# Optimization of Ethnomathematics-Based Realistic Mathematics Learning through Interactive Digital Platform: A Systematic Literature Review

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**Abstract**. The development of educational technology in Indonesia shows rapid progress, but the gap in access to technology between urban and rural areas remains a crucial issue. The main problems in this study are limited infrastructure, low internet access, and lack of digital literacy among educators and students. This research aims to analyze the development of educational technology, identify obstacles in its implementation, and offer solutions to overcome these obstacles. This study collects data from various academic sources, policy reports, and related publications using the literature review method. The results show significant challenges in educational technology access and readiness in Indonesia, especially in remote areas. The proposed solutions include improving internet infrastructure, digital training for educators, and collaboration between the government and the private sector. In conclusion, equitable access to educational technology is needed to improve the quality of national education inclusively. This research has significant implications in mathematics education, especially in optimizing ethnomathematics-based realistic mathematics learning through interactive digital platforms. Teachers can adapt technology-based ethnomath approaches to increase student engagement and make learning more engaging and contextual.

**Keywords:** Ethnomathematics; Technology; Realistic Mathematics Learning; Interactive Digital Platform ; Mathematics Education

## 1 Introduction

Mathematics learning is often considered abstract and less relevant by students because of its concepts that are difficult to relate directly to everyday experiences. This results in low motivation and understanding of students to understand mathematics material in depth. Ethnomathematics is a solution with a culture-based approach that helps students relate mathematical concepts to their environment and traditions. On the other hand, technological developments in education, especially through interactive digital platforms, provide tools and features that allow students to visualize and interact with learning materials dynamically [1], [2]. Therefore, there is an excellent opportunity to optimize ethnomathematics-based realistic mathematics learning through interactive digital platforms to be more relevant, engaging, and effective in building student understanding.

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Previous research has shown the importance of these two variables. For example, [3] shows that ethnomathematics helps students appreciate local cultures in the context of mathematics, while [4] highlights the positive impact of ethnomathematics on student creativity. [5] revealed that this approach improved conceptual understanding, while [6] explored the application of ethnomathematics in Malay traditional buildings. In the context of technology, research by [7] emphasizes the flexibility of digital platforms in developing learning interactions, while [8] found that Virtual Mathematics Kits (VMK) are effective in improving mathematical literacy. [9] emphasized the benefits of digital games in mathematics learning at the K-12 level, and [10] demonstrated a variety of effective digital game designs for mathematics. This combination of approaches is promising because it offers a contextual way of learning while being supported by modern technology.

This study aims to explore how the optimization of ethnomathematics-based realistic mathematics learning can be supported through an interactive digital platform. Therefore, some of the research questions raised in this study include: (1) How can the integration of ethnomathematical concepts in realistic mathematics learning be implemented through interactive digital platforms? (2) To what extent is the effectiveness of the use of digital technology in improving the understanding of mathematical concepts based on local culture? (3) What are the challenges and solutions in the application of ethnomathematics-based realistic mathematics learning through digital technology? (4) What is the effect of the use of interactive digital platforms on student engagement, motivation, and learning outcomes in understanding culture-based mathematical concepts? Through these questions, this study seeks to provide in-depth insights into the potential for technological innovation in mathematics learning that is more contextual, inclusive, and effective.

From the discussion of this research, combining ethnomathematics with digital platforms positively impacts student motivation and understanding. Ethnomathematics enriches the learning experience with cultural contexts, while digital platforms provide easy access and interactive features that support self-paced learning. In particular, findings from previous studies on Ethnomathematics-Based Realistic Mathematics Learning show that students are more enthusiastic and creative when math materials are associated with their local culture. Meanwhile, studies related to Mathematics Learning through Digital Platforms emphasized how digital media can support students' mathematical literacy and conceptual understanding through visualization and game-based activities.

## 2 Method

In this study, the object of the research material is a realistic mathematics learning method based on ethnomathematics integrated with an interactive digital platform. This learning method aims to combine mathematical concepts with relevant local cultural elements so that students can learn in a more accurate context and close to daily life. Interactive digital platforms are expected to increase student engagement and support understanding by visualizing mathematical concepts in a more exciting and interactive form.

The design of this study uses the *Systematic Literature Review* (SLR) approach to analyze and integrate various related research from accredited scientific sources. The sources of information in this study include articles published in indexed international journals, conference proceedings, books, and other research reports relevant to ethnomathematics-based mathematics learning and the use of digital platforms in mathematics education. These studies were selected using relevant keywords such as "ethnomathematics," "realistic mathematics education," "digital platforms," and "interactive learning." Data collection is carried out from

academic database sources such as Scopus, Web of Science, and Google Scholar to ensure the quality and validity of the data.

The data collection stage begins with literature screening through the *screening* and *eligibility* process. Literature that does not meet the inclusion and exclusion criteria will be eliminated at this stage. Articles that meet the requirements are then classified based on theme and relevance to the research focus, namely the optimization of ethnomathematics-based realistic mathematics learning through digital platforms. The study also records each article's methods, samples, and critical results to obtain comprehensive information on the best practices and challenges of implementing the technique in various educational contexts.

The data analysis stage involves a thematic coding process to identify key themes and patterns in the results of the study that have been collected. This analysis follows a descriptive approach describing how ethnomathematics and digital platforms can be optimized in mathematics learning. In addition, comparative analyses were conducted to understand the differences and similarities of study outcomes in different contexts and identify the most effective elements in supporting learning success.

## 3 Results and Discussion

### 3. 1. Result

In the search results based on the results of studies related to the theme and objectivity of research on Ethnomathematics-Based Realistic Mathematics Learning through Digital Platforms, ten related studies are considered very relevant in the systematic review, and related articles will be described in Tables 1 and 2 below:

#### 3.1.1 Ethnomathematics-Based Realistic Mathematics Learning

Ethnomathematics-Based Realistic Mathematics Learning (EBRML) is an educational approach that combines the principles of realistic mathematics learning with local cultural elements known as ethnomathematics. In this approach, mathematical concepts are taught by relating them to the context of the local community's culture, traditions, and daily lives to make them more relevant and accessible for students to understand. Realistic Mathematics Education (RME), developed in the Netherlands by Freudenthal, emphasizes the importance of bringing real context into learning so that students can solve mathematical problems through concrete experience [11]. By incorporating ethnomathematical elements, such as patterns in art or traditional buildings, students gain a learning experience closer to their social reality.

In EBRML, ethnomathematics is crucial to provide a cultural foundation for understanding mathematical concepts. Ethnomathematics is a branch of study that identifies and explores how mathematics is present in local cultures, such as in the work of D'Ambrosio, who introduced this concept in the 1980s. Ethnomathematics provides a cultural and historical context in teaching mathematics, thus allowing students to understand mathematics in the abstract and see its application in their daily lives. For example, in certain societies, the concepts of symmetry and geometry can be introduced through traditional weaving patterns or the architecture of conventional buildings [12]. EBRML allows students to build a deeper and more applicable understanding of mathematics by connecting mathematics to real life.

Studies that support the effectiveness of EBRML says that this approach can improve students' motivation, concept understanding, and critical thinking skills. Research conducted by [13] in the context of mathematics learning in Indonesia shows that using local context in mathematics learning helps students understand complex mathematical concepts more quickly. PMRE also fits the theory of *constructivism*, where students build understanding from their own

learning experiences. By leveraging cultural context, students can relate math lessons to their everyday experiences, improving their analytical abilities and mathematical applications in real-life situations.

**Table 1.** Summary of related studies in Ethnomathematics-Based Realistic Mathematics Learning

| No | Title | Author/Year | Type of Research | Instruments, Data collection, and analysis techniques | Findings | Source |
|---|---|---|---|---|---|---|
| *1* | *Implementasi Pembelajaran Matematika Realistik Berbasis Etnomatematika [14]* | Ari Irawan, Gita Kencanawaty/ 2017 | Qualitative approach. | Survey method Exploratory, instrument In this study, observation sheets, interview guidelines and documentation. | Application of learning Realistic Mathematics berbasis ethnomathematics can make students become more Passionate about learning and cultivating a love for local culture so that it can make students become more acquainted, preserve s You can connecting Sundanese culture with mathematics according to learning materials Flat Wake Up. | SINTA 3 Accredited National Journal |
| *2* | *Implementasi Pembelajaran Matematika Realistik Berbasis Etnomatematika [15]* | Utami Asih/2023 | Descriptive Quantitative | The instrument used in this study is an observation sheet and creativity assessment sheets. | Activity student deep follow Learning mathematics Realistic Ethnomathematics Belong well with presentation Average 91,43%. Creativeness student deep Plan Learning mathematics Ethnomathematics has fulfilled Multiple Assessment Indicators creativeness. | SINTA 3 Accredited National Journal |

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| *3* | *Meningkatkan kemampuan pemahaman konsep siswa sma melalui pendekatan pembelajaran matematika realistik berbasis etnomatematika [16]* | Umaedi Heryan, Zamzaili Zamzaili/2018 | Descriptive Quantitative | To obtain data in this study, several types of instruments were used, namely a set of concept comprehension ability tests. | The ability to understand concepts of students whose learning uses ethnomathematics -based PMR learning is significantly better than those whose learning uses conventional methods. | SINTA 4 Accredited National Journal |
| *4* | *EksplorasiEtno matematika pada Balai Adat Melayu [17]* | Khairunnisa, Siti Salamah Br Ginting/2023 | Qualitative descriptive using an ethnographic approach | Human instrument, meaning that the researcher is the main instrument that cannot be replaced or represented by others | The Malay traditional hall has various applications of mathematical concepts such as; (1) measuring wood to form the hall, (2) designing the appropriate building is carried out by arranging each level of the hall, (3) the concept of the set which is proven that there are several variations of the contents of the hall according to the tastes of the celebrants, and (4) the study of the concept of geometry contained in the hall and the supporting ornaments of the hall which are closely related to geometric shapes | SINTA 4 Accredited National Journal |
| *5* | *Modul Pembelajaran Matematika Realistik Berbantuan Kahoot untuk Meningkatkan Koneksi* | Ikmilul Maula An, Nidhof Zaenuri, Walid/2024 | Literary research methods | Data that obtained from literature research is secondary data collected by researchers from journals, | Various ethnographic elements in historical buildings in Indonesia contain many simple geometric | SINTA 4 Accredited National Journal |

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| *Matematis Peserta Didik [18]* | proceedings, books or sources other related to the research topic | concepts, including lines, diagonal lengths, angles, area and circumference, and many other mathematical concepts |

Table one shows that Ethnomathematics-Based Realistic Mathematics Learning (EBRML) effectively increases students' understanding of mathematical concepts, creativity, and motivation. EBRML proves relevant for relating mathematical concepts to local cultures, so students learn mathematics in the abstract and the context of their natural life and culture. From research conducted with various qualitative and quantitative approaches, EBRML has created more meaningful learning experiences, actively involving students and fostering a sense of love and appreciation for local culture. In particular, the results of this study also show that an ethnomathematical approach can help students develop critical and creative thinking skills and improve mathematical connections. Some studies show that student involvement in PMRE learning is relatively high, and students who learn with this method show a better understanding of concepts than with conventional methods [19]. This conclusion supports the great potential of EBRML as an innovative learning model that can be implemented more widely to improve the quality of mathematics education and cultural engagement in schools.

### 3.1.2 Mathematics Learning through Digital Platforms

Mathematics Learning through Digital Platforms is a modern approach that utilizes technology to enrich the student learning experience. With digital platforms, math learning is no longer limited to textbooks or whiteboards; students can interact with the material through apps, simulations, videos, or educational games designed to help them understand math concepts more easily and enjoyably. According to *the theory of Connectivism* developed by [20], learning in the digital era involves information networks and the interconnectedness of various sources, where students can build knowledge from various available digital sources. Digital platforms provide flexibility of time and place so that students can learn anytime and from anywhere, increasing accessibility and convenience.

In addition to flexibility, learning mathematics through digital platforms supports the development of critical thinking and problem-solving skills. Digital applications and tools often have interactive features such as mathematical simulations, data visualizations, and problem-based problems that allow students to apply mathematical concepts in real-world contexts. Based on the *Constructivism* theory of Piaget and Vygotsky, learning becomes more effective when students can actively engage and build their understanding through hands-on experience [21]. This interactive digital platform allows students to explore, try, and experiment with various mathematical concepts independently, providing space for self-regulated learning [22], [23].

Research supports that using digital platforms in mathematics learning can increase students' motivation to learn and provide better academic results. According to a study conducted by [24], students who use technological devices in mathematics learning show increased understanding and participation compared to students who learn using traditional methods. Digital platforms also allow for personalization in learning, where content can be tailored to each student's needs, learning speed, and level of understanding [25], [26]. With this feature, mathematics learning through digital platforms offers great potential in increasing student engagement [27],

strengthening conceptual understanding [28], and providing wider and easier access to a variety of learning resources [29], [30].

**Table 2. Mathematics Learning through Digital Platforms**

| No | Title | Author/Year | Type of Research | Instruments, Data collection, and analysis techniques | Findings | Source |
|---|---|---|---|---|---|---|
| 1 | An e-Learning Model for Teaching Mathematics on an Open-Source Learning Platform | Jeong-Yong Ahn, Edwin Henneken/ 2018 | Systematic Literature Review | Data obtained from literature research is secondary data collected by researchers from journals, proceedings, books, or sources other related to the research topic | The platform offers a developer's tool for coding and customizing templates to attain higher levels of usage and interactivity in which learners can create and control learning objects while they observe the results. | International Journal Indexed Scopus Q1 |
| 2 | Virtual Mathematics Kits (VMK): Connecting Digital Media to Mathematical Literacy | L. N. Pradana, O. H. Sholikhah, S. Maharani+1 more/2018 | Mixed Method Analysis | The digital media used in this study was Virtual Mathematics Kits (VMK). This study involved 83 primary school students (45 intervention classes and 28 non-intervention classes) as participants in mathematical literacy training (6 weeks). A two-section mathematical literacy test evaluates students' mathematical literacy. | VMK, as a digital medium, has a significant impact on supporting students' mathematical literacy abilities. | International Journal Indexed Ebsco |

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| 3 | Digital game-based learning in K-12 mathematics education: a systematic literature review | Mahmood H. Hussein, S. H. Ow, Monther M. Elaish+1 more/2021 | Systematic literature review | This study reviewed 43 articles published in the Social Sciences Citation Index (SSCI) of Web of Science and other top-ranked educational technology journals between 2008 and 2019. | Many DGBL applications were constructed based on a specific design feature or learning theory. | International Journal Indexed Scopus Q1 |
| 4 | A Systematic Review of Digital Mathematics Game Articles Published in Peer-Reviewed Journals in Türkiye From 2005 to 2023 | Seher Avcu/2023 | Systematic literature review | Digital mathematics game articles published in peer-reviewed journals from 2005 to 2023 were systematically reviewed. To locate these articles, the following keywords were searched in TR Index, DergiPark Academic, and Google Scholar: "digital game," "video game," "computer game," "interactive game," "mobile game," and "serious game." | Using the following research trends: (i) research aims, (ii) research methodologies, (iii) research participants, (iv) sample sizes, (v) designers of the digital mathematics games, (vi) environments used for designing digital mathematics games, and (vii) learning domains of the digital mathematics game topics | International Journal Indexed Ebsco |
| 5 | Digital Game Preparation Experiences of Pre-service Mathematics Teachers | Ruhşen Aldemir Engin/2022 | Qualitative case study | The data were obtained from a semi-structured interview form consisting of seven | An advantage to be used in mathematics education and to be memorable, while game addiction and | International Journal Indexed Ebsco |

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| | | questions and digital games designed by the participants. | going out of the game's purpose are disadvantages. It has been observed that the designed games are mostly related to the secondary school level, the red and black elements are used extensively, and the games of destruction are generally intended. |

Table two describes that digital platforms and digital-based games have great potential to improve students' mathematical literacy skills and make mathematics learning more interactive and exciting. Studies conducted on e-learning platforms have been proven to provide flexibility and customization capabilities to create learning objects directly controlled by students, improving student engagement and understanding. These digital platforms, as researched by [31], leverage developer tools to create more interactive learning experiences.

Meanwhile, the use of digital games in mathematics education has been proven to be effective in improving mathematical literacy, as seen in a study using Virtual Mathematics Kits (VMK), which showed a positive impact on the mathematical literacy skills of elementary school students. In addition, literature reviews show that many digital games are designed with specific features and learning theories that support better learning outcomes in mathematics [32]. However, there are concerns about the potential for game addiction as well as the challenge of staying focused on the goals of learning mathematics [33].

Overall, this study indicates that digital platforms and digital-based games can positively impact mathematics learning as long as they are used with the proper methods and good supervision [34]. This conclusion supports the importance of continuing to develop and apply digital technology in mathematics education to enrich the learning experience and overcome the challenges related to game-based learning.

### 3. 2. Discussion

This study explores how applying ethnomathematics-based realistic mathematics learning through digital platforms can optimize students' learning experience. The results show that using cultural elements in mathematics learning can foster a deeper understanding of concepts in students because students can see the application of mathematics in the context of the local culture they are familiar with. Using digital platforms to teach ethnomathematics-based mathematics provides easy access and flexibility that allows students to learn independently. The platform also enhances student engagement by giving visual interaction and adaptive features that adapt to individual learning needs.

The results of this study indicate the importance of combining local cultural context and digital technology in mathematics learning. The implications for education are that math teachers can adopt this approach to build students' understanding of mathematical concepts associated with local culture through digital media. This implementation can also expand the use of educational technology inclusively, especially in supporting mathematical knowledge in

areas rich in cultural diversity. Thus, integrating ethnomathematics and digital platforms can be a valuable strategy for improving mathematical literacy at all levels of education.

The results of this study show that the interactivity and visualization provided by digital platforms allow students to understand mathematical concepts more concretely and relevantly. This method facilitates learning mathematics and increases students' awareness of local cultural values. This is in line with the findings in the research on Ethnomathematics-Based Realistic Mathematics Learning, which emphasizes the importance of applying cultural context to help students visualize mathematics in real life. Digital platforms support this method by allowing students to explore and interact directly with the material [35] to understand abstract concepts more realistically [36].

This study strengthens the findings in the Mathematics Learning through Digital Platforms research, where digital platforms improve students' understanding through adaptive interactive features. In addition, this study's findings align with the study of Ethnomathematics-Based Realistic Mathematics Learning, which found that the cultural context in mathematics learning can increase students' motivation to learn mathematics and relate it to daily life [37], [38]. While previous research has emphasized the direct use of culture-based content [39], this study shows that digital technology can be an effective medium to bring the content more widely and interactively [40], [41].

The study recommends further development in two areas: the exploration of the design of more adaptive digital platforms for ethnomathematical learning and research on the influence of digital ethnomathematics at different levels of education and cultural backgrounds. Further research should also examine more deeply how variations in platform design can affect the achievement of mathematics learning and cultural understanding in students. In addition, there is a need to evaluate the effectiveness of ethnomathematics-based learning in strengthening critical thinking skills, which can support sustainable mathematics education based on cultural context in the digital era.

## 4 Conclusion

This research shows that integrating ethnomathematics and digital platforms in realistic mathematics learning can improve student understanding and engagement. The findings revealed that the cultural context in mathematics learning allows students to associate abstract mathematical concepts with daily life, thereby increasing motivation and memory. In addition, using digital platforms adds a layer of interactivity that strengthens the visualization and application of concepts, allowing students to learn independently at their own pace. This implementation has optimized the student learning experience, significantly enhancing the connection between mathematics and local culture. This research has significant implications in mathematics education, especially in optimizing ethnomathematics-based realistic mathematics learning through interactive digital platforms. Teachers can adapt technology-based ethnomath approaches to increase student engagement and make learning more engaging and contextual. In terms of curriculum, the integration of ethnomathematics with digital technology can create a learning experience that is more relevant to students' daily lives, while the development of teaching materials based on local culture can deepen the understanding of mathematical concepts. In the realm of educational technology, interactive digital platforms supported by artificial intelligence (AI) and augmented reality (AR) have the potential to increase the effectiveness of learning and student engagement. In addition, this research opens up opportunities for further exploration related to the effectiveness of various digital platforms in supporting ethnomathematics-based learning, including the development of an evaluation model to measure the impact of its implementation on students' understanding of concepts and critical

thinking skills. Further studies can also explore the adaptation of this approach at different levels of education and cultural contexts, so that the contribution of this research not only improves the effectiveness of mathematics learning but also creates a more meaningful and contextual learning experience for students.

This research is essential to the academic world, especially in combining cultural perspectives with educational technology. This study shows that digital platforms can effectively teach culture-based mathematical concepts, which were previously only applied traditionally. By connecting cultural elements through interactive technology, this research expands the scope of ethnomathematics so that it can be accessed in different regions with different cultural backgrounds. This opens up opportunities for further research and development on how local cultures can be integrated into mathematics learning materials digitally and how the results impact students' understanding.

However, this research has limitations, primarily related to the various digital platform designs used. Many of the studies reviewed still need to have a standard framework for measuring the effectiveness of ethnomathematics-based learning through technology so that results may vary depending on the platform used and the technological skills of both students and teachers. In addition, the limitations of several studies that have yet to test implementation at different levels of education and other types of cultures make the scope of influence of digital ethnomathematics not fully defined. Referring to related research, "Ethnomathematics-Based Realistic Mathematics Learning" and "Mathematics Learning through Digital Platforms," this research provides an essential foundation. Still, it must be expanded to ensure these methods can be adapted in various educational and cultural contexts.

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