that had taken place. The results of the questionnaire recapitulation from 2 classes (N = 62 students) are shown in the following table 4.

Table 4. Students' perception of HOTS Creative Problem Solving question-based learning

Statement	**Agree/Strongly Agree**
Lessons using HOTS Creative Problem Solving are fun	89%
Students will find it easier to understand numeracy problems	84%
Students enjoy discussing with friends	90%
Students are more confident in doing their own problems	75%
Students want this method to be used in the next lesson.	88%

In addition, from open-ended questions, the majority of students said that they liked the freedom to try first before the teacher explained, group discussions that helped them understand faster, and problems that were easy to understand because they were similar to examples.

DISCUSSION

The discussion in this study describes the findings in a systematic and in-depth manner, with reference to theories and findings of previous research. The main focus of the discussion was on student responses, learning activities, student

interests, attitudes in dealing with numeracy problems, initial analysis (normality and homogeneity test), final analysis (N-Gain pre-post numeracy), and completeness of numeracy learning outcomes.

Student Response to Learning

Students' responses to Design Thinking-based mathematics learning with HOTS questions based on Creative Problem Solving (CPS) showed very positive results. Based on the questionnaire data, as many as 89% of students stated that learning was enjoyable, and 88% wanted this method to be used in the next lesson. This result reflects an increase in students' affection for mathematics learning, which was previously often considered difficult and boring.

The Design Thinking approach, which is centered on student needs (human-centered Design), has been proven to facilitate a more meaningful learning experience. This strategy creates a space for students to be an active part of the learning process, encouraging emotional and motivational engagement that is essential in improving learning outcomes.

Student Activities During Learning

Student engagement during the learning process showed a significant increase, especially in experimental classes. Observations show that 85–90% of students actively discuss, answer questions, and work together in groups. Students also perform as peer tutors and show the courage to express ideas openly. These findings show that Design Thinking-based learning provides an optimal participatory space for students.

The use of CPS-based HOTS questions without initial explanation encourages students to build understanding independently through the Ideate and Prototype stages. This strategy is effective in fostering divergent and convergent thinking skills as described in the CPS theory by Osborn (1953) and Parnes (1967). CPS strategies are also effective in developing critical thinking skills and quality social interaction in the learning process.

Students' Interest in Mathematics

Innovative learning that is oriented towards problem solving and real context also has an impact on students' interests. Most students (47.3%) said they enjoyed

learning mathematics because they felt they were able to solve problems independently. Other factors that affect interest are the ability to understand concepts (36.3%), creative teachers (8.2%), and group learning (7%).

This condition reinforces the importance of contextual and exploratory learning in building students' interest in learning. (Taufik & Suryani, 2024) States that high interest in learning correlates with learning models that provide space for exploration, cognitive challenges, and the relevance of the material to daily life.

Students' Attitudes in Facing Difficult Problems

Students' attitudes towards difficult questions show a diverse tendency. As many as 45% of students show a frustrated reaction, while the rest use adaptive strategies such as trying to solve independently (15%), looking for other ways (15%), and asking a friend or teacher (10%). This attitude suggests that most students still need emotional support and learning strategies that help them cope with challenges without pressure.

CPS learning with HOTS questions is able to create a safe space for students to explore without fear of making mistakes. Thus, challenge-based learning like this reinforces Sukestiyarno et al. (2024) that CPS learning with HOTS questions not only forms cognitive abilities but also students' resilience in facing difficulties.

After the learning took place, the students' perception in general was very positive. The results of the questionnaire showed that 84% of students found it easier to understand numeracy problems, 90% said they enjoyed discussing with friends, and 75% felt more confident in doing problems on their own. In addition, the majority of students liked the opportunity to try first before getting an explanation from the teacher, and felt that the questions used were easier to understand because they were contextual and resembled examples that had been encountered.

This data reinforces that the Design Thinking approach and CPS-based HOTS questions create a learning climate that is safe, exploratory, and provides space for students to express themselves. This positive perception plays an important role in building students' internal motivation to continue learning and developing. Shahira

et al. (2023) also stated that positive perceptions of learning are closely related to the success of numeracy-based learning.

Preliminary Analysis: Normality and Homogeneity Test

Normality and homogeneity tests were performed on nine classes to ensure the validity of the experimental and control sample selection. The results show that the data is distributed normally and homogeneously, which means that the basic statistical assumptions are met. Therefore, the selection of 7G as an experimental class and 7I as a control class through cluster random sampling techniques can be methodologically justified.

The fulfillment of this assumption is a strong foundation in the implementation of advanced inferential tests, ensuring that the improvement in learning outcomes is not caused by differences in students' initial characteristics, but by the learning interventions provided.

Final Analysis: N-Gain Pre-Post Numeracy

N-Gain analysis showed that the experimental class (7G) experienced a significant improvement in numeracy ability. The average N-Gain of 0.72 was in the high category, while the control class (7I) reached 0.63 in the medium category. This increase shows the effectiveness of Design Thinking-based learning in improving student numeracy.

These findings are supported by (Ramadhanti et al., 2022b; Wahyuni et al., 2018), which shows that HOTS and CPS-based learning are effective in developing numerical and reflective thinking skills. The interventions carried out not only have a statistically significant impact but also show a strong practical impact in the context of mathematics learning.

Completeness of Numeracy Learning Outcomes

The average posttest of students in the experimental class reached 91.61, with the majority of students obtaining scores above the KKM (76). This result shows that, in addition to increasing N-Gain, there is also classical learning completeness. This completeness is an indicator of the success of learning-based learning Design Thinking in helping students achieve numeracy competencies according to PISA 2023 standards (OECD, 2023). Learning that facilitates higher-level thinking

processes, contextual problem-solving, and collaboration has led to the transformation of students' ways of thinking to be more reflective, analytical, and systematic.

Relevance to Previous Theory and Research

The findings of this study reinforce the relevance of Design Thinking in the context of numeracy learning with an empathy-based approach that involves exploration and iteration of solutions, in line with the spirit of problem-based learning and projects in the Independent Curriculum. Research (Kusumawati et al., 2024) emphasized that design-based learning and assessment can increase creativity and concept mastery. These findings are reinforced by Aisyah et al. (2025), who developed numeracy-based media Design Thinking and showed positive results in students' mathematical literacy.

Thus, learning strategies based on Design Thinking with CPS-based HOTS questions have been proven to not only improve numeracy skills but also create an active, collaborative, and meaningful learning experience that is very suitable for wider application in learning. These findings are in line with research by Ubaidah & Kusmaryono (2020).

Reflections and Pedagogical Implications

These findings not only demonstrate the effectiveness of the method quantitatively and qualitatively, but also confirm the need for a paradigm shift in mathematics learning from a teacher-centered approach to a student-centered approach. In the context of the Independent Curriculum, teachers are required not only as material presenters but also as facilitators who are able to design learning based on empathy, creativity, and collaboration. Therefore, teacher training and mentoring in adopting the Design Thinking and CPS is a strategic approach to improve the quality of numeracy learning in schools in an ongoing manner.

CONCLUSION

Based on the findings and discussions that have been submitted, it can be concluded as follows. 1) The exploration of Creative Problem Solving (CPS) learning based on Design Thinking with HOTS questions on students' numeracy

can be seen from the response of student activities, interests, reactions, and factors that make students happy with mathematics. 2) The numeracy ability of junior high school students after Creative Problem Solving (CPS) learning based on Design Thinking with HOTS questions increased. 3) The learning outcomes of students with Creative Problem Solving (CPS) learning based on Design Thinking with HOTS questions reached completeness.

Thus, Creative Problem Solving (CPS) learning based on Design Thinking with HOTS questions can be recommended as one of the alternative strategies that are effective in mathematics learning and relevant to the demands of the Independent Curriculum. This approach not only contributes to improving learning outcomes but also facilitates the development of students' character as independent, critical, creative, and collaborative learners.

The limitations of this study lie in the relatively limited scope, which is only conducted in one school and has not taken into account all variables that may affect the results, such as student background, environmental factors, and parental support. Therefore, the suggestion for further research is to expand the subject and location of the study, use more varied experimental designs, and examine the integration of Design Thinking-based CPS with other subjects in order to obtain a more comprehensive picture of the effectiveness of this approach.

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