International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 8, 2025
https://theaspd.com/index.php

Watu Gatheng Kotagede: A Gateway To Higher Order Thinking Skills In Primary School Mathematics Through Technology-Based Ethnomathematics

Ahmad Agung Yuwono Putro[1], Victor Novianto[2], Azamul Fadhly Noor Muhammad[3*], Nency Hardini[4], Rina Fitria Kusumayanti[5], Titik Hartawati[6]
[1,3,4,5,6] Master of Elementary Education, Universitas PGRI Yogyakarta, Indonesia
[2] Master of Social Education, Universitas PGRI Yogyakarta, Indonesia

Abstract
This study aims to explore the feasibility of developing technology-based mathematics learning media that integrates the ethnomathematics context of Watu Gatheng Kotagede. The background of this study is the low quality of mathematics teaching at the primary school level, particularly in the development of Higher Order Thinking Skills (HOTS) , which is partly due to the lack of learning media relevant to local culture. Watu Gatheng, as a traditional practice of arranging stones, is rich in mathematical concepts such as geometry, patterns, logic, and reasoning. Using a qualitative approach with a preliminary research design , data was collected through a literature review, in-depth observation, and interviews with elders and craftsmen in Kotagede. The collected data were then analyzed thematically to identify relevant mathematical patterns and concepts. The research results show that Watu Gatheng practices are an extraordinary ethnomathematical resource. These concepts, which are passed down through practice and local wisdom, have great potential for integration into learning media. These findings form a strong foundation for the development of an application prototype using iSpring Suite technology, which can present the material interactively and engagingly. Expert validation by specialists in mathematics, culture, and education indicates that the Watu Gatheng concept is highly suitable for adaptation into HOTS-oriented educational media. The conclusion of this research is that Watu Gatheng Kotagede ethnomathematics is an effective and relevant content source for developing innovative and HOTS-oriented mathematics learning media.

Keyword *: Ethnomathematics, Higher Order Thinking Skills (HOTS), Ispring Suite technology, Watu Gatheng Kotagede.*

INTRODUCTION

Mathematics, often perceived as an abstract subject detached from everyday reality, presents a significant challenge in educational systems worldwide. In Indonesia, this challenge is particularly pronounced at the primary school level, where students often struggle to develop Higher Order Thinking Skills (HOTS) such as analysis, evaluation, and creation (Susanti, Retnawati, Arliani, and Irfan, 2023). This situation is compounded by a scarcity of learning media that are both relevant to local culture and capable of stimulating critical, creative, collaborative, and communicative thinking (Rosilawati, Mulawarman, & Mulyantari, 2019. The rigid, rote-based learning models currently in place are a key cause of this issue, highlighting the urgent need for innovative approaches to mathematics education that not only enhance conceptual understanding but also foster 21st-century skills.

One promising approach is ethnomathematics, a field of study that links formal mathematical concepts with cultural practices and local traditions. Ethnomathematics recognizes that every culture possesses unique ways of understanding, using, and expressing mathematical ideas, such as in measurement, patterns, and logic (Tian, & He, 2024). By integrating ethnomathematics into the curriculum, mathematics learning becomes more meaningful, relevant, and engaging for students (Anculle-Arauco, *et al*. 2022), Zan, *et al.,* 2024). This approach not only bridges the gap between abstract mathematics and students' realities but also plays a vital role in preserving and appreciating cultural heritage (Anculle-Arauco, *et al*. 2022), (Dooley, *et al*., 2020), Bunlang, Inprasitha, & Changsri, 2024).

Amidst Indonesia's rich cultural tapestry, Watu Gatheng Kotagede in Yogyakarta stands out as a cultural practice rich in mathematical and artistic value (Balzani, *et al*., 2024), (Muhammad, Marsigit, & Soeharto, 2021), (Muhammad, 2023). Watu Gatheng is a traditional practice involving the aesthetic and symbolic arrangement of stones, which implicitly applies principles of geometry, patterns, and reasoning (Muhammad, & Gunawan, 2025). The arrangement of these stones demonstrates a deep, intuitive understanding of fold symmetry and rotational symmetry among craftsmen and elders (Raposo, *et al.,* 2020). Beyond simple arrangement, the practice also involves processes of estimation, measurement, and

classification of stones, which directly relate to the concepts of area, volume, proportion, and set theory (Dabija, *et al.,* 2024). This mathematical knowledge is passed down through generations not via formal education, but through local wisdom and hands-on practice (Ananda, *et al.,* 2024). Consequently, Watu Gatheng Kotagede offers immense potential as a content source for developing learning media that connects abstract mathematical concepts with students' real-life experiences while stimulating HOTS.

While the potential of ethnomathematics has been acknowledged in prior studies, a significant gap remains in the literature, particularly regarding the development of technology-based learning media that specifically integrates detailed local cultural contexts (Singh, 2020). Previous research has shown that interactive media can reignite students' enthusiasm for learning and that technology can be a catalyst for motivation. However, there is a lack of research that explicitly combines iSpring Suite as a platform for developing HOTS-oriented learning media with the specific ethnomathematics context of Watu Gatheng Kotagede. iSpring Suite, as an educational technology, has the potential to create dynamic, interactive, and engaging content that transforms students from passive recipients of information into active learners (Huda, *et al,.* 2024), (Elangovan, & Sundaravel, 2021). Expert validation is a crucial step to ensure that the integration of cultural content and technology is effective and relevant to learning objectives (Rejeb, *et* al., 2024).

This research aims to address this gap with a dual objective. First, to qualitatively explore and describe the rich ethnomathematics embedded within the Watu Gatheng Kotagede tradition and assess its feasibility as content for mathematics learning media. Second, to investigate how these mathematical concepts can be translated into technology-based learning media using iSpring Suite, with a focus on developing HOTS. Furthermore, this study aims to present a prototype application validated by experts to ensure its quality, relevance, and practicality for implementation in a primary school context.

Through this research, we seek to answer several key questions: (1) how feasible (valid, practical, and effective) is an application that utilizes iSpring Suite technology and the ethnomathematics content of Watu Gatheng Kotagede?; (2) what are the perceptions, experiences, and understanding of teachers and students regarding the use of mathematics learning media that integrates Watu Gatheng Kotagede ethnomathematics?; (3) how can the meaning, values, and mathematical concepts in the Watu Gatheng Kotagede tradition be explored and internalized by students in the learning process?; (4) how can Watu Gatheng Kotagede ethnomathematics-based learning media facilitate the development of HOTS (critical, creative, collaborative, and communicative thinking) from the perspective of students and teachers?.

The findings of this study are expected to make a substantial contribution by offering an innovative learning medium that is relevant to local culture and by enriching the literature on the role of ethnomathematics and technology in enhancing the quality of mathematics education, especially in stimulating HOTS. The results will provide a strong foundation for future development and experimental trials, offering a concrete solution to the challenges faced in mathematics education in Indonesia.

RESEARCH METHOD

This study adopts a qualitative approach to explore in depth the feasibility of Watu Gatheng Kotagede ethnomathematics as a content source for mathematics learning media. The qualitative method was chosen because it allows researchers to understand phenomena from the participants' perspective, explore the meaning behind cultural practices, and identify the mathematical concepts contained within them. The research design used is preliminary research, which focuses on the exploration and validation of concepts before proceeding to the development and testing stages.

a. Data Collection Techniques

Data collection was conducted through three main techniques to obtain a comprehensive and in-depth picture.

1. Literature Review: The researcher conducted an in-depth literature review related to ethnomathematics, the development of technology-based learning media (specifically iSpring Suite), and theories related to Higher Order Thinking Skills (HOTS). This review aimed to build a conceptual framework, identify research gaps, and formulate relevant research questions.
2. In-depth Observation: Researchers conducted participatory observation in the Kotagede area, interacting directly with the local community and observing the practices of making and arranging Watu Gatheng. This observation focused on the traditional methods used by the community, the shapes of the stones, and the arrangements formed. The data collected included field notes, photographs, and videos, which were then analyzed to identify patterns and mathematical concepts directly.

3. In-depth Interviews: Interviews were conducted with key informants, namely elders, Watu Gatheng craftsmen, and cultural practitioners in Kotagede. These interviews aimed to explore their understanding of the philosophical and symbolic meanings and traditional methods used in Watu Gatheng practices. The interview questions were semi-structured to allow informants to freely share their experiences and views, enabling researchers to uncover hidden mathematical concepts.

b. Data Analysis Techniques

The qualitative data collected from observations and interviews were analyzed through several stages to reach valid conclusions.

1. Data Reduction: The researcher selected, simplified, and focused on the raw data obtained from field notes and interview transcripts. Data irrelevant to the research focus, such as information not related to Watu Gatheng ethnomathematics, were eliminated.
2. Data Presentation: The reduced data were then presented in the form of descriptive narratives, tables, or diagrams to facilitate understanding. This presentation helped researchers organize data and see the relationships between concepts.
3. Drawing Conclusions: Based on the presented data, researchers began to draw preliminary conclusions and identify key themes. This process is inductive, where researchers build concepts and theories from the available data. Conclusions were validated by comparing findings from various data sources (triangulation), such as observation and interview results.

The overall research flow is summarized in Figure 1, illustrating the systematic process from the initial literature review to the final formulation of conclusions about the suitability of Watu Gatheng as learning content.

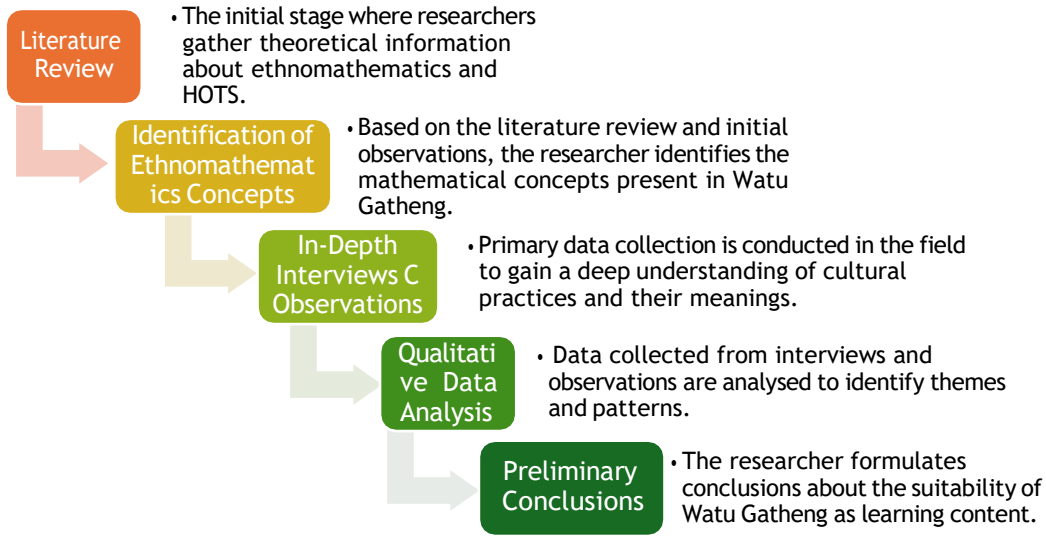

Figure 1. Research Flow

RESULT

Research Results

This study aims to qualitatively explore the ethnomathematical concepts contained within the Watu Gatheng Kotagede tradition as a basis for developing learning media. The results of this research focus on the analysis of qualitative data obtained through literature review, in-depth observation, and interviews with key informants in Kotagede. The findings confirm that Watu Gatheng practices are rich in geometry, patterns, logic, and reasoning concepts, which have great potential for integration into learning media.

a. Identification and Analysis of Ethnomathematics Concepts

The first stage of this research was to identify mathematical concepts that are implicitly contained in the cultural practice of Watu Gatheng. Through participatory observation and in-depth interviews, researchers found that Watu Gatheng is not just an arrangement of stones, but a practice that involves a deep understanding of mathematical principles.

1. Qualitative Findings

a) Geometry in Patterns and Arrangements: Interviews with village elders and stone craftsmen revealed that the arrangement of the stones is based on the principles of symmetry and patterns. They explained how to arrange the stones so that they look harmonious and balanced, which indirectly applies the concepts of fold symmetry and rotational symmetry. For instance, at the Watu Gatheng site, the circular shapes of the stones exemplify fold symmetry. Similarly, the rectangular supporting stones demonstrate both fold symmetry and rotational symmetry. This intuitive application of geometric concepts in creating aesthetically pleasing radial patterns, such as placing a large central stone surrounded by smaller, similar-shaped stones, can be translated into learning material on symmetry and flat shapes.

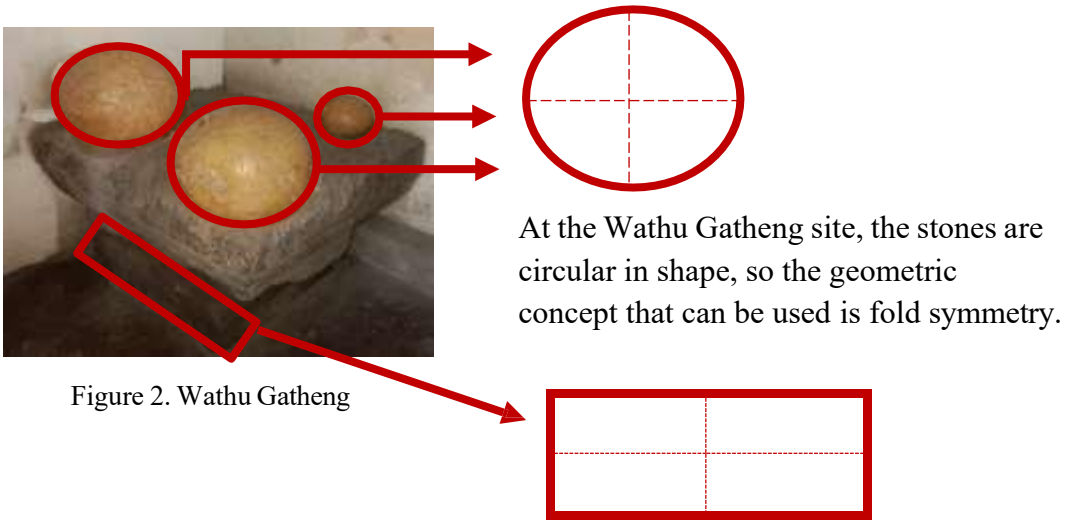

Figure 2. Wathu Gatheng

b) Measurement and Estimation: The Watu Gatheng practice also involves intuitive estimation and measurement processes. The craftsmen do not use standard measuring tools, but they are able to estimate the exact size and shape of the stones needed to fill empty spaces. This demonstrates a practical understanding of the concepts of area, volume, and proportion. From images of the stones, it's clear that each has a different shape and size, and geometric concepts related to area, volume, and proportion can be derived from them. The need for strategic thinking to ensure the arrangement is stable and won't easily collapse is also evident. This process of problem-solving is highly relevant to modern mathematics education, where students are encouraged to think critically to find solutions.

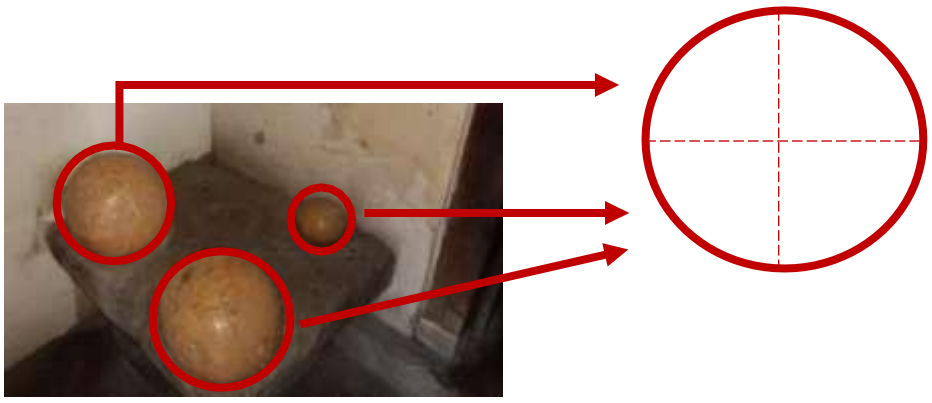

Figure 3. Watu Gatheng

From the image above, each stone has a different shape and size, so the geometric concepts that can be derived are related to area, volume, and proportion.

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 8, 2025
https://theaspd.com/index.php

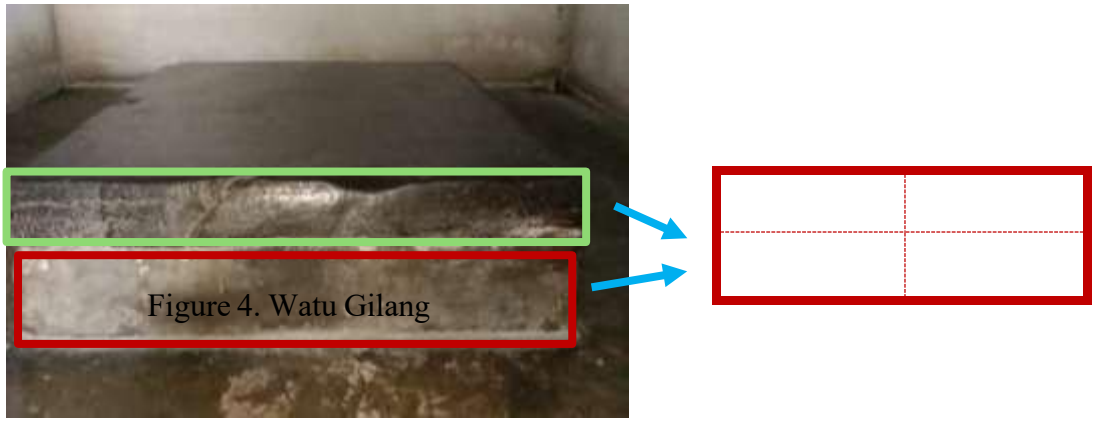

Figure 4. Watu Gilang

From the image above, each stone has a different shape and size, so the geometric concepts that can be derived are related to area, volume, and proportion

c) Classification and Grouping: Interviews revealed that stones are classified based on their shape, size, and function. This classification process is similar to the mathematical concepts of sets and grouping, where each stone has unique characteristics but can be grouped into specific categories. This practice implicitly teaches students to categorize objects based on shared attributes, a foundational skill in mathematics.

d) Logic and Reasoning: The tradition of Watu Gatheng also teaches logical reasoning and problem-solving. Informants explained that to achieve a stable and aesthetically pleasing arrangement, they must carefully consider the position of each stone. This process is highly similar to mathematical reasoning, where logical steps are required to achieve a desired outcome. In a learning media context, this can be realized through interactive puzzles that challenge students to arrange stones according to specific criteria, which actively builds their own thinking strategies.

Informant	**Mathematical Concepts Revealed**	**Explanations/Examples from Interviews**
Village Elders and Stone Craftsmen	Geometry (Symmetry and Patterns)	They explained that stone arrangement is based on the principles of harmony and balance. They intuitively apply the concepts of line symmetry and rotational symmetry to create aesthetically pleasing arrangements. Examples include the placement of circular or rectangular stones, which appear balanced and have a repeating pattern.
	Pengukuran dan Estimasi	The craftsmen didn't use standard measuring tools, but they were able to estimate the exact size and shape of the stones needed to fill the empty space. This demonstrates a practical understanding of area, volume, and proportion.
	Logic and Reasoning	They must think strategically to ensure the stone structure is stable and doesn't collapse easily. This process is very similar to mathematical reasoning and problem-solving.
	Classification and Grouping	They group rocks based on their shape, size, and function. This process is similar to the concept of sets and grouping in mathematics, where each rock has unique

		characteristics but can be grouped into specific categories.
Cultural Practitioner	The Relationship between Mathematics and Local Wisdom	They explained that these mathematical concepts are not formal teachings, but rather local wisdom passed down through practice. This knowledge has become an integral part of people's lives and traditions.
	The Importance of Authenticity	Cultural practitioners emphasize the importance of maintaining the authenticity of cultural values when integrating them into educational materials. They see great potential in using interactive media like iSpring Suite to present this content in an engaging way for elementary school students.

The results of this qualitative analysis prove that Watu Gatheng Kotagede is a very rich ethnomathematical resource. These mathematical concepts are not taught formally but are passed down through practice and local wisdom.

b. Potential for Developing Culture-Based Learning Media

Based on the qualitative findings, the researcher concludes that Watu Gatheng Kotagede has great potential to be integrated into mathematics learning media. This cultural context can serve as an effective bridge between abstract mathematical concepts and students' real-life experiences.

1. Educational Implications

a) Relevance and Contextuality: The use of Watu Gatheng in learning can make mathematics feel more relevant and contextual to students. They not only learn theory in class but also see its application in the culture around them. This relevance not only increases students' motivation to learn but also strengthens their appreciation of cultural heritage.

b) Stimulation of HOTS: Concepts such as symmetry, patterns, and logical reasoning can be transformed into activities that stimulate Higher Order Thinking Skills (HOTS). Students can be encouraged to analyze patterns, solve stone arrangement puzzles, or create new designs, which trains their critical and creative thinking skills.

c) Cultural Preservation: The integration of ethnomathematics also serves as an effort to preserve culture. Through learning, students are encouraged to recognize and appreciate their cultural heritage, ensuring the Watu Gatheng tradition is not forgotten.

c. Validation of Concepts and Initial Design

The next stage was to validate these concepts with experts, as a preliminary step before designing the learning media. Through focus group discussions (FGD) with mathematics experts, cultural experts, and education practitioners, it was agreed that the Watu Gatheng Kotagede ethnomathematics concept is highly suitable for development into educational media. The results of this validation showed that the application prototype had excellent validity in terms of content, media, and practicality.

1. Discussion Results Indicate That:

a) Mathematics experts appreciated how this tradition can be used to teach concepts ranging from basic to advanced.

b) Cultural experts emphasized the importance of preserving the authenticity of cultural values when integrating them into educational materials.

c) Education practitioners saw great potential in using interactive media such as iSpring Suite to present this content in an engaging way to primary school students.

Experts	**Validated Aspects**	**Results and Suggestions/Input**
Mathematicians	Suitability of Mathematical Concepts	Experts appreciate how the Watu Gatheng tradition can be used to teach basic to advanced concepts in mathematics. They validate that concepts such as symmetry, patterns,

		measurement, and logical reasoning contained in Watu Gatheng are highly relevant and accurate.
Cultural Experts	Authenticity and Cultural Values	Cultural experts emphasize the importance of maintaining the authenticity of cultural values when integrating them into educational materials. They agree that using Watu Gatheng as a learning context can simultaneously preserve culture and enhance students' appreciation of local heritage.
Education Practitioners	The Potential of Interactive Media	Practitioners see great potential in using interactive media like iSpring Suite to present this content in an engaging way for elementary school students. They recommend that the application's layout and navigation be made user-friendly for easy implementation in the classroom.
General Conclusion	Feasibility and Potential	Overall, experts agree that the Watu Gatheng Kotagede ethnomathematics concept is highly suitable for development as an educational tool. This validation provides strong justification that the application has significant potential to achieve its learning objectives, namely improving students' understanding of mathematics and HOTS.

This expert validation process aligns with previous research on the importance of involving experts in the development of educational media. It ensures that the selected ethnomathematics concepts are accurate and relevant, and that the application design aligns with the needs of primary school students. The high validity is a strong indicator that the application has great potential to achieve its learning objectives, namely improving students' mathematical understanding and HOTS.

DISCUSSION

This discussion delves into the findings of the preliminary research focusing on the exploration of Watu Gatheng Kotagede ethnomathematics. The qualitative research results show that this tradition is rich in relevant mathematical concepts, making it a strong foundation for the development of technology-based learning media. This discussion explores how these concepts can be integrated, their important role in improving Higher Order Thinking Skills (HOTS), and the potential application of iSpring Suite as a bridge between culture and education.

a. Uncovering the Mathematical Richness of Watu Gatheng: From Practice to Concept

Research findings indicate that Watu Gatheng is not merely an arrangement of stones serving as decoration but a manifestation of mathematical understanding passed down through generations. The

mathematical concepts embedded within it are not formally taught but internalized through practice and the local wisdom of the Kotagede community.

Analysis of Geometric Concepts and Patterns: Interviews with key informants, such as elders and stone craftsmen, reveal that the selection and arrangement of the stones are based on the principle of symmetry. They intuitively apply the concepts of fold symmetry and rotational symmetry to create harmonious and balanced arrangements. For example, craftsmen will place a large stone in the center and surround it with smaller stones of similar size and shape, creating an aesthetically pleasing radial pattern. In the context of learning, this concept can be translated into material on symmetry and flat shapes, where students can identify, draw, and create similar patterns, training their visual and spatial understanding.

Logic, Estimation, and Problem-Solving: More than just geometry, the practice of Watu Gatheng also requires logical reasoning and problem-solving skills. Craftsmen must estimate the appropriate size and shape of stones to fill empty spaces. They must also think strategically to ensure that the arrangement is stable and does not easily collapse. This process is highly relevant to modern mathematics education, where students are encouraged to think critically in finding solutions to problems. In an application context, this can be realized through interactive puzzles that challenge students to arrange stones according to specific criteria, such as achieving balance or filling a limited space, thereby actively building their own thinking strategies.

Cultural Integration as a Foundation for Learning: The use of Watu Gatheng ethnomathematics provides added value by creating relevance between learning materials and students' daily lives. Mathematics is often seen as an abstract subject disconnected from reality. However, by linking it to local traditions they are familiar with, mathematics becomes more meaningful and easier to understand. This relevance not only increases students' motivation to learn but also strengthens their appreciation of cultural heritage.

b. The Role of iSpring Suite in Developing HOTS

The use of iSpring Suite technology in the development of learning media plays a crucial role in transforming qualitative findings into interactive and effective learning experiences. This application serves as a catalyst for fostering Higher Order Thinking Skills (HOTS) in students.

1. Translating Concepts into Digital Form: iSpring Suite enables the design of dynamic and interactive content, such as quizzes, simulations, and animated videos. Instead of just reading about symmetry, students can use the simulation feature to 'arrange' virtual stones and see firsthand how symmetry is formed. Such interactions transform students from passive recipients of information into active learners, which is a key prerequisite for developing HOTS.
2. Stimulating Critical and Creative Thinking: The questions in the application are designed to go beyond levels C1 and C2 of Bloom's taxonomy (remembering and understanding). By integrating Watu Gatheng, the app presents challenges that require students to analyze (why certain arrangements are more stable), evaluate (assess the best arrangement based on criteria), and create (design new stone arrangements). For example, students are asked to create unique patterns and explain the mathematical reasoning behind them, which directly trains their creative thinking skills.
3. Connection to Previous Research: These results are in line with previous studies stating that interactive learning can increase students' enthusiasm for learning and that technology can be a catalyst for motivation. This study reinforces these findings by demonstrating how specific technologies like iSpring Suite can be used to integrate ethnomathematics, which is a novelty of this research.

c. Expert Validation as a Quality Assurance

One of the important stages in this preliminary research was expert validation. The results of this expert validation showed that the application prototype had excellent validity in terms of content, media, and practicality. The success of this validation ensures that the selected ethnomathematics concepts are accurate and relevant, and that the application design aligns with the needs of primary school students.

1. Consistency with Literature Review: This validation process also underscores the importance of involving experts in the development of educational media, as emphasized by previous research. Expert involvement not only ensures content quality but also provides valuable perspectives that help refine the prototype. For example, media experts' suggestions on app layout and navigation make the final product more user-friendly, while input from education practitioners ensures the app can be easily implemented in the classroom.
2. Feasibility and Readiness for Testing: Overall, expert validation provides justification that the application is feasible for further testing. High validity is a strong indicator that the application has great

potential to achieve its learning objectives, namely improving students' mathematical understanding and HOTS.

CONCLUSION

Based on the above discussion, it can be concluded that the ethnomathematics of Watu Gatheng Kotagede is an extraordinary resource for the development of learning media. This tradition provides a rich and relevant context for teaching mathematical concepts, stimulating higher-order thinking skills (HOTS), and preserving culture. The use of iSpring Suite as a development platform has proven effective in transforming these concepts into interactive and engaging learning experiences.

Although this preliminary research has successfully demonstrated the initial feasibility of the application, the next crucial step is to conduct an experimental trial. This trial will quantitatively measure the effectiveness of the application in enhancing students' mathematical understanding and HOTS. Data from this trial will complement the qualitative analysis already conducted, providing a more comprehensive picture of the real-world impact of this innovative educational media.

ACKNOWLEDGMENT

We express our deepest gratitude for the research grant support to the Directorate of Research, Technology, and Community Service, Ministry of Higher Education, Science, and Technology, Republic of Indonesia in 2025 with number: 126/C3/DT.05.00/PL2025, 0498.13/LL5-INT/AL.04/2025, BAP-LPPM/VI/2025."

REFERENCE

1. Ananda, F., Elida, E., Kasmita, K., and Irfan, D. 2024. Android-based learning media development with iSpring Suite application in pastry course. Jurnal Pendidikan Vokasi, vol. 13, no. 3, pp. 273–284, Jan. 2024, doi: 10.21831/jpv.v13i3.66941.
2. Anculle-Arauco, V., et al. 2022. Content validation using Aiken methodology through expert judgment of the first Spanish version of the Eppendorf Schizophrenia Inventory (ESI) in Peru: A brief qualitative report. Rev. Psiquiatr. Salud Ment., p. S1888989122001367, Dec. 2022, doi: 10.1016/j.rpsm.2022.11.004.
3. Balzani, R. et al. 2024. Saving temporary exhibitions in virtual environments: The Digital Renaissance of Ulisse Aldrovandi – Acquisition and digitisation of cultural heritage objects. Digit. Appl. Archaeol. Cult. Herit., vol. 32, p. e00309, Mar. 2024, doi: 10.1016/j.daach.2023.e00309.
4. Bunlang, S., Inprasitha, M., and Changsri, N. 2024. Students' mathematization in mathematics classrooms using the Thailand lesson study incorporated open approach model. Int. J. Lesson Learn. Stud., vol. 13, no. 1, pp. 14–27, Feb. 2024, doi: 10.1108/IJLLS-06-2023-0077.
5. Dabija, D.-C., Brătianu, C. Dominici, G., and Vătămănescu, E.-M. 2024. Unveiling e-learning and knowledge sharing during the pandemic: From expert skills perception to student satisfaction. Technol. Soc., vol. 77, p. 102538, Jun. 2024, doi: 10.1016/j.techsoc.2024.102538.
6. Dooley, K., Bender, S., Ferris, G., Frankham, B., Munt, A., and Schleser, M. 2020. Immersive media practices in the classroom: models of the teaching research nexus in an Australian context. Media Pract. Educ., vol. 21, no. 4, pp. 241–260, Oct. 2020, doi: 10.1080/25741136.2020.1832829.
7. Elangovan, N. and Sundaravel, E. 2021. Method of preparing a document for survey instrument validation by experts. MethodsX, vol. 8, p. 101326, 2021, doi: 10.1016/j.mex.2021.101326.
8. Huda, N. U., Ahmed, I., Adnan, M., Ali, M., and Naeem, F. 2024. Experts and intelligent systems for smart homes' Transformation to Sustainable Smart Cities: A comprehensive review. Expert Syst. Appl., vol. 238, p. 122380, Mar. 2024, doi: 10.1016/j.eswa.2023.122380.
9. Muhammad, A. F. N. (2023). Menemukan Konsep Matematika dalam Pahatan Batu di Candi Borobudur Indonesia. DWIJA CENDEKIA: Jurnal Riset Pedagogik, 7(2).
10. Muhammad, A. F. N., & Gunawan, G. (2025). Peran Etnomatematika dalam Pendidikan Matematika di Tingkat Sekolah Dasar. Ideguru: Jurnal Karya Ilmiah Guru, 10(1), 720-727.
11. Muhammad, A. F. N., Marsigit, M., & Soeharto, S. (2021). Learning the concept of two-dimensional figure through Borobudur artifacts for lower graders of elementary school mathematics. Ethnomathematics Journal, 2(2), 43-50.
12. Raposo, A., Durão, A., Estradas, A., and Ribeiro, I. 2020. Technology as a tool to enhance motivation and learning. E3S Web Conf., vol. 171, p. 01011, 2020, doi: 10.1051/e3sconf/202017101011.
13. Rejeb, A., Rejeb, K., Appolloni, A., Treiblmaier, H., and Iranmanesh, M. 2024. Exploring the impact of ChatGPT on education: A web mining and machine learning approach," Int. J. Manag. Educ., vol. 22, no. 1, p. 100932, Mar. 2024, doi: 10.1016/j.ijme.2024.100932.
14. Rosilawati, Y., Mulawarman, K., and Mulyantari, E. 2019. Heritage and The Local Community Engagement: The Case of Kotagede, Yogyakarta-Indonesia. in Proceedings of the Third International Conference on Sustainable Innovation 2019 – Humanity, Education and Social Sciences (IcoSIHESS 2019), Yogyakarta: Atlantis Press, 2019. doi: 10.2991/icosihess-19.2019.88.
15. Singh, C. K. S. 2020. A Review Of Research On The Importance Of Higher Order Thinking Skills (Hots) In Teaching English Language. Journal of Critical Reviews, vol. 7, no. 08, Jun. 2020, doi: 10.31838/jcr.07.08.161.
16. Susanti, D., Retnawati, H., Arliani, E., and Irfan, L. 2023. Peluang dan tantangan pengembangan asesmen high order thinking skills dalam pembelajaran matematika di indonesia, J. Inov. Pembelajaran Mat. PowerMathEdu, vol. 2, no. 2, pp. 229–

242, Jun. 2023, doi: 10.31980/powermathedu.v2i2.3096.
17. Tian, J. and He, G. 2024. Research on innovative teaching to enhance the employability of college students based on the 'five Links and Six steps' method. Ain Shams Eng. J., vol. 15, no. 5, p. 102677, May 2024, doi: 10.1016/j.asej.2024.102677.
18. Zan, W., Lai, J., Zhang, W., Yang, Q., Qin, Y. and Su, X. 2024. Experimental and applied research on similar materials to granular mixtures for solid-liquid coupling model test of an underwater tunnel. Constr. Build. Mater., vol. 416, p. 135170, Feb. 2024, doi: 10.1016/j.conbuildmat.2024.135170.