Kalamatika: Jurnal Pendidikan Matematika

P-ISSN 2527-5615
E-ISSN 2527-5607

Journal homepage: https://kalamatika.matematika-uhamka.com/

Developing ethnomathematics-based interactive digital book to improve mathematical connections and self-confidence: The PMRI approach

Ratna Marlina, Wahyu Hidayat*, and Tatang Supriatna

To cite this entry:

Marlina, R., Hidayat, W. & Supriatna, T. (2026). Developing ethnomathematics-based interactive digital book to improve mathematical connections and self-confidence: The PMRI approach. *Kalamatika: Jurnal Pendidikan Matematika*, *11*(1), 120-145. https://doi.org/10.22236/KALAMATIKA.vol11no1.2026pp120-145

Link to the article online:
https://kalamatika.matematika-uhamka.com/index.php/kmk/article/view/855

Submitted: *Feb 27, 2026* | Revised: *Mar 15, 2026* | Accepted: *Mar 16, 2026*
Published online: *April 21, 2026*

Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

Developing ethnomathematics-based interactive digital book to improve mathematical connections and self-confidence: The PMRI approach

Ratna Marlina, Wahyu Hidayat, and Tatang Supriatna

Department of Mathematics Education, IKIP Siliwangi, Cimahi, Indonesia

ABSTRACT

One reason students have difficulty understanding the relationships among quadrilaterals, area, and perimeter is the lack of innovative teaching materials in schools. Therefore, this study aims to develop an interactive digital book using a valid, practical, and effective PMRI approach based on ethnomathematics to improve students' mathematical connection skills and self-confidence. The research method employed was Design Research of the development study type. The research subjects consisted of three subject matter experts, three language experts, and one media expert, as well as 64 students from an Islamic middle school in West Bandung, Indonesia. The students included three eighth-grade students for one-to-one testing, nine eighth-grade students for small-group testing, and 52 seventh-grade students for field testing. The research instruments included validation sheets for subject matter, media, and language experts; unstructured interviews; student response questionnaires; a self-confidence questionnaire consisting of 40 The results of the study indicate that the mean validation score from subject matter experts was 95% (highly valid), from language experts 98% (highly valid), and from media experts 95% (highly valid). Student responses reached 92% (highly practical). The post-test significance values for mathematical connection skills (0.000) and self-confidence (0.001) were both below 0.05, indicating that the developed digital book was effective in improving students' mathematical connection skills and self-confidence compared to conventional learning. Additionally, students' self-confidence was categorized as high.

KEYWORDS

Digital book; ethnomathematics; mathematical connections; PMRI; self confidence

CORRESPONDING AUTHOR

Wahyu Hidayat ✉ wahyu@ikipsiliwangi.ac.id 🖃 Department of Mathematics Education, IKIP Siliwangi, Cimahi, Indonesia

INTRODUCTION

Mathematical connection skills refer to the ability to link mathematical concepts. These skills help students understand relationships among concepts within mathematics as well as across other disciplines and real-life situations. Integrating mathematics into practical contexts not only reinforces understanding but also cultivates a sense of relevance and purpose in the learning process, as highlighted by recent studies emphasizing the importance of connecting mathematics to real-life situations and interdisciplinary applications (Kappassova et al., 2025; Al Ameer, 2022). Given the importance of mathematical connections in linking concepts to real-world applications, innovative learning solutions are needed to strengthen these skills and enhance students' understanding of mathematics.

However, evidence from international surveys indicates that Indonesian students' mathematics achievement remains low. The latest PISA results (2022) show that Indonesia's

mathematics literacy score of 366 is below the average score of 472 among the 81 participating countries (OECD, 2023b). Moreover, the 2022 results declined compared to those of 2018 and 2015 in mathematics, reading, and science (OECD, 2023a). PISA mathematics tasks emphasize real-world contexts—such as personal, occupational, societal, and scientific situations—which are closely related to mathematical connection skills. This highlights the need to prioritize these skills in mathematics learning.

In addition, a study by Ansori (2020) found that students' mathematical connection skills are still in the moderate to low category, with an achievement rate of 64%. This indicates that many students have difficulty understanding and connecting mathematical concepts effectively. These challenges are particularly evident in the topic of quadrilaterals, which has numerous applications in real life and other disciplines.

The topic of quadrilaterals can support students in everyday situations, such as classifying objects and calculating the perimeter and area of land, fields, and other objects (Al Jabar & Supriatna, 2023). However, interviews with three teachers and 16 students at a junior high school in West Bandung Regency revealed that students still struggle to distinguish between different types of quadrilaterals, such as squares and rectangles. Similarly, a study by Kadir et al. (2024) involving 59 junior high school teachers in Sampit found that 68% of students did not meet the minimum learning standards for quadrilaterals, with more than 60% achieving unsatisfactory evaluation results. Observations by Soneta et al. (2024) in a junior high school in Bungo Regency also showed that many students had difficulty solving problems related to the area of rectangles when the context differed slightly from examples provided by the teacher. This suggests that students lack conceptual understanding, which limits their ability to solve varied problems. Therefore, mathematical connection skills need to be improved not only from a cognitive perspective but also from an affective perspective, particularly in terms of self-confidence.

Self-confidence is the belief in one's own abilities. In practice, students often struggle to understand problem statements, grasp mathematical concepts, use formulas and symbolic notation, perform calculations, and maintain motivation; many even develop a dislike for mathematics (Unaenah et al., 2020). These challenges contribute to low confidence in solving mathematical problems. With strong self-confidence, students are more likely to take responsibility for their learning, remain motivated, and engage actively in the learning process. Students with higher self-confidence tend to learn mathematics more effectively (Rahmasuri et al., 2022). Moreover, self-confidence supports students in facing challenges,

participating actively in class, and maintaining focus during learning and assessments, thereby improving their mathematical understanding Andriani (2023).

Furthermore, interviews with several junior high school mathematics teachers indicate that although teachers aim for optimal student learning, many students face difficulties when encountering new or contextualized concepts (Supriatna et al., 2017). The availability of engaging and innovative teaching materials remains limited, as teachers often rely on standard textbooks that do not fully support conceptual understanding (Marlina et al., 2025). To address this issue, it is important to develop interactive teaching materials that incorporate familiar and meaningful contexts. One effective approach is to use contexts from students' immediate environments that also carry cultural value, making learning more meaningful.

Culture-based mathematics learning integrates mathematical concepts with students' cultural knowledge (Hidayat & Linda, 2023). Ethnomathematics explores how different cultures develop and apply mathematical ideas in daily life, such as in measurement, timekeeping, and geometric patterns in art or architecture (Siregar, 2025). Culture and education are fundamentally interconnected (Miftahurrahmi et al., 2024). Research by Susanti et al. (2023) shows that ethnomathematics-based learning can enhance learning quality by connecting abstract mathematical concepts to real-life activities. Similarly, relating mathematics to students' cultural backgrounds can increase motivation, interest, and understanding (Izzatin & Dewi, 2025).

The goal of ethnomathematics is to recognize diverse ways of understanding and practicing mathematics across cultures (Nova & Putra, 2022). Culturally based mathematics instruction emphasizes meaningful activities and plays an important role in developing mathematical literacy (Hidayati & Prahmana, 2022; Sakinah et al., 2023; Wahyuni et al., 2025). One relevant approach that incorporates real-world contexts is Indonesian Realistic Mathematics Education (PMRI).

PMRI is an adaptation of Realistic Mathematics Education (RME) that is tailored to Indonesia's cultural, geographical, and social context. RME has significantly influenced mathematics education worldwide, including in Indonesia (Palinussa et al., 2025). In PMRI, teachers do not simply present formulas; instead, they guide students to discover concepts through structured learning activities, such as worksheets (Sutarni et al., 2024). This approach is expected to improve learning conditions, student confidence, and mathematical reasoning skills.

To address these challenges, one potential solution is to develop interactive digital books that help students construct concepts related to quadrilaterals, connect them to real-life situations and other disciplines, and integrate ethnomathematics within the PMRI framework. Research by O'Bannon et al. (2017) shows that interactive digital books enhance motivation, engagement, focus, and learning efficiency. Similarly, Huff et al. (2025) highlight their potential to improve motivation and support specific learning outcomes. By incorporating ethnomathematics and PMRI, students can develop stronger mathematical connections while engaging in meaningful and contextual learning experiences that also foster self-confidence.

Previous studies have explored ethnomathematics-based digital books, demonstrating their effectiveness in helping students understand abstract concepts, increasing engagement, and improving problem-solving skills (Susiliastini & Sujana, 2022; Zaini et al., 2023). Other research has shown that culturally integrated e-books can enhance conceptual understanding, student participation, and character development (Suwarji & Faradiba, 2025; Hutauruk et al. 2024; Rezki et al. 2024).

However, relatively few studies have focused on developing interactive digital books that emphasize concept construction and deeper exploration of quadrilateral concepts, particularly through the integration of GeoGebra. Therefore, this study aims to develop an interactive digital book integrating GeoGebra, based on ethnomathematics and the PMRI framework, to improve students' mathematical connection skills and self-confidence.

This research is expected to produce a valid, practical, and effective interactive digital book that enhances students' mathematical connection skills and self-confidence. It also provides practical guidance for teachers and researchers in developing culturally integrated digital learning materials. Based on previous literature, ethnomathematics- and PMRI-based interactive digital books can help students recognize the relevance of mathematics in daily life, make learning more meaningful, and improve self-confidence, while guiding students to discover, understand, and apply mathematical concepts through interactive features.

METHODS

The research method used in this study is design research of the development study type, which aims to design, develop, and evaluate an instructional product to determine its validity, practicality, and effectiveness in instructional implementation. Design research seeks to improve education by introducing and examining forms of learning, as well as investigating key elements of instructional arrangements necessary to achieve the intended learning outcomes (Gravemeijer & Eerde, 2009). This method is also used to produce a product and

test its effectiveness.

This study aims to develop learning media that are valid, practical, and effective. Learning media are categorized as valid if they meet good or very good criteria. They are considered practical if student responses and their usefulness in learning are classified as good. They are categorized as effective if they are able to increase student motivation and learning outcomes. Development studies consist of two main stages: preliminary design and formative evaluation (Rahmasuri et al., 2022).

Preliminary Stage

This phase involves needs analysis, curriculum analysis, interviews, and an assessment of student characteristics. It also includes exploration of Islamic geometric patterns at Cililin Alun-Alun Park in West Bandung Regency, a religious tourism site known for its architectural representation of Islamic geometric designs. These patterns serve as inspiration for the content design of the digital book.

Formative Evaluation Design

Formative evaluation is conducted during the research process to assess and refine the design or instruments based on feedback and preliminary testing results. Its purpose is to ensure that the research design aligns with the objectives. This stage consists of self-evaluation, prototype design, and field testing. The prototype design phase includes expert review, one-to-one testing, and small group testing.

In the self-evaluation stage, the researchers analyze and design the digital book based on ethnomathematics content. The PMRI approach is used as the framework for development, incorporating six principles: activity, reality, level, interactivity, intertwinement, and guidance/reinvention.

In the prototype design stage, an initial model of the product is developed and tested to obtain feedback, identify weaknesses, and ensure that it meets the required criteria before further development. This stage includes the following steps:

1) Expert Review

At this stage, the product is evaluated by three groups of experts: subject matter, language, and media experts. The language experts consist of one Indonesian language lecturer and two Indonesian language teachers. The subject matter experts include one mathematics teacher from Cililin, Indonesia, and one mathematics education lecturer. The media expert is a mathematics education lecturer. These experts assess and validate Prototype

I developed during the self-evaluation stage. Based on their feedback, Prototype I is revised to produce Prototype II.

2) One-to-one Testing

Prototype I is tested on three eighth-grade students representing high, medium, and low ability levels. Feedback from these students is used to revise the product and produce Prototype II.

3) Small Group

Prototype II is tested on nine students with varying ability levels (three high, three medium, and three low). The grouping is conducted heterogeneously to encourage collaboration and shared understanding.

Field testing stage

At this stage, the product is tested on a larger sample. The product tested has already passed expert validation and earlier student trials. The experiment involves two classes: 28 students from class VII-A as the experimental group and 30 students from class VII-B as the control group.

The research subjects include three subject matter experts (one mathematics education lecturer and two mathematics teachers), three language experts (one Indonesian language and literature lecturer and two Indonesian language teachers), and one media expert (a mathematics education lecturer). Additionally, 64 students from an Islamic middle school in West Bandung participated: three eighth-grade students for one-to-one testing, nine eighth-grade students for small group testing, and 52 seventh-grade students for field testing.

Seventh-grade students were selected as the main sample because, according to the independent curriculum, they had not yet studied the quadrilateral material included in the digital book. In this study, the instruments used consisted of two types: test instruments and non-test instruments.

The research instruments consisted of test and non-test instruments. The test instrument was designed to measure students' mathematical connection skills using five questions on quadrilateral material. This instrument was validated both theoretically (through expert judgment) and empirically (through tests of validity, reliability, and difficulty index). The non-test instrument was a self-confidence questionnaire adapted from the book *Hard Skills and Soft Skills*, used to assess students' confidence levels.

Data analysis employed both descriptive and inferential statistics. Inferential analysis included normality tests and the Mann–Whitney test to determine the effectiveness of the

Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

developed digital book. Descriptive statistics were used to analyze expert validation results, student responses, and self-confidence levels, which were interpreted based on the criteria presented in Table 1, Table 2, and Table 3.

The first analysis involved validation data from subject matter experts to determine the feasibility of the developed digital book. This analysis used four response options for each indicator, with score intervals presented in Table 1 (see Akbar, 2017).

Table 1. Teaching Material Validity Criteria

Interval	Category
$85\% < Va \leq 100\%$	Highly Valid
$70\% < Va \leq 85\%$	Valid
$50\% < Va \leq 70\%$	Less Valid
$1\% < Va \leq 50\%$	Not Valid

The second analysis focused on student practicality data, aiming to measure the practicality of the developed digital book. To assess practicality, four response options were provided for each indicator, with corresponding score intervals as presented in Table 2 (see Akbar, 2017).

Table 2. Criteria for the Practicality of Teaching Materials

Interval	Category
$85\% < Va \leq 100\%$	Very Practical
$70\% < Va \leq 85\%$	Practical
$50\% < Va \leq 70\%$	Less Practical
$1\% < Va \leq 50\%$	Not Practical

Next, students' self-confidence achievement was measured for each indicator using score intervals presented in Table 3 (see Aini et al., 2023).

Table 3. Criteria for Self-Confidence Achievement Based on the Normal Curve

Interval	Category
80% - 100%	Very High
60% - 79%	High
40% - 59%	Moderate
20% - 39%	Low
1% - 19%	Very Low

RESULT AND DISCUSSION

Preliminary Stage

The researcher conducted a needs analysis by interviewing several mathematics teachers to identify the initial conditions related to the needs of students, teachers, the curriculum, and the required learning media. The following is an excerpt from an interview between the researcher (P) and one of the mathematics teachers (T):

P : *Do students find the learning process difficult, ma'am?*
T : *Based on last year's experience, students still find it difficult to distinguish between plane figures, such as squares and rectangles.*
P : *What could be the reason for this, ma'am?*

Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

T : *Students do not fully understand the concepts. They tend to recognize shapes only from pictures and memorize their characteristics without truly understanding them. As a result, when the shapes are presented differently or rotated, students become confused. This indicates that students do not yet have a comprehensive understanding of quadrilaterals.*

P : *Regarding learning materials, do students use specific textbooks or other reference books?*

T : *There are no specific reference books; only standard textbooks are used. However, I hope there will be additional books that can help reinforce and guide students' understanding of the concepts.*

P : *Thank you for the information.*

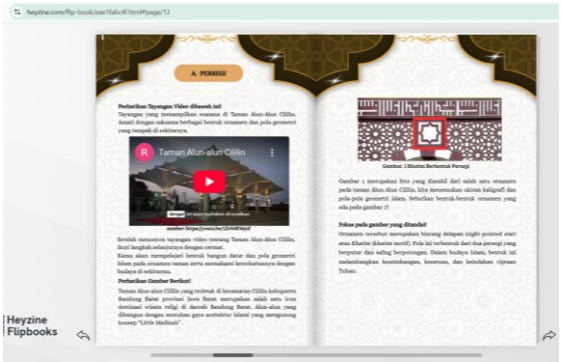
In general, the interview results indicate that students still experience difficulties with quadrilateral material, particularly in analyzing properties and solving contextual problems. This suggests that the learning objectives in the curriculum have not been optimally achieved. The learning media used by teachers is still limited, especially digital media, highlighting the need for innovative digital learning resources to support the learning process. Additionally, the learning context should be closely related to students' daily lives to make it easier for them to understand and visualize concepts.

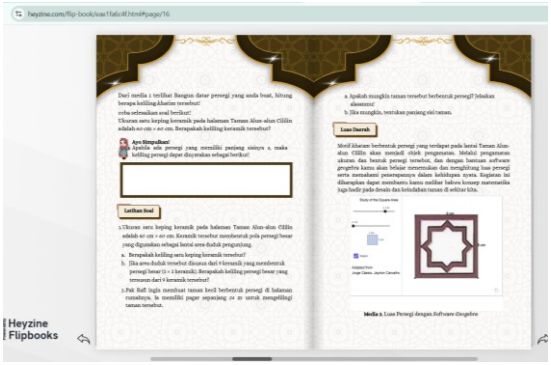
To identify contexts relevant to students, the researcher conducted an ethnomathematics exploration study at Cililin Square Park. The findings revealed various Islamic geometric patterns related to mathematical concepts, including plane figures, solid shapes, pentagons, rotations, and dilations. These findings formed the basis for developing an ethnomathematics-based digital book using the PMRI approach for quadrilateral material.

Formative Evaluation Design

Self-Evaluation

The results of the preliminary study indicate a gap between the intended learning objectives and the actual conditions in the field. This gap served as the foundation for developing a PMRI-based digital book integrated with ethnomathematics as an alternative solution to existing learning problems.





Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

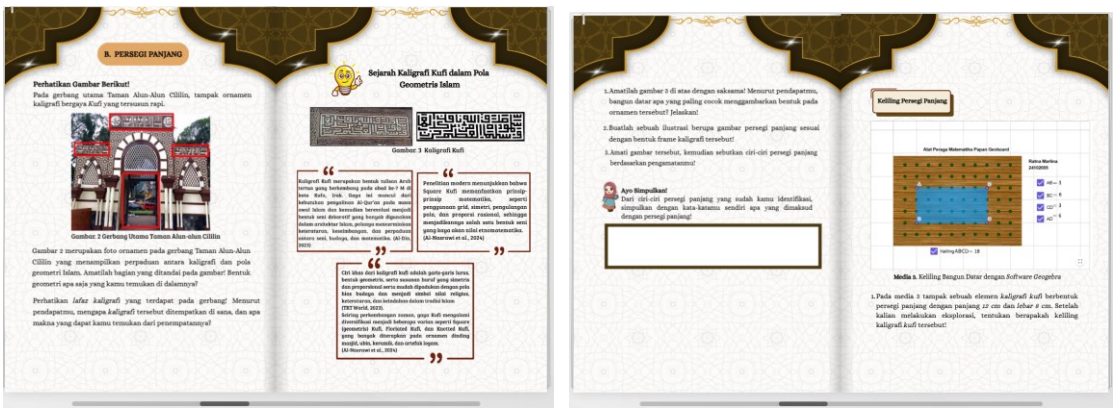


Figure 1. Digital Book Display with an Ethnomathematics-Based PMRI Approach

This digital book is based on ethnomathematics derived from Islamic geometric architecture found in Cililin Square Park. Figure 1 presents an illustration from the digital book that applies an ethnomathematics-based PMRI approach. In this book, students are guided to explore geometric patterns, beginning with their shapes, historical background, and philosophical meanings, and progressing toward constructing concepts of various quadrilaterals. During the learning process, students are first encouraged to watch and observe Islamic geometric patterns through a video featuring Cililin Square Park.

One of the Islamic geometric patterns found in the park is *khatim*, which in mathematics corresponds to a square. Students analyze its properties to develop an understanding of the concept of a square. Another pattern is Kufi calligraphy, which can be associated with the concept of a rectangle. Students examine its properties to construct the concept of a rectangle. Additionally, the interactive GeoGebra media embedded in the digital book enables students to explore the concepts of area and perimeter of quadrilaterals in a more engaging and meaningful way.

Designing the Prototype

This stage of the research consists of three main components: expert review, one-to-one testing, and small group testing. In the expert review phase, the developed digital book is evaluated by three subject matter experts to determine its appropriateness in terms of learning objectives, content relevance, student characteristics, theoretical foundations, and learning approaches.

Based on Table 4, the results of the subject matter expert assessment indicate that the suitability with learning objectives is 100%, alignment with the material is 93%, alignment with student characteristics is 100%, alignment with theory is 100%, and alignment with learning styles is 83%. Overall, the mean percentage from subject matter experts is 95%

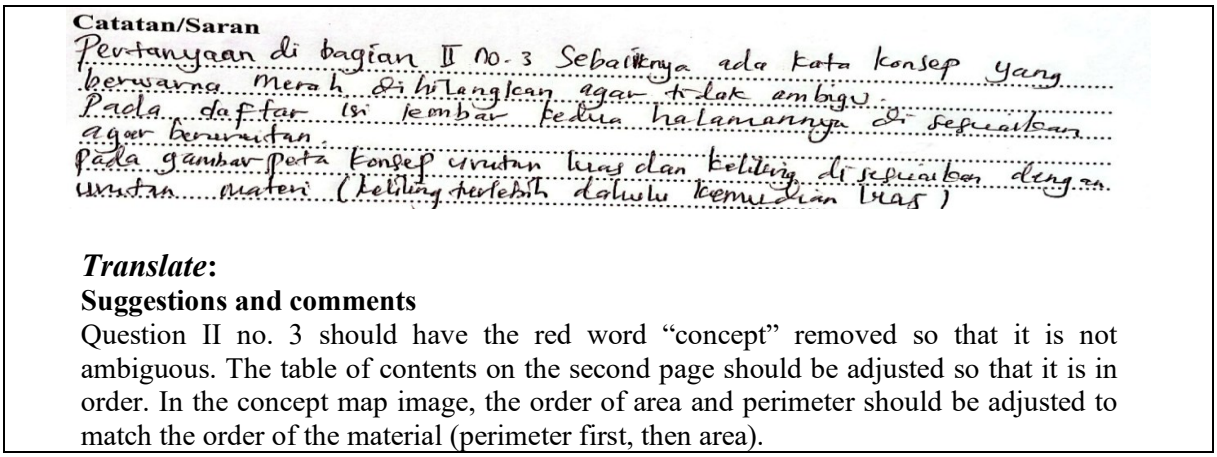
Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

(highly valid). Therefore, the developed digital book is considered highly valid and suitable for use in learning.

Table 4. Assessment by Three Subject Matter Experts

Indicator	Percentage	Category
Suitability with Learning Objectives	100%	Highly Valid
Suitability with Material	93%	Highly Valid
Suitability with Student Characteristics	100%	Highly Valid
Suitability with Theory	100%	Highly Valid
Suitability with Learning Styles	83%	Highly Valid
Mean	95%	Highly Valid

Based on Figure 2, Several notes and suggestions were identified that need to be addressed in the developed digital book. These include removing the word "concept," marked in red in Question II, number 3, to avoid ambiguity; revising the page order in the table of contents to ensure a more systematic structure; and adjusting the sequence in the concept map of area and perimeter to align with the learning stages, with perimeter presented before area.


Catatan/Saran
Pertanyaan di bagian II No. 3 Sebaiknya ada kata konsep yang berwarna merah dihilangkan agar tidak ambigu.
Pada daftar isi lembar kedua halamannya di sesuaikan agar berurutan.
Pada gambar peta konsep urutan luas dan keliling di sesuaikan dengan urutan materi (keliling terlebih dahulu kemudian luas)

***Translate*:**
Suggestions and comments
Question II no. 3 should have the red word "concept" removed so that it is not ambiguous. The table of contents on the second page should be adjusted so that it is in order. In the concept map image, the order of area and perimeter should be adjusted to match the order of the material (perimeter first, then area).

Figure 2. Suggestions from Subject Matter Experts

Overall, based on the assessment results, the developed digital book is considered suitable for use with revisions.

Table 5. Assessment by Three Language Experts

Indicator	Percentage	Category
Linguistic Aspect	100%	Very Valid
Clarity and Readability Aspect	92%	Very Valid
Conformity with Learning Aspect	100%	Very Valid
Consistency and Politeness of Language Aspect	100%	Very Valid
Mean	98%	Very Valid

Based on Table 5, The results of the language experts' assessment indicate that the suitability of linguistic aspects is 100%, clarity and readability aspects 92%, learning aspects 100%, and consistency and politeness aspects 100%. Overall, the mean percentage from the language experts is 98% (highly valid). Therefore, the developed digital book is considered highly valid and suitable for use in learning.

Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

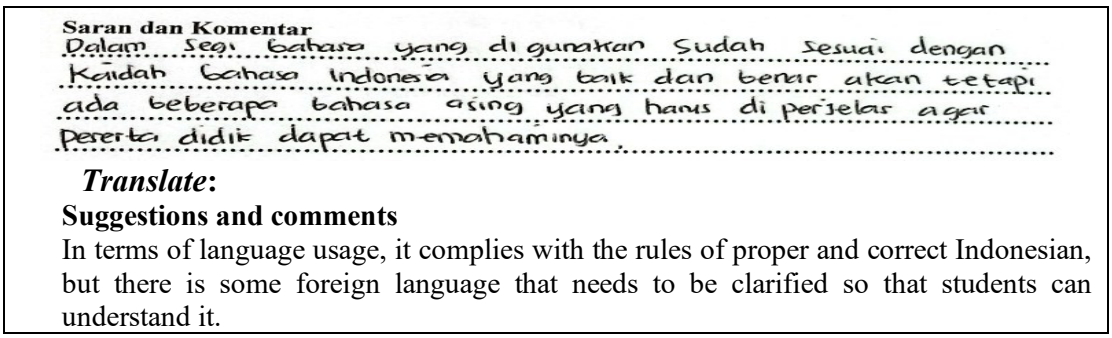


Figure 3. Language Expert Validator's Recommendations

Based on Figure 3, several notes and recommendations were provided that need to be addressed in the developed digital book. These include the need to ensure that the language used in the digital book complies with the rules of standard Indonesian. However, the validator suggested that some foreign terms or expressions should be clarified to make them easier for students to understand. Overall, based on the results of this assessment, the developed digital book is considered suitable for use with revisions.

Table 6. Media Expert Assessment

Indicator	Percentage	Category
Appearance Aspects	100%	Very Valid
Navigation and Ease of Use Aspects	75%	Very Valid
Interactivity and Media Integration Aspects	100%	Very Valid
Consistency and Politeness Aspects	100%	Very Valid
Suitability for Learning Aspects	100%	Very Valid
Mean	95%	Very Valid

Based on Table 6, the results of the media expert assessment show that the suitability of the appearance aspect is 100%, navigation and ease of use 75%, with the expert noting that the GeoGebra user instructions are still unclear and suggesting the inclusion of more detailed technical instructions (see Figure 4). Other assessment results include interactivity and media integration (100%), consistency and language politeness (100%), and compliance with learning aspects (100%). Overall, the mean percentage from media experts is 95% (very valid). Therefore, the developed digital book is considered highly valid and suitable for use in learning.

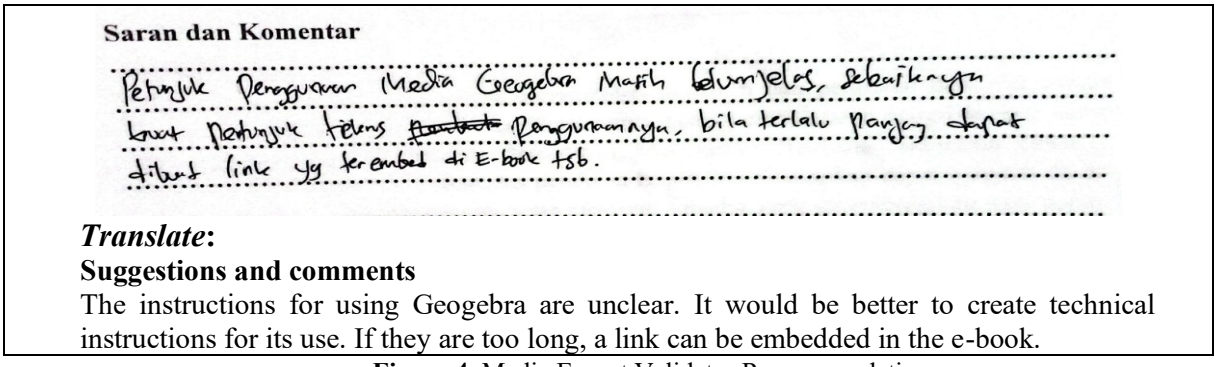


Figure 4. Media Expert Validator Recommendations

Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

To assess the practicality of the product, individual testing was conducted. In the one-to-one phase, the respondents consisted of three eighth-grade students selected based on high, medium, and low academic abilities. This trial aimed to obtain students' assessments and responses to the digital book developed using the PMRI approach based on ethnomathematics.

Based on Figure 5 the assessment of individual student responses shows that all aspects of the digital book's practicality are in the very practical category. The ease of use and clarity aspects obtained a percentage of 92%, indicating that the digital book is easy to use and understand by students. Meanwhile, the aspects of visual appearance and design, contextuality and ethnomathematics, the PMRI approach and meaningfulness of learning, media interactivity, and motivation and attitude toward learning each obtained a score of 100%. Overall, the mean percentage of practicality reached 99%, so the developed digital book is classified as very practical for use in mathematics learning.

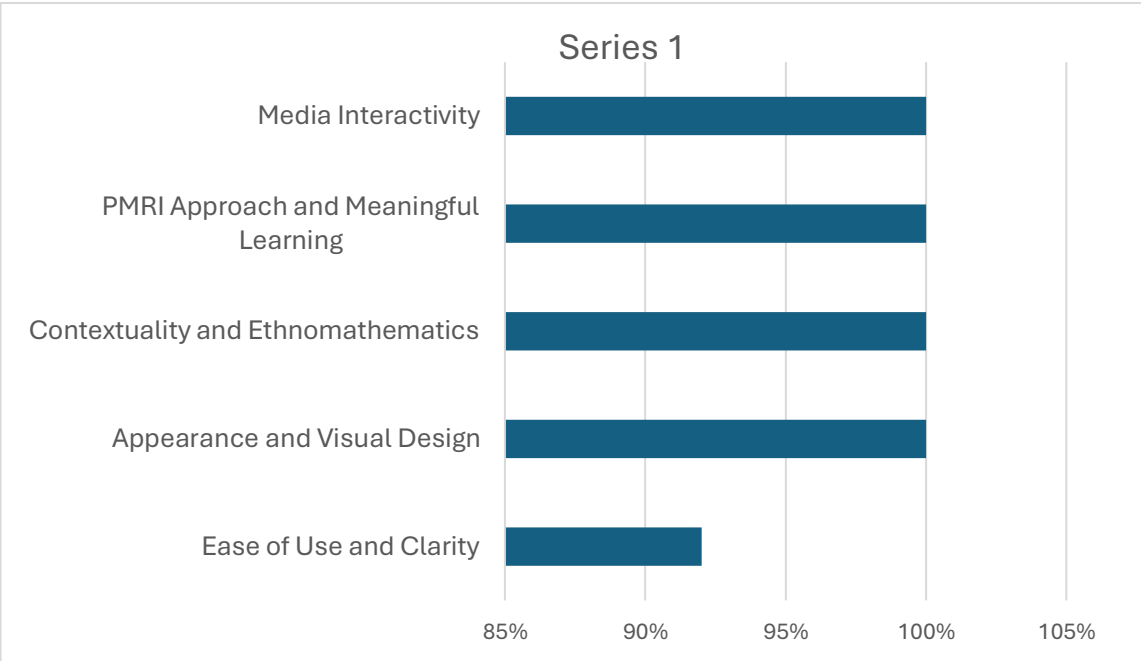


Figure 5. Individual Practicality Test of Digital Book

At the small group phase, the respondents consisted of nine eighth-grade students selected based on their academic abilities: high, medium, and low.

Based on Table 7, it can be seen that the assessment of all aspects of the digital book's practicality falls into the very practical category. The ease of use and clarity aspects obtained a percentage of 92%, indicating that the digital book is easy for students to use and understand. Meanwhile, the aspects of appearance and visual design, contextuality and ethnomathematics, the PMRI approach and meaningfulness of learning, media interactivity,

Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

and motivation and attitude toward learning each obtained a score of 100%. Overall, the mean percentage of practicality reached 99%, so the developed digital book is classified as very practical for use in mathematics learning.

Table 7. Group Practicality Test of Digital Book

Indicators	*N*	Percentage	Category
Ease of Use and Clarity	11	92%	Very Practical
Appearance and Visual Design	12	100%	Very Practical
Contextuality and Ethnomathematics	12	100%	Very Practical
PMRI Approach and Learning Meaningfulness	12	100%	Very Practical
Media Interactivity	12	100%	Very Practical
Motivation and Attitude towards Learning	12	100%	Very Practical
Mean		99%	Very Practical

Field Test

A field test was conducted to examine the effectiveness of the digital book with an ethnomathematics-based PMRI approach on students' mathematical connection skills and self-confidence. The experiment involved two classes, with class VII-A as the experimental group and class VII-B as the control group. A pre-test was administered before the treatment, and a post-test was administered after the treatment to determine learning outcomes. Data analysis began with a normality test (see Table 8).

Table 8. Test of Normality

Class		Shapiro-Wilk		
		Statistic	df	Sig.
Pretest	Experimental Class	.880	26	.006
	Control Class	.818	25	.000
Postest	Experimental Class	.837	26	.001
	Control Class	.770	25	.000
Self Confidence	Experimental Class	.901	26	.016
	Control Class	.955	25	.319

Based on the Shapiro-Wilk output (see Table 8), the pretest yielded Sig. values of 0.006 for the experimental class and 0.000 for the control class, while the posttest yielded Sig. values of 0.001 for the experimental class and 0.000 for the control class. The self-confidence data showed a significance value of 0.016 for the experimental class. Since all Sig. values for the pretest, posttest, and self-confidence data were less than 0.05, the data were not normally distributed. Therefore, a Mann–Whitney test was conducted for the pretest, posttest, and self-confidence data (see Table 9).

Table 9. Two-Sample T-Test Mann-Whitney

	Pretest	Posttest	Self Confdence
Mann-Whitney U	264.500	11.000	155.000
Wilcoxon W	589.500	336.000	480.000
Z	-1.162	-5.978	-3.210
Asymp. Sig.	.245	.000	.001

Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

Looking at Table 9 (test statistics output), the Asymp. Sig. (2-tailed) value for the pretest is 0.245, which is greater than 0.05. Therefore, H_0 is accepted, indicating that there is no significant difference in students' mathematical connection abilities between the experimental and control groups based on the mean pretest scores. This means that both classes had equivalent abilities before the learning intervention.

For the post-test data, the Asymp. Sig. (1-tailed) value is 0.000, which is less than 0.05; therefore, H_0 is rejected. This indicates that students who learned using the digital book with an ethnomathematics-based PMRI approach demonstrated better mathematical connection abilities than those who learned using conventional methods. This shows that the digital book with the PMRI approach based on ethnomathematics is effective in improving students' mathematical connection abilities.

In addition, for students' self-confidence, the Asymp. Sig. (1-tailed) value is 0.001, which is also less than 0.05; therefore, H_0 is rejected. This means that students who learned using the ethnomathematics-based PMRI digital book showed higher self-confidence compared to those in the conventional learning group. This indicates that the digital book is effective in supporting students' self-confidence.

Table 10. Description of Student Self-Confidence Based on Assessment Indicators

Indicator	Percentage	Category
Believe in Your Own Abilities	55%	Medium
Feel Free and Responsible for Your Actions	59%	Medium
Act Independently in Making Decisions	67%	High
Dare to Express Your Opinions and Have the Drive toAchieve	62%	High
Know Your Own Strengths and Weaknesses	65%	High
Mean	62%	High

Table 10 shows the results of the analysis of students' self-confidence, with a mean percentage of 62% in the high category. The indicators of believing in one's own abilities and feeling free and responsible for one's actions obtained percentages of 55% and 59%, respectively, which fall into the moderate category. This indicates that some students still need reinforcement in the aspects of self-confidence and personal responsibility.

Meanwhile, the indicators of acting independently in decision-making, daring to express opinions, having the drive to achieve, and recognizing one's strengths and weaknesses obtained percentages of 67%, 62%, and 65%, respectively, which are in the high category. This shows that students have demonstrated independence, courage, and good self-awareness in learning. Overall, these findings indicate that students' self-confidence is in the high category after participating in learning using the developed digital book.

The purpose of this study is to develop a valid, practical, and effective digital book using an ethnomathematics-based PMRI approach for quadrilateral material to improve students' mathematical connection skills and self-confidence. The digital book is equipped with interactive media using GeoGebra software embedded within it, which helps students discover concepts of area and perimeter and analyze the properties of quadrilaterals. After the prototype was completed, it underwent feasibility testing by experts to ensure its appropriateness for use.

The feasibility test results showed that the digital book was highly valid according to material, media, and language experts. This indicates that the digital book meets academic, pedagogical, and technical standards required for instructional materials. In addition, the integration of digital books into educational settings has been shown to improve teaching and learning processes, in line with the need for continuous training and development to enhance educators' digital competence (Aldaleel, 2025). This integration not only supports teachers in adapting to new instructional models but also helps address the limitations of traditional materials (Aldaleel, 2025; Tlili et al., 2024). Properly designed digital books that align with student learning needs in terms of content, language clarity, and usability make the learning materials more practical, meaningful, and appropriate for students.

Several validators noted that these digital books are more engaging and interesting compared to conventional textbooks. In traditional textbooks, students typically only apply formulas for perimeter and area, whereas the developed digital book presents structured learning activities that guide students in discovering these concepts themselves. This aligns with the PMRI principle of guided reinvention, which emphasizes guiding students to construct mathematical concepts independently. This is also the first-time students have learned mathematics using interactive digital books, providing them with a new learning environment. In addition to creating an engaging learning atmosphere, the use of interactive digital books has been shown to improve students' mathematics achievement, as they support independent learning and cognitive engagement (Alshehri, 2024). As digital learning tools become increasingly adopted in education, it is important to examine their long-term impact on student achievement and motivation, highlighting the need for further research on the effectiveness of various digital platforms (Aviyanti & Widiaty, 2021).

Findings from the practical testing show that the developed digital book is easy and clear for students to use, with an attractive design featuring aesthetic architectural images and an appropriate color scheme that enhances student engagement and makes learning more

Kalamatika: Jurnal Pendidikan Matematika
Volume 11, No. 1, April 2026, pages 120-145
DOI: 10.22236/KALAMATIKA.vol11no1.2026pp120-145

enjoyable. In line with Jin (2013) aesthetic factors such as color schemes and layout design influence student motivation and cognitive engagement, thereby supporting a more effective learning environment. Additionally, Chen & Lee, (2025) found that ease of navigation and user-friendly interfaces in digital textbooks reduce cognitive load, allowing students to focus more on understanding the content rather than the interface. Therefore, design considerations such as layout and color significantly influence student engagement and learning responses.

The ethnomathematics context used in this study, specifically Islamic geometric architecture found in Cililin Square Park, is particularly appealing to students because it connects abstract mathematical concepts to familiar cultural environments. Students were previously unaccustomed to linking mathematics, which is often presented in formulaic form, with real-life cultural artifacts. This approach aligns with recent findings emphasizing culturally responsive pedagogy, which has been shown to improve motivation and learning outcomes by connecting academic content with students' cultural backgrounds (Kucirkova & Littleton, 2020). Ethnomathematics can serve as a solution to both mathematics education challenges and cultural preservation (Kusuma et al., 2024).

For example, by examining mathematical principles embedded in Islamic geometric patterns, students not only learn mathematical concepts but also appreciate their aesthetic and historical value, thereby strengthening their understanding of cultural heritage within mathematics education (Mollah & Kanu, 2024; Tschofen, 2012). Furthermore, the integration of GeoGebra in the digital book makes learning more interactive and enjoyable, helping students better understand mathematical concepts and increasing their interest in learning. Students even suggested that similar digital books be developed for other materials, as shown in Figure 6.

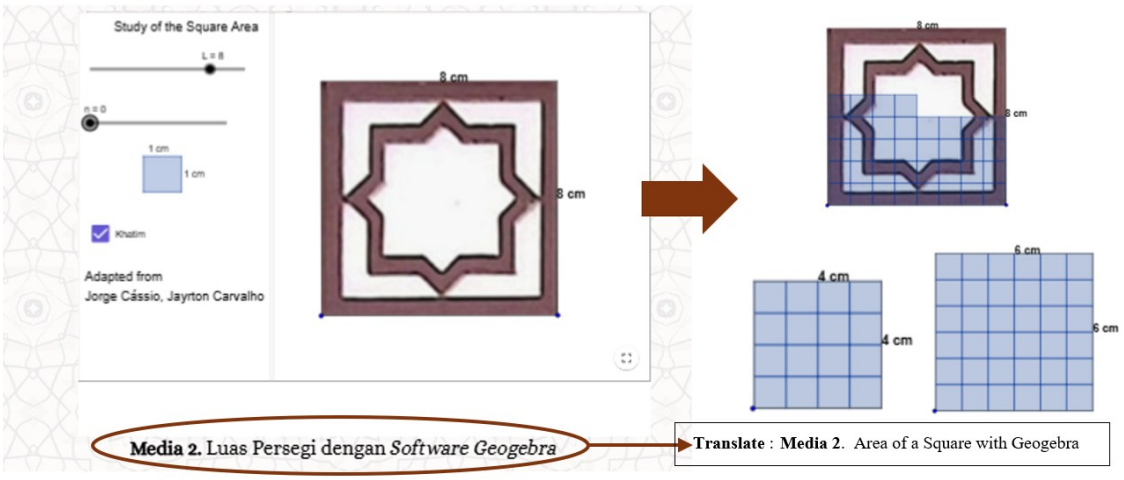


Figure 6. Visualization of GeoGebra Interactive Media Embedded in Digital Book

The interactive media display in Figure 6 one example of Islamic geometric architecture, namely the square-shaped *khatim*. At the beginning of the lesson, students observe the *khatim* and explore its meaning and philosophical significance. Although students have frequently encountered this pattern, most of them are not familiar with its name, philosophical meaning, or historical background. Therefore, students not only learn mathematics but also become acquainted with the art and beauty of Islamic architecture that is close to their cultural environment.

Purniati et al. (2022) found that integrating Islamic architectural elements into mosque ornamentation can serve as an alternative learning medium to address students' difficulties in mathematics, particularly geometry. Similarly, Solihin et al. (2025) suggest that cultural contexts can serve as a powerful source of inspiration for designing contextual, meaningful, and relevant mathematics instruction that bridges local knowledge with universal mathematical principles. In this regard, ethnomathematics plays an important role as a foundation for implementing more meaningful and realistic learning.

Next, students are guided to calculate the number of unit squares that can cover the *khatim* image. At this stage, students engage in informal mathematics by determining the area without using formal formulas while still working within the given context. The next stage is formalization, where the context is gradually removed by activating the interactive feature in Figure 6 transforming the image into a manipulable square whose dimensions can be adjusted by students.

For example, students may create squares with side lengths of 4 cm and 6 cm and calculate the number of unit squares covering each shape. Students are then guided to identify the mathematical concept underlying this process, namely multiplication, which in the PMRI approach is related to the principle of intertwinement. Through this principle, students observe patterns in the number of unit squares: for a side length of 8 cm, there are 8×8 squares; for 4 cm, there are 4×4 squares; and for 6 cm, there are 6×6 squares.

Next, without using software and relying on reasoning, the teacher guides students to generalize the pattern. For instance, when the side length is 20 cm, students conclude that the number of unit squares is 20×20. Finally, students generalize that if the side length is s, then the area is $s \times s$. At this stage, the principles of guided reinvention and level progression in PMRI are applied, moving from contextual and informal mathematics toward formal mathematical understanding of the area of a square.

Based on the results of the effectiveness test during the learning process, the

developed digital book was found to be effective in improving students' mathematical connection skills. This is evident from students' ability to connect real-world contexts, such as Islamic geometric architecture, with mathematical concepts, particularly quadrilaterals involving area and perimeter. The learning process begins with students observing contextual situations presented in the digital book that are closely related to their daily lives, making the concepts easier to understand and imagine. This aligns with recent findings highlighting the importance of contextual learning, which has been shown to improve cognitive engagement and knowledge retention among students (Hayati & Jannah, 2024). Furthermore, the implementation of this approach also encourages collaborative learning, as students share insights influenced by their cultural backgrounds, thereby enriching the overall learning experience (Maharbid et al., 2025). As a result, students demonstrate better mathematical connection skills compared to those in conventional learning settings.

When students learn in contexts that are close to their daily lives, their enthusiasm and curiosity in learning increase. This process also encourages students to ask questions, respond actively, and demonstrate confidence during learning activities. As students explore the digital platform, they are encouraged to analyze information and make decisions, thereby strengthening their self-efficacy and confidence in handling complex tasks (Titik, 2024). This shift from passive to active learning creates an environment where students feel empowered to express their thoughts and opinions, ultimately improving academic performance and conceptual understanding (Antika et al., 2023). In PMRI, this reflects the principle of interactivity, which promotes the development of self-confidence through interaction between students and between students and teachers.

In the research process, the development of the digital book using an ethnomathematics-based PMRI approach has both strengths and limitations. The advantages include the use of simple and understandable language, practicality (accessible via smartphones, laptops, or tablets), and portability, allowing students to learn anytime and anywhere. The GeoGebra activities embedded in the digital book also help students better understand the concepts of perimeter and area of quadrilaterals. In addition, the use of Islamic geometric patterns from Cililin Square increases students' enthusiasm and motivation because the context is familiar and easy to visualize, making learning more meaningful.

This research contributes theoretically to the development of an innovative learning model by integrating ethnomathematics content, the PMRI approach, digital learning media, and interactive GeoGebra-based activities that support active learning and concept discovery.

In addition, the developed digital book can serve as a learning resource for both teachers and students. However, this study has limitations, as access to the digital book still requires an internet connection, and unstable connections may cause delays in GeoGebra interactive features. Therefore, further research is recommended to develop an offline version of the digital book, expand the research sample, and examine its impact on other mathematical abilities to strengthen its contribution to mathematics education.

CONCLUSION

This study developed an interactive digital book using an ethnomathematics-based PMRI approach for quadrilateral material that meets the criteria of validity, practicality, and effectiveness. The implementation of this digital book significantly improves students' mathematical connection skills and self-confidence through the context of Islamic geometric architecture at Cililin Square and the integration of interactive GeoGebra software, which supports students in exploring and discovering concepts of perimeter and area of quadrilaterals.

Students' mathematical connection skills and self-confidence were significantly higher than those of the control class, which used conventional learning methods. The PMRI approach proved highly relevant, as it emphasizes meaningful contexts familiar to students and supports the reinvention of mathematical concepts through interactive learning experiences. The ethnomathematics context also serves as a strong motivating factor, as students not only learn mathematical concepts but also explore the historical and cultural significance of Islamic geometric patterns found in Cililin Square.

ACKNOWLEDGMENTS

The authors would like to thank all individuals who contributed to the completion of this research. Special thanks are extended to the teachers and students who participated in the study, as well as to the subject matter experts, media experts, and language experts who provided valuable feedback for the development of the digital book.

REFERENCES

Aini, W. H., Saman, A., & Pandang, A. (2023). The Influence of Self-Management Techniques in Overcoming Late Coming to School Behavior in Junior High School Students. *Pinisi Journal of Education*, *4*(1), 247–267.

Akbar, S. (2017). *Instrumen perangkat pembelajaran*. Bandung: PT Remaja Rosdakarya.

Al Ameer, L. F. J. (2022). Mathematical connection skills and their relationship with productive thinking among secondary school students. *Periodicals of Engineering and Natural Sciences (PEN)*, *10*, 421–430. https://doi.org/10.21533/pen.v10i1.2667

Al Jabar, S. Z., & Supriatna, T. (2023). Development of learning media for square topics using scratch platform for grade VII. *Pi-Radian: Journal of Mathematics Education*, *1*(2), 83–92. https://doi.org/10.63214/piradian.v1i2.pp83-92

Aldaleel, A. M. (2025). Assessing middle school teachers ' digital innovation skills in bisha province : A comprehensive study. *Journal of Educational Technology Development and Exchange*, *18*(2), 47–66. https://doi.org/10.18785/jetde.1802.03

Alshehri, S. M. (2024). The e-books and students ' mathematics performance : A qualitative systematic review. *Páginas de Educación*, *17*(2), 1–22. https://doi.org/10.22235/pe.v17i1.3479

Andriani, D. G. (2023). The effect of self-confidence on students ' understanding of mathematical concepts through the implementation of the independent curriculum. *Noumerico Journal of Technology in Mathematics Education*, *1*(1), 1–9. https://doi.org/doi.org/10.33367/jtme.v1i1.3548

Ansori, A. (2020). Analisis kemampuan resiliensi dalam meningkatkan kemampuan koneksi matematis siswa. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *3*(4), 353–362. https://doi.org/10.22460/jpmi.v3i4.p%25p

Antika, L., Oktavia, M., & Rachmawati, P. A. (2023). Analisis kepercayaan diri siswa kelas III sekolah dasar. *Jurnal DIDIKA : Wahana Ilmiah Pendidikan Dasar*, *9*(2), 355–362. https://doi.org/10.29408/didika.v9i2.24276

Aviyanti, S. D., & Widiaty, I. (2021). Identifying effective e-books for effective digital learning. *IOP Conference Series: Materials Science and Engineering*, *1098*(2), 22115. https://doi.org/10.1088/1757-899X/1098/2/022115

Chen, Z., & Lee, J. (2025). The influence of ui design attributes and users ' uncertainty avoidance on stickiness of the young elderly toward mhealth applications. *Behavioral*

Sciences, *15*(5), 581. https://doi.org/10.3390/bs15050581

Gravemeijer, K., & Eerde, D. Van. (2009). Design research as a means for building a knowledge base for teachers and teaching in mathematics education. *Elementary School Journal*, *109*(5), 510–524. https://doi.org/10.1086/596999

Hayati, M., & Jannah, M. (2024). Pentingnya kemampuan literasi matematika dalam pembelajaran matematika. *Griya Journal of Mathematics Education and Application*, *4*(1), 40–54. https://doi.org/10.29303/griya.v4i1.416

Hidayat, W., & Linda, L. (2023). The effectiveness of developing culture-based mathematics learning media through visual basic application. *Journal of Honai Math*, *6*(1), 1–16. https://doi.org/10.30862/jhm.v6i1.396

Hidayati, F. N., & Prahmana, R. C. I. (2022). Ethnomathematics ' Research in Indonesia during 2015 -2020. *Indonesian Journal of Ethnomathematics*, *1*(1), 29–42. https://doi.org/10.48135/ije.v1i1.29-42

Huff, T., Ching, D., & Tseng, Y. (2025). Active learning in open digital textbooks : Designing for learner engagement and motivation using H5P. *TechTrends*, *70*(1), 240–252. https://doi.org/10.1007/s11528-025-01144-3

Hutauruk, S. M., Anggraini, V., Azis, S., & Nurshobiha, S. L. (2024). Potensi pocket book find the math-nics in nusantara bernuansa etnomatematika berbasis petualangan pada model problem based learning untuk meningkatkan literasi numerasi siswa. *SEMANTIK: Prosiding Seminar Nasional Pendidikan Matematika*, *2*, 175–190. Retieved from https://seminar.ustjogja.ac.id/index.php/SEMANTIK/article/view/2833

Izzatin, M., & Dewi, N. R. (2025). Numeracy literacy outcomes of RME with local wisdom across cognitive styles. *Kalamatika: Jurnal Pendidikan Matematika*, *10*(2), 137–152. https://doi.org/10.22236/KALAMATIKA.vol10no2.2025pp137-152

Jin, K. A. (2013). Research on the influence of perceived interest on digital textbook learning motivation. *International Journal of Multimedia and Ubiquitous Engineering*, *8*(6), 237–244. https://doi.org/10.14257/ijmue.2013.8.6.24

Kadir, K., Fatimah, S., Dahrim, D., & Rusli, A. Z. M. (2024). Identifying learning obstacles of seventh-grade students in quadrilateral topics. *Jurnal Nalar Pendidikan*, *12*(2), 139–147. https://doi.org/10.26858/jnp.v12i2.66142

Kappassova, S., Abylkassymova, A., Bulut, U., Zykrina, S., Zhumagulova, Z., & Balta, N. (2025). Mathematical literacy and its influencing factors: A decade of research findings (2015-2024). *Eurasia Journal of Mathematics, Science and Technology Education*, *21*(7), em2671. https://doi.org/10.29333/ejmste/16615

Kucirkova, N., & Littleton, K. (2020). The distance between the "Self" and the "Other" in children's digital books. *Frontiers in Psychology*, *11*, 589281. https://doi.org/10.3389/fpsyg.2020.589281

Kusuma, A. B., Hanum, F., Abadi, A. M., & Ahmad. (2024). Exploration of ethnomathematics research in indonesia 2010-2023. *Infinity: Journal of Mathematics Education*, *13*(2), 393–412. https://doi.org/10.22460/infinity.v13i2.p393-412

Maharbid, D. A., Herman, T., Agustin, M., & Riyana, C. (2025). Design of a digital ethnomathematics module based on augmented reality : A study on geometric concepts through the exploration of the mande karesemen for elementary schools. *The International Conference on Teaching, Learning and Technology 2024*, 59–68. https://doi.org/10.18502/kss.v10i12.18862

Marlina, R., Hanifah, N. F., & Fitriani, N. (2025). Developing problem based learning digital worksheet to learn triangle : A validity study. *Journal of Innovative Mathematics Learning (JIML)*, *8*(4), 805–815. https://doi.org/10.22460/jiml.v8i4.p30016

Miftahurrahmi, Pratiwi, I. O., Huda, F., & Habibi, M. (2024). Ethnomathematics exploration in the traditional art of randai Minangkabau. *Kalamatika: Jurnal Pendidikan Matematika*, *9*(1), 99–120. https://doi.org/10.22236/KALAMATIKA.vol9no1.2024pp99-120

Mollah, D., & Kanu, D. (2024). Folk mathematics in everyday life. *International Journal for Multidimensional Research Perspectives*, *2*, 19–26. https://doi.org/10.61877/ijmrp.v2i9.187

Nova, I. S., & Putra, A. (2022). Eksplorasi etnomatematika pada cerita rakyat. *Plusminus:*

Jurnal Pendidikan Matematika, *2*(1), 67–76. https://doi.org/10.31980/plusminus.v2i1.1085

O'Bannon, B. W., Skolits, G. J., & Lubke, J. K. (2017). The influence of digital interactive textbook instruction on student learning preferences, outcomes, and motivation. *Journal of Research on Technology in Education*, *49*(3–4), 103–116. https://doi.org/10.1080/15391523.2017.1303798

OECD. (2023a). *PISA 2022 results: Factsheets – Indonesia*. OECD Publishing.

OECD. (2023b). *PISA 2022 results (Volume I): The state of learning and equity in education: Vol. I*. OECD Publishing.

Palinussa, A. L., Tupamahu, P. Z., Sabandar, V. P., Makaruku, Y. H., & Sabandar, J. (2025). Realistic mathematics education: Mathematics e-modules in improving student learning outcomes. *Infinity: Journal of Mathematics Education*, *14*(1), 45–64. https://doi.org/10.22460/infinity.v14i1.p45-64

Purniati, T., Juandi, D., & Suhaedi, D. (2022). Ethnomathematics study: Learning geometry in the mosque ornaments. *IJASEIT*, *12*(5), 2096–2104. https://dx.doi.org/10.18517/ijaseit.12.5.17063

Rahmasuri, A. R., Dwijayanti, I., & Wulandari, D. (2022). Profil kemampuan komunikasi matematis siswa ditinjau dari self confidence siswa. *Jurnal Silogisme*, *7*(1), 38–47. https://doi.org/10.24269/silogisme.v7i1.3267

Rezki, I., Hanisah, R., & Sari, Y. (2024). *Pengembangan E-book Materi Jual Beli dengan Pendekatan Matematika Realistik Berbasis Kearifan Lokal Suku Dayak Kalimantan Tengah untuk Mengatasi Cognitive Load*. *10*(2), 51–68. https://doi.org/10.37058/jp3m.v10i2.12532

Sakinah, D., Lubis, I. I., & Habibi, M. (2023). Ethnomathematical exploration of Tumbu'Bugis food. *Kalamatika: Jurnal Pendidikan Matematika*, *8*(2), 133–148. https://doi.org/10.22236/KALAMATIKA.vol8no2.2023pp133-148

Siregar, T. (2025). *Integrasi etnomatematika dengan kearifan budaya lokal*. Goresan Pena.

Solihin, A., Mariana, N., Rahmawati, I., & Abidin, Z. (2025). Cultural exploration as realistic context in mathematics learning: An ethnomathematics perspective in Indonesian elementary education. *Glocal Praxis in Elementary Education*, *1*(2), 34–50. Retieved from https://journal.unesa.ac.id/index.php/GPrEEc/article/view/45603

Soneta, V., Nurjanah, N., & Prabawanto, S. (2024). Learning obstacles in the concept of quadrilateral constructed areas. *ICMScE International Conference On Mathematics And Science Education*, 561–568. https://doi.org/10.18502/kss.v9i13.15959

Supriatna, T., Darhim, D., & Turmudi, T. (2017). Local intruction theory dalam pendidikan matematika realistik untuk menumbuhkan kemampuan berpikir logis. *Mimbar Pendidikan*, *2*(2), 173–184. https://doi.org/10.17509/mimbardik.v2i2.8627

Susanti, E., Kurniawan, H., Widodo, S. A., & Perbowo, K. S. (2023). Ethnomathematics : Concept of geometry and cultural wisdom in the construction of the Minangkabau gadang house. *MATHLINE: Jurnal Matematika Dan Pendidikan Matematika*, *8*(11), 1259–1270. https://doi.org/10.31943/mathline.v8i4.474

Susiliastini, N. K. T., & Sujana, I. W. (2022). Flipbook : Media pembelajaran inovatif berbasis etnomatematika pada muatan pelajaran matematika kelas V sekolah dasar. *Jurnal Pendidikan Multikultural Indonesia*, *5*(2), 105–118. https://doi.org/10.23887/jpmu.v5i2.54596

Sutarni, S., Prayitno, H. J., Sutopo, A., & Laksmiwati, P. A. (2024). The development of realistic mathematics education-based student worksheets to enhance higher-order thinking skills and mathematical ability. *Infinity: Journal of Mathematics Education*, *13*(2), 285–300. https://doi.org/10.22460/infinity.v13i2.p285-300

Suwarji, W. K., & Faradiba, S. S. (2025). Integrasi nilai-nilai islam dalam media pembelajaran digital berbasis etnomatematika. *Mandalika Mathematics and Education Journal*, *7*(3), 1530–1543. https://doi.org/10.29303/jm.v7i3.9947

Titik, S. (2024). The influence of the integration of digital literature books and recitation methods on the development of critical thinking abilities and self-confidence in middle school students in social studies learning. *Journal of Education Technology and*

Inovation, *7*, 108–118. https://doi.org/10.31537/jeti.v7i1.1888

Tlili, A., Zhao, J., Yang, K., Wang, Y., Bozkurt, A., Huang, R., Bonk, C. J., & Ashraf, M. A. (2024). Going beyond books to using e-books in education: A systematic literature review of empirical studies. *Interactive Learning Environments*, *32*(5), 2207–2231. https://doi.org/10.1080/10494820.2022.2141786

Tschofen, B. (2012). Challenging ethnography and cultural analysis bernhard tschofen heritage – contemporary uses of culture beyond the everyday ? *Taditiones*, *4*(2), 29–40. https://doi.org/10.3986/Traditio2012410202

Unaenah, E., Hidyah, A., Aditya, A. M., Yolawati, N. N., Maghfiroh, N., Dewanti, R. R., & Safitri, T. (2020). Teori brunner pada konsep bangun datar sekolah dasar. *Nusantara Jurnal Pendidikan Dan Ilmu Sosial*, *2*(2), 327–349. https://doi.org/10.36088/nusantara.v2i2.840

Wahyuni, R. T., Azizah, N., Nugroho, G. E., & Muslikhatul, S. (2025). Wordwall on the effectiveness , motivation , and interest in learning fraction : Voice from student version. *Kalamatika: Jurnal Pendidikan Matematika*, *10*(2), 1–16. https://doi.org/10.22236/KALAMATIKA.vol10no2.2025pp1-16

Zaini, R. A. D., Wiryanto, & Ekawati, R. (2023). International journal of current science research and review development of ethnomatematics-based e-book teaching materials to train numeracy skills in geometry materials in elementary schools. *International Journal of Current Science Research and Review*, *6*(6), 3408–3415. https://doi.org/10.47191/ijcsrr/V6-i6-33