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Revitalizing Math Education: Unveiling the Impact of Holistic Mathematics Education Based "Sistem Among" in Elementary Classrooms

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ABSTRACT

This research examines the impact of the Holistic Mathematics Education (HME) model based on the Among system on the mathematical concept understanding of third grade students at SD Negeri 21 Pulau Punjung. This model holds significant relevance to the current paradigm of liberating learning. In the era of modern education, there is a strong emphasis on learning approaches that promote independence, creativity, and critical thinking among students. The implementation of this model has shown an increase in mathematical concept understanding, as evidenced by statistical analysis (significance level 0.001). Based on the analysis results, it can be proven that the HME model based on the "among" system has a positive impact on the mathematical concept understanding of third-grade students at SDN 21 Pulau Punjung. The success of this method in enhancing mathematical concept understanding underscores the urgency to integrate more innovative and inclusive approaches in the mathematics curriculum, especially at the elementary level, as liberating education focuses not only on academic knowledge but also on the development of students' competencies and character. This study provides empirical evidence of the importance of adopting a more holistic and interactive educational model in elementary schools. Consequently, these findings support a transition towards more responsive, participatory, and future-ready learning methods.

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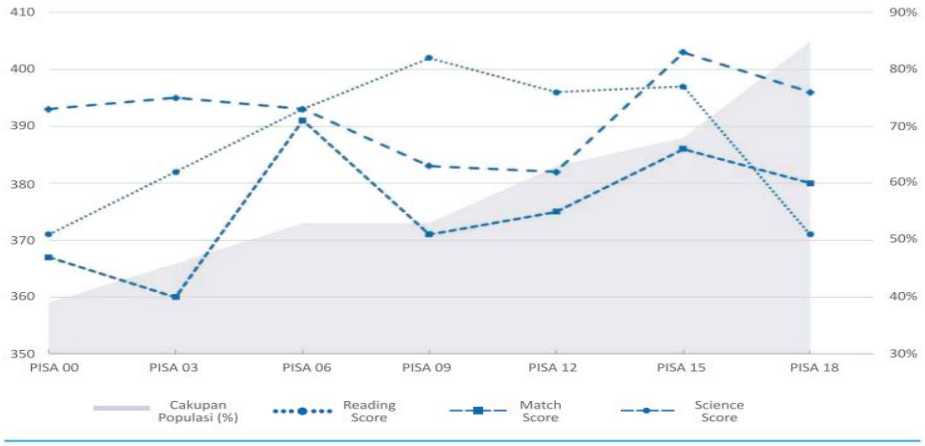
1. INTRODUCTION

In the current context of mathematics education, building conceptual understanding in elementary students is a critical need penting (Asfar, Asmawaty, & Nursyam, 2019; Rahmatul Hayati, 2018a; Rahmatul Hayati & Asmara, 2021; Komarudin, Puspita, Suherman, & Fauziyyah, 2020; Pratama, Yurniwati, & Chaeruman, 2022; Radiusman, 2020; Unaenah & Sumantri, 2019; Utami, Anitra, & Moseki, 2020). Conceptual understanding in elementary mathematics is vital as it lays the foundation for students' formal engagement with mathematics, thereby aiding them in future stages. This is particularly

significant in light of the current education curriculum, which emphasizes liberating learning, creativity stimulation, and critical thinking development.

According to TIMSS and PISA studies, students' mathematical literacy abilities are relatively low compared to other countries. Despite Indonesia's rising rankings, student scores have declined (Hadi, 2019; Kemendikbud, 2019; Martin, Kelly, & Fishbein, 2019; Melisa Ratna Sari & Ekayanti, 2022; Pusat Penelitian Kebijakan (Balitbang Kemendikbudristek), 2021a, 2021b; Rosnawati, 2013; Safitra et al., 2022; TIMSS & PIRLS (International Study Center), 2019b, 2019a; TIMSS, 2021). The PISA 2028 data illustrates this trend in Figure 1.



Sumber: OECD/UNESCO, 2003; OECD, 2004; OECD, 2007;OECD, 2010; OECD, 2013; OECD, 2016a; OECD, 2016b.

Figure 1. Trend of Indonesia's PISA Scores from 2000 to 2018

As shown in Figure 1, the 2018 student mathematics scores decreased from previous years, indicating persistently low mathematical abilities among Indonesian students. Other research also highlights this issue, showing low levels of mathematical concept understanding (Gultom & Tambunan, 2022; Pratama et al., 2022; Rahmadani, Nurlaelah, Herman, & Anaguna, 2019; Sreylak, Sampouw, Victor, Saputro, & Lumbantobing, 2022). Based on the observations and interviews conducted by the researcher with teachers and students, it can be concluded that there is a low level of mathematics learning outcomes among students in grade III A at SD Negeri 21 Pulau Punjung. This is also evidenced by the results of the Midterm Exam (UTS) in mathematics, where only 17% of students achieved a level of proficiency. The low learning outcomes indicate problems in the ongoing learning process, which lacks innovation and active student involvement. This was observed in the teaching methods used by the teacher during the learning process. The methods applied by the teacher have not been able to actively engage students in learning, nor fully provide freedom and independence in accordance with student characteristics, thus impacting student learning outcomes.

Effective mathematics learning should prioritize knowledge aspects while fostering learning motivation, engaging student interest, and providing meaningful learning experiences. Thus, the implementation of holistic, differentiated, and enjoyable learning models is necessary. One such model is the Holistic Mathematics Education (HME) based on the Among system. This model is an innovation in mathematics teaching, focusing on a holistic approach that develops cognitive, spiritual, emotional, social, and physical aspects of students siswa (R. Hayati, Fauzan, Iswari, & Khaidir, 2018; Rahmatul Hayati, 2018a, 2018b; Rahmatul Hayati, Fauzan, Iswari, & Khaidir, 2018, 2019; Komarudin et al., 2020; Prima, Ganefri, Krismadinata, & Hayati, 2019a; Radiusman, 2020; Unaenah & Sumantri, 2019). This approach aims to stimulate learning enthusiasm, foster critical thinking, and strengthen mathematical concept understanding.

The HME model based on the Among system aligns with the "Tut Wuri Handayani" motto, interpreting the teacher's role as a facilitator who supports and motivates students from behind. In this context, the teacher acts as a companion, enabling students to explore and understand mathematical

concepts in their own way. This approach also emphasizes student-centered learning, where students are actively involved in the learning process through discussion, exploration, and reflection (Rahmatul Hayati, 2018b, 2018a; Rahmatul Hayati et al., 2019).

This study uses three indicators of mathematical concept understanding: (1) Restating learned concepts, (2) Classifying objects based on mathematical concepts, and (3) Presenting concepts in various representations (Klorina & Prabawanto, 2023). The assessment methods include tests covering these indicators to measure the extent of students' conceptual understanding development.

This research's uniqueness lies in applying the HME model based on the Among system in the context of elementary mathematics learning. This combination of holistic educational approaches with liberating learning methods is not widely explored in the mathematics education literature (Rahmatul Hayati, 2018b; Rahmatul Hayati et al., 2018; Prima, Ganefri, Krismadinata, & Hayati, 2019b). The study potentially offers new insights into how holistic and student-centered approaches can contribute to enhancing elementary students' mathematical concept understanding.

Additionally, this study aims to fill the gap in existing literature regarding the effectiveness of liberating learning methods in the context of elementary mathematics education.

The results are expected to significantly contribute to mathematics education practices and curriculum development, particularly in Indonesia. In an ever-evolving educational landscape, a strong understanding of mathematical concepts is crucial for students, especially at the elementary level like grade III. This study highlights the importance of developing a robust conceptual understanding from an early age, laying the groundwork for advanced learning. The research at SD Negeri 21 Pulau Punjung reveals that most grade III students struggle to meet the Minimum Mastery Criteria (KKM) in mathematics, raising serious concerns about the inadequacy of current teaching methods and their inability to meet student learning needs in the contemporary era.

In addressing these challenges, mathematical understanding should not be limited to memorizing formulas but understanding the underlying meanings of learning (Abidin, Mulyati, & Yunansah, 2017; Asfar et al., 2019; Fauzan, 2002; Fauzan, Plomp, & Gravemeijer, 2013; Pratama et al., 2022). To achieve deep understanding, students should be taught to restate learned concepts, classify objects based on mathematical concepts, apply concepts algorithmically, provide examples or non-examples of concepts, present concepts in various representations, and interrelate mathematical concepts internally or externally.

The Holistic Mathematics Education (HME) model is based on the Among system, emphasizing the holistic development of students - spiritual, intellectual, creative, social, emotional, and physical - and offers an innovative solution. This approach aligns with the nine pillars of national education and implements the "Tut Wuri Handayani" motto, where the teacher acts as a facilitator inspiring and supporting students (Rahmatul Hayati, 2018b). This model not only stimulates learning interest but also helps students perceive mathematics as an engaging and enjoyable subject, rather than a boring or daunting burden (Rahmatul Hayati, 2018a, 2018b; Rahmatul Hayati et al., 2018, 2019).

The purpose of this research is to evaluate the impact of the Holistic Mathematics Education (HME) model based on the Among system on the mathematical concept understanding of third-grade students at SD Negeri 21 Pulau Punjung. By focusing on conceptual understanding as the foundation of learning, this study aims to enrich the discussion and practice of evolving mathematics education in Indonesia, particularly at the elementary level.

2. METHODS

This study adopted a nonequivalent control group design, a form of quasi-experimental design. The primary aim was to evaluate the effectiveness of the Holistic Mathematics Education (HME) model based on the Among system in enhancing the mathematical concept understanding of third-grade students at SD Negeri 21 Pulau Punjung during the even semester of the 2020/2021 academic year. The research involved 30 students from class III A as subjects, selected through purposive sampling due to their specificity aligning with the research objectives. In this study, 30 students were divided into two groups (experimental and control) that were evenly distributed to prevent data bias. The selection of subjects was

carried out using purposive sampling method, considering its specifications that match the research objectives.

The primary instrument for data collection was a mathematics test consisting of descriptive questions designed to measure students' understanding of mathematical concepts using three indicators of mathematical concept understanding: (1) Restating the concepts learned, (2) Classifying objects based on mathematical concepts, and (3) Presenting concepts in various representations. The test questions were compiled and validated by mathematics and education experts to ensure content validity and relevance to the current curriculum. Data collection was conducted through the administration of pretests and posttests, where the pretest and posttest questions were the same. The pretest, given before implementing the HME model, assessed the initial understanding level of the students. Following the application of the HME model based on the Among system for a certain period, a posttest was administered to measure the model's effectiveness in enhancing mathematical concept understanding. The data obtained from the pretests and posttests were analyzed using an independent sample t-test to determine the presence of a significant difference in the mathematical concept understanding between students who participated in the HME model and those who did not. The significance level used was 0.05.

This research, examining the impact of the Holistic Mathematics Education (HME) model based on the Among system on the mathematical concept understanding of third-grade students at SD Negeri 21 Pulau Punjung, holds significant relevance to the current paradigm of liberating learning. In the modern education era, there is a strong emphasis on learning approaches promoting independence, creativity, and critical thinking among students. The HME model based on the Among system, with its focus on holistic and collaborative development in mathematics learning, aligns with these objectives.

3. FINDINGS AND DISCUSSION

3.1. Research Results

This study focused on the application of the Holistic Mathematics Education (HME) model based on the Among system at SD Negeri 21 Pulau Punjung, located in Jorong Kampung Baru, Desa Sikabau, Kecamatan Pulau Punjung, Kabupaten Dharmasraya, Provinsi Sumatera Barat. Sampling from class III A with 30 students, the study was divided into two groups: the experimental group and the control group, each consisting of 15 students.

At the beginning of the learning process, both groups were given a pretest consisting of four descriptive questions. The teaching method applied in the experimental group integrated natural environments and concrete objects to facilitate students' understanding of the properties of flat shapes. Students were engaged in learning both inside and outside the classroom, using concrete objects shaped like flat shapes and interesting learning media, such as cardboard shaped like flat shapes, to enhance their mathematical concept understanding in mathematics learning. This learning was conducted during the even semester of the 2020/2021 academic year.

At the end of the learning period, both groups were given a posttest in the same format as the pretest. The study used SPSS 20 for data analysis. Based on the results of the independent sample t-test, as presented in Table 1, the null hypothesis (H0) was rejected.

Table 1. Hypothesis Test Results

t-test	Sig	Conclusion
3,583	0.001	Reject H_0

This indicates that the application of the Holistic Mathematics Education (HME) model based on the Among system had a significant impact on the improvement of mathematical concept understanding of third-grade students at SD Negeri 21 Pulau Punjung.

3.2. Discussion

The research at SD Negeri 21 Pulau Punjung on the application of the Holistic Mathematics Education (HME) model based on the Among system has been a significant milestone in mathematics education innovation. The primary focus was to address the challenge of low mathematical concept understanding among third-grade students. The implemented solution, the HME model based on the Among system, combined the use of concrete objects and the surrounding environment. This led to a significant improvement in students' understanding of mathematical concepts, as reflected by the significance value of 0.001 in the independent sample t-test. This method was not only effective in enhancing learning outcomes but also provided a pleasant and meaningful learning experience, in line with the needs of the current educational era that emphasizes student-centered learning approaches (Rahmatul Hayati, 2018a, 2018b; Rahmatul Hayati, Fauzan, Iswari, & Khaidir, 2017; Rahmatul Hayati et al., 2018, 2019).

The HME model prioritizes cognitive, emotional, and social aspects in learning, supporting the formation of students as holistic learners. This research finds resonance with other studies that demonstrate the potential of holistic and innovative approaches in mathematics education, such as the work of Zbiek et al. (Zbiek, Peters, Galluzzo, & White, 2022) and YIĞ & SEZGİN (YIĞ & SEZGİN, 2021), highlighting the importance of interactive learning in enhancing student motivation and engagement.

Furthermore, findings from Cecilia Ka et al. and Kirstin Macdonald et al. affirm that the HME model can contribute to the holistic competency development of students, including the correlation between motor skills and academic achievement in mathematics (Chan & Luo, 2021; Macdonald, Milne, Orr, & Pope, 2020). Research by Susanne Brand also shows the effectiveness of holistic approaches in mathematics education, particularly for students with lower mathematical performance, indicating its benefits in inclusive education contexts (Brand, 2014) . Chong Xiao et al. demonstrate that this method can also be successfully applied in online learning environments, marking the adaptation of the HME model to current technologies and learning methodologies (Xiao, Wan, & Chan, 2022).

Antoine Trad's research provides a broader perspective on the importance of holistic and interdisciplinary approaches in education. It suggests that the principles of HME are not only relevant to mathematics but can also be applied in various educational contexts (Trad, 2020).

The implementation of the HME model in this school has not only revitalized the way mathematics is taught but also affirmed that education must align with the evolving world and the current and future needs of students. By combining contextual learning and real-life experiences, this model supports the development of critical skills and creativity and promotes students' natural curiosity.

The results of this research have significant implications for curriculum development and mathematics teaching practices in elementary schools. Demonstrating the effectiveness of the HME model in enhancing mathematical concept understanding, this study underscores the need for more student-centered approaches that can transform students' perceptions of mathematics into something more engaging and enjoyable.

Overall, this research provides empirical evidence supporting the importance of adopting more responsive, participatory education models capable of preparing students for future challenges. These findings support a transition towards more adaptive and engaging learning methods, essential in preparing students for success in a constantly changing world.

From this effectiveness test, it is evident that the HME model based on the Among system is effective not only for students with high initial abilities but also for those with low initial abilities. This indicates that the model can be adapted for various student ability levels in elementary classes. The model is suitable for younger students as it aligns with their holistic characteristics, preference for group learning, use of the surrounding environment, and enjoyment of concrete learning.

According to Bloom's theory (Gulo, 2004), mathematical concept understanding occurs when students can compare, distinguish, and relate one concept to another and can explain a concept in their own language. The HME model based on the Among system facilitates this process by providing opportunities for students to discuss, express opinions, present their work, and solve mathematical

problems according to their understanding. This process encourages the development of critical thinking in students and allows them to understand mathematical concepts more deeply.

The model, with its ten stages, is designed to enhance students' understanding of mathematical concepts thoroughly. The ten stages are: (a) Apperception through the surrounding environment, (b) Discussion utilizing the surrounding environment, (c) Group demonstration, (d) Individual practice, (e) Mathematical modeling, (f) Individual demonstration, (g) Reflection, (h) Impressions and messages, along with meaning-making, (i) Celebration, and (j) Comprehensive assessment. The first stage, apperception through the environment, utilizes real-life contexts to build interest and connect mathematical concepts to students' lives, in line with the constructivist theory that emphasizes the importance of real experiences in learning (Piaget, 2013, 2015, 2017).

The second stage, discussion using the surrounding environment, facilitates collaborative learning strengthened through social interaction, supporting Vygotsky's theory of social learning (VYGOTSKY, 1978). Subsequently, group and individual demonstrations allow students to apply and present their understanding practically, combining the theories of experiential learning (Dewey, 1938) and hands-on learning approaches. Individual practice reinforces concepts through independent practice, in line with the principles of learning through repetition and reinforcement (Skinner, 2017).

Mathematical modeling invites students to construct representations of concepts, supporting the transition from abstract to concrete understanding in line with Bruner's learning theory (Ervayani, Iis Holisin, 2016; Lestari, 2013). Further individual demonstrations enhance students' self-confidence and communication abilities, affirming Bandura's theory of observational learning (Albert Bandura, 1977).

Reflection, as the next stage, allows students to contemplate and consolidate their learning, supporting the reflective theory (Schon, 1983). Impressions, messages, and meaning-making give students the opportunity to articulate their learning experiences personally, in line with Maslow's humanistic theory of education (Maslow, 1943).

Celebration, as the ninth stage, fosters students' intrinsic motivation and recognition of their achievements, consistent with the theory of positive reinforcement (Skinner, 2017). The final stage, comprehensive assessment, provides holistic feedback on students' understanding of mathematical concepts, in line with the theory of formative assessment (Johnson, 1967).

Overall, the application of the HME model based on the Among system at SD Negeri 21 Pulau Punjung has successfully integrated relevant educational theories into classroom practice, resulting in substantial improvement in students understanding of mathematical concepts. This approach not only emphasizes academic knowledge but also pays attention to the development of students' competencies and character, which are crucial in modern holistic education.

In conclusion, the HME model based on the Among system effectively addresses the challenges of mathematical education at the elementary level, offering a comprehensive and engaging approach that caters to diverse student needs and learning styles. This model demonstrates the potential to revolutionize mathematics teaching and learning, emphasizing the importance of holistic development in education. The study at SD Negeri 21 Pulau Punjung serves as a valuable model for other educational institutions seeking to enhance mathematical understanding and overall student development through innovative and holistic educational approaches.

4. CONCLUSION

This research successfully evaluated the effectiveness of the Holistic Mathematics Education (HME) model, based on the Among system, in enhancing third-grade students' understanding of mathematical concepts at SD Negeri 21 Pulau Punjung. The results indicate that the HME model significantly improves mathematical concept comprehension, with a significance level of 0.001, showing a marked difference compared to conventional teaching methods. These findings are particularly relevant within the modern educational paradigm, which emphasizes independence, creativity, and critical thinking. By implementing the HME model, this study underscores the importance of liberating educational approaches and demonstrates how holistic and interactive methods can enhance academic understanding.

The research highlights the importance of adopting innovative, student-centered teaching methods that cater to holistic development, suggesting a shift in educational practices towards more engaging and effective learning experiences. The success of the HME model in this context provides a valuable framework for other educational settings, emphasizing the need for strategies that impart knowledge while fostering overall student development and preparedness for future challenges. It is recommended that elementary schools integrate the HME model into their mathematics curriculum to promote a more interactive and holistic learning approach. Additionally, specialized training should be provided to mathematics teachers to aid in the effective implementation of the HME model. Further research should explore the application of the HME model at different educational levels and in diverse subjects to gain broader insights into its effectiveness in various contexts.

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