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Heyzine Flipbook as a Learning Media: Development of a Digital Realistic Mathematics Education Module

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Abstract

Many students struggle with understanding congruence due to the abstract nature of mathematical concepts and the lack of contextual learning approaches. Existing digital learning modules often lack interactive features that support independent learning and real-world applications. This study aims to develop and evaluate an interactive digital module based on Realistic Mathematics Education (RME) to enhance students' conceptual understanding of congruence.This research follows the ADDIE model, consisting of analysis, design, development, implementation, and evaluation. The module was developed using Canva and integrated into Heyzine Flipbook for accessibility, incorporating interactive exercises via Liveworksheet for immediate feedback. The module was validated by three experts and tested on eight students from an accelerated learning program at MTs Negeri 1 Pacitan. Data collection included expert validation sheets, student questionnaires, and observations. The validity was assessed using the Content Validity Index (CVI), and practicality was determined through student response analysis. Results indicate that the module achieved a high validity score (S-CVI = 0.8) and was classified as highly practical, with student response scores averaging above 4.2 on a 5-point Likert scale. The integration of interactive features enhanced engagement and facilitated independent learning. These findings suggest that an interactive digital module grounded in RME principles effectively supports conceptual understanding and motivation in learning congruence. Future research should explore the effectiveness of this module across different mathematical topics and diverse student populations.

Keywords: Congruence , Digital Module, Realistic Mathematics Education

Abstrak

Banyak siswa mengalami kesulitan dalam memahami konsep kekongruenan karena sifatnya yang abstrak serta kurangnya pendekatan pembelajaran kontekstual. Modul pembelajaran digital yang ada sering kali tidak memiliki fitur interaktif yang mendukung pembelajaran mandiri dan penerapan dalam kehidupan nyata. Penelitian ini bertujuan untuk mengembangkan dan mengevaluasi modul digital interaktif berbasis Realistic Mathematics Education (RME) guna meningkatkan pemahaman konsep kekongruenan pada siswa. Penelitian ini menggunakan model ADDIE yang mencakup tahap analisis, desain, pengembangan, implementasi, dan evaluasi. Modul dikembangkan menggunakan Canva dan diintegrasikan ke dalam Heyzine Flipbook untuk aksesibilitas, serta dilengkapi dengan latihan interaktif melalui Liveworksheet yang memberikan umpan balik otomatis. Modul ini divalidasi oleh tiga ahli dan diuji coba pada delapan siswa dalam program percepatan di MTs Negeri 1 Pacitan. Pengumpulan data dilakukan melalui lembar validasi ahli, kuesioner siswa, dan observasi. Validitas modul dianalisis menggunakan Content Validity Index (CVI), sedangkan kepraktisan dinilai berdasarkan tanggapan siswa.Hasil penelitian menunjukkan bahwa modul memiliki tingkat validitas tinggi (S-CVI = 0,8) dan masuk dalam kategori sangat praktis, dengan skor rata-rata respons siswa di atas 4,2 pada skala Likert 5 poin. Integrasi fitur interaktif dalam modul meningkatkan keterlibatan siswa serta mendukung

pembelajaran mandiri. Temuan ini menunjukkan bahwa modul digital interaktif berbasis RME efektif dalam meningkatkan pemahaman konsep dan motivasi siswa dalam mempelajari kekongruenan. Penelitian selanjutnya disarankan untuk mengeksplorasi efektivitas modul ini pada topik matematika lainnya dan pada populasi siswa yang lebih beragam.

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INTRODUCTION

Mathematics plays a crucial role across various disciplines, from physics and engineering to economics and biology. A strong understanding of mathematical concepts enables individuals to develop critical thinking, abstract reasoning, and creative problem-solving skills, which are essential for addressing real-life challenges. The vision of mathematics is to orient the learning process toward a deep understanding of mathematical concepts and ideas, ensuring their effective application in problem-solving and interdisciplinary contexts (Hendriana & Soemarmo, 2014). In line with this vision, innovative learning approaches are needed to bridge abstract concepts with real-life experiences, making it easier for students to understand and apply mathematics in everyday situations.

Although mathematical problem-solving skills are crucial for developing critical and logical thinking, Indonesia's proficiency in this area remains low. This is evident from various studies, including the 2018 Program for International Student Assessment (PISA), which ranked Indonesia 74th out of 79 countries in mathematical literacy, with an average score of 379—well below the OECD average of 489 (OECD, 2019). Additionally, local studies indicate that many students struggle with applying mathematical concepts to real-world problems (Gumanti et al., 2022). This low performance highlights the need for innovative teaching methods and the development of more contextual and interactive learning materials to enhance students' mathematical problem-solving skills.

Realistic Mathematics Education (RME) is a context-based approach effective in enhancing mathematical problem-solving skills. It emphasizes the connection between mathematical concepts and real-world situations, fostering deeper and more applicable understanding (Aisyah & Madio, 2021; Ariyanti, 2016). Additionally, RME supports the development of students' computational thinking, enabling them to link mathematical theory with practical solutions in daily life (Batul et al., 2022). By implementing RME, students not only gain stronger conceptual understanding but also develop critical and systematic thinking skills essential for mathematical problem-solving (Supiarmo et al., 2022).

Technology, such as mathematical software, serves as an effective tool for engaging students in exploration and problem-solving. In the digital era, interactive digital modules enhance students' understanding of mathematical concepts through visual and contextual learning (Mahfudhah et al., 2022; Prasetyo & Wantoro, 2024). One innovative digital learning method is the flipbook, which presents materials dynamically and engagingly. When integrated with RME, flipbooks promote interactivity through illustrations, simulations, and contextual examples, helping

students bridge abstract concepts with real-world experiences. Additionally, their flexibility allows students to learn independently at their own pace, effectively improving conceptual understanding and problem-solving skills (Handayani et al., 2023).

Digital modules in flipbook format offer high accessibility and an interactive visual experience. Flipbooks enhance student motivation through dynamic and engaging presentations, as studies have shown that interactive digital learning media can boost interest, conceptual understanding, and student engagement (Fitriyah & Sahda, 2023; Haryanti & Saputro, 2016; Qomah & Khosiyono, 2022). One platform supporting flipbook development is Heyzine, chosen for its easy access without requiring downloads, making it a more practical and flexible tool for innovative learning (Erawati et al., 2022).

Previous studies have extensively explored the development of digital learning media based on Realistic Mathematics Education (RME) and its effectiveness in enhancing students' mathematical understanding. However, most research still relies on conventional formats such as PDFs or desktop-based applications, which are static, less interactive, and often require specific devices or installations, limiting accessibility and flexibility in learning (Suyanti et al., 2021). Furthermore, existing digital learning media have yet to fully optimize web-based technology, which enables real-time access, more intuitive navigation, and a more engaging and interactive learning experience.

In this context, research on the use of Heyzine Flipbook as a platform for RME-based digital modules remains limited. Heyzine Flipbook stands out for its ability to transform static content into dynamic, interactive learning materials with features such as animations, hyperlinks, and multimedia elements that enhance concept exploration. Additionally, its no-download access feature makes it more flexible for supporting remote and hybrid learning. This module not only improves accessibility and interactivity in mathematics learning but also provides a more contextual and engaging learning experience, potentially enhancing students' understanding and problem-solving skills. Therefore, this study aims to evaluate the feasibility of the developed RME-based digital mathematics module.

METHOD

This study employs the Research and Development (R&D) method, which aims to create and evaluate the effectiveness of an educational product (Sugiyono, 2013). To ensure a systematic development process, the study adopts the ADDIE model, consisting of five key stages: Analysis, Design, Development, Implementation, and Evaluation. This model is integrated into the R&D approach to ensure that the developed RME-based digital module aligns with students' needs and effectively enhances their representational skills and computational thinking in the topic of congruence.

In the Analysis stage, relevant curriculum materials are identified, along with an assessment of student and teacher needs for the learning module and an exploration of technological tools to support digital module development. The Design stage focuses on structuring the digital module based on RME principles, incorporating contextual problems and interactive navigation. During the Development stage, the module is created according to the planned design, followed by validation by experts, teachers, and students to assess feasibility, interactivity, and content relevance.

Finally, the Implementation stage involves testing the module in a learning environment to evaluate its effectiveness in practice. The final stage, Evaluation, aims to assess the effectiveness of the developed media by analyzing student responses through distributed questionnaires. This study

employs summative evaluation, conducted at the end of the research to refine the learning media, ensuring it becomes more optimal and effective for student learning.

This study involved eight eighth-grade students from MTs Negeri 1 Pacitan as subjects. The sample size was determined based on the school's unique characteristics, as MTs Negeri 1 Pacitan is the only junior high madrasah in Pacitan that offers a Semester Credit System (SKS) or accelerated learning program. This program is exclusively available to a select group of students who have passed academic and IQ tests to ensure their readiness for an accelerated curriculum. Within this program, students utilize Self-Directed Learning Units (UKBM) as their primary learning guide, developed in a digital module format for flexible access anytime and anywhere. Therefore, this study focuses on the development and implementation of an RME-based digital module within the context of flexible learning applied to this specialized group of students.

The data collection techniques in this study were aligned with the ADDIE framework to ensure a systematic evaluation of the RME-based digital module. During the Analysis stage, observations and interviews were conducted to identify the needs of students and teachers. The Design and Development stages involved documentation of the module creation process and expert validation. In the Implementation stage, questionnaires and tests were used to assess the module's effectiveness in enhancing students' conceptual understanding and skills. Finally, during the Evaluation stage, a combination of interviews, questionnaires, and tests was employed to gather feedback and assess the module's sustainability in the learning process.

The data analysis techniques in this study included reduction, presentation, and conclusion drawing for data obtained through observations, interviews, and documentation. Meanwhile, module validation data were analyzed using the Content Validity Index (CVI) by experts, and module practicality data were collected through student questionnaires. The validity criteria for the digital module were determined based on the following index (Guilford & Fruchter, 1978):

Table 1. Validity Criteria

CVI Score	Description
CVI < 0.0	Not valid
0.0 ≤ CVI < 0.2	Very low validity
0.2 ≤ CVI < 0.4	Low validity
0.4 ≤ CVI < 0.6	Moderate validity
0.6 ≤ CVI < 0.8	High validity
0.8 ≤ CVI < 1	Very high validity

Based on these criteria, the module is considered valid and ready for use if it falls at least within the moderate category, with a score of 0.4 ≤ CVI < 0.6.

Furthermore, the practicality of the digital module is determined based on student responses collected through a Likert scale (1-5) questionnaire. The total score is then calculated from student response ratings using the following formula:

Average score = (Total Questionnaire Score) / (Number of Respondents)

The practicality criteria for the digital module based on percentage categories are as follows (Sudjana, 1995):

Table 2. Practically Criteria

Average Score	Category
1,00 – 1,80	Highly Impractical
1,81 – 2,60	Impractical
2,61 – 3,40	Moderate
3,41 – 4,20	Practical
4,21 – 5,00	Highly Practical

Table 2 indicates that the e-module is considered effective in supporting the learning process if it falls within the practical or highly practical category.

RESULTS AND DISCUSSION

Results

The first stage of this research is analysis, which involves several sub-stages to ensure that the development of the digital module based on Realistic Mathematics Education (RME) aligns with students' needs and characteristics. First, a material analysis was conducted through interviews with mathematics teachers at MTs Negeri 1 Pacitan to identify mathematical concepts that students find difficult to understand, particularly in the topic of congruence. The results of these interviews served as a foundation for designing a module that addresses these learning challenges.

Additionally, a questionnaire distributed to 22 mathematics teachers from various MTs in Pacitan Regency revealed that many teachers struggle to teach the concept of congruence in a concrete and relevant manner. Based on the needs analysis, it was found that 72.7% of teachers faced difficulties in motivating students to grasp this material, highlighting the importance of developing an interactive module that connects mathematical concepts to real-life contexts.

Next, an analysis of student characteristics was conducted through observations and questionnaires to identify the challenges students face, particularly in understanding more abstract mathematical concepts such as congruence. The findings revealed that students tend to feel bored with monotonous material, highlighting the need for a visually engaging and contextually relevant module to enhance their understanding. Lastly, a literature review analysis indicated that while several studies have developed digital modules to support mathematical problem-solving, the integration of RME principles in these modules remains very limited. This underscores the importance of this research in developing a digital module based on RME that effectively helps students understand mathematical concepts in a more applicable and real-life-relevant manner.

The next step in the design phase involved establishing learning objectives aligned with the national curriculum and developing module content relevant to the concept of congruence in mathematics. The Realistic Mathematics Education (RME) approach was applied to ensure that students could understand mathematical concepts through real-life contexts. The module consists of several learning activities that progressively build an understanding of congruence, starting from observing congruent objects in the students' surroundings to applying congruence rules in solving geometric problems. In designing the user interface (UI), the researcher utilized Canva templates to select an engaging color palette and create a visually appealing, easy-to-read module layout. This ensures that students can easily follow and effectively engage with the learning materials.

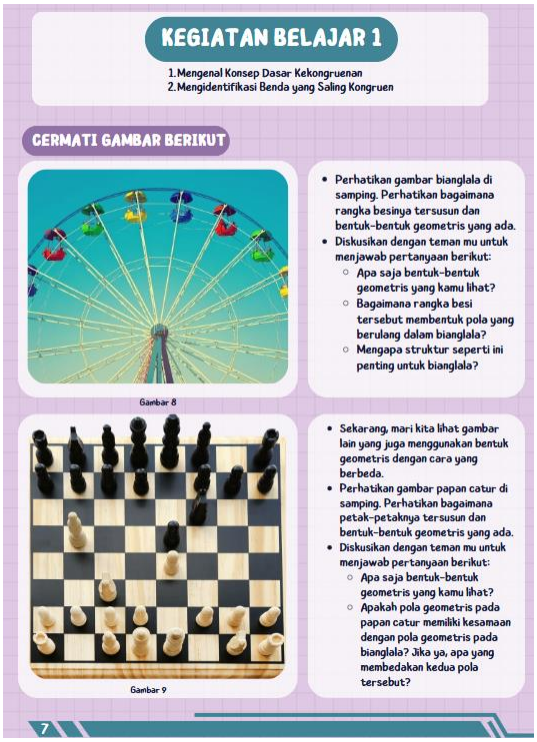

Figure 1. Module Content Display

Figure 1 presents the module's introductory section, which engages students in observing everyday objects based on the principles of Realistic Mathematics Education (RME). This approach connects the concept of congruence with real-life situations, making it easier for students to understand the material contextually and applicatively.

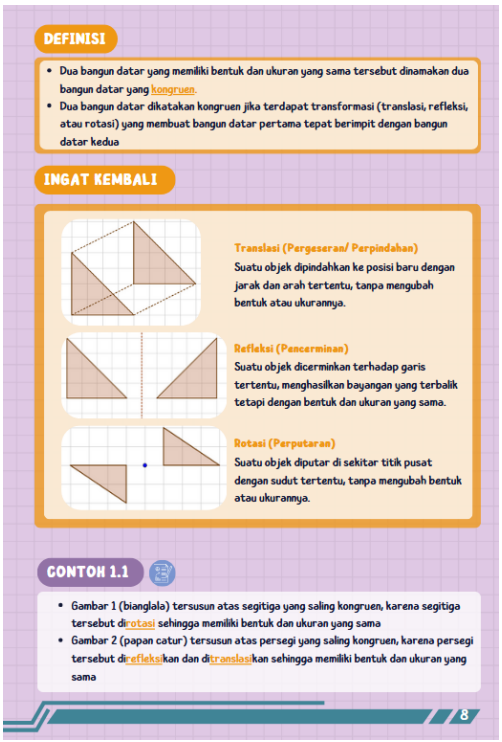

Figure 2. Definition Section Display

Figure 2 presents the concept of congruence with an engaging design. The "DEFINISI" section features a bright orange background to highlight the conditions for congruence, while the "INGAT KEMBALI" section illustrates geometric transformations with visuals. “CONTOH 1.1” incorporates a

Ferris wheel and a chessboard to connect the concept to real-world applications, making learning more visual and enjoyable.

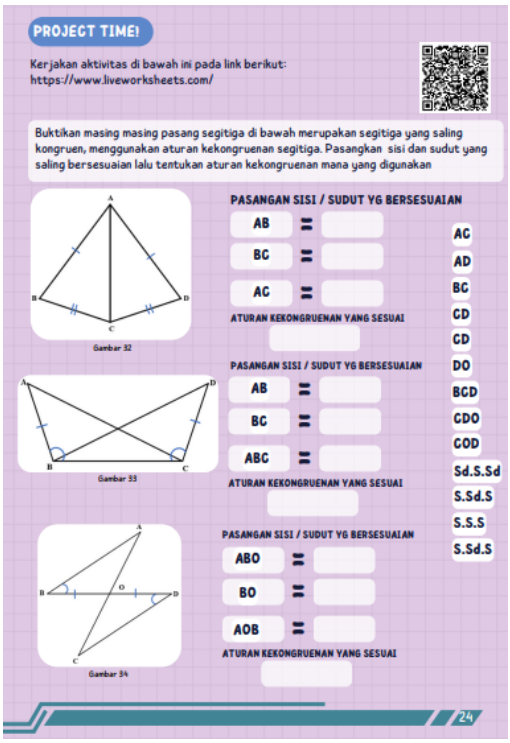

Figure 3. Project Section Display

Figure 3 presents the project section of the module, designed to provide an interactive learning experience. Developed using Canva and accessible via Heyzine Flipbook, the module is integrated with Liveworksheet, enabling students to complete exercises with real-time automated feedback. This integration enhances engagement, facilitates deeper conceptual understanding, and fosters active student participation.

Subsequently, in the Development phase, the digital module underwent validation by three experts from the Mathematics Education Study Program at Universitas Muhammadiyah Surakarta to ensure its quality and suitability. Content validation was conducted to assess the accuracy, clarity, and alignment of the material with the principles of Realistic Mathematics Education (RME), while media validation focused on evaluating the module's design, usability, and graphical consistency. The validation results are summarized in the following table:

Table 3. Expert Validation Results

No	Aspect	Validator 1	Validator 2	Validator 3
1	Content Feasibility	4,4	4,1	3,4
2	Language Clarity	5	4	3
3	Presentation	4,25	4,25	3,25
4	Module Design Layout	4	4,6	3,4
5	Ease of Use	4	4	4
6	Consistency	4	5	3,3
7	Graphic Quality	4,75	4	3,75

Based on Table 2, the expert scores were analyzed using the Content Validity Index (CVI) to quantitatively assess the module's validity. The first step involved converting the Likert scale scores (1-5) into binary data, where scores of 1-3 were categorized as "not relevant" (0), and scores of 4-5 as

"relevant" (1). Next, the Item-Level Content Validity Index (I-CVI) was calculated for each item by dividing the number of experts who rated the item as relevant (1) by the total number of experts. Once I-CVI was determined for all items, the Scale-Level Content Validity Index (S-CVI) was computed. S-CVI includes two types: S-CVI/Ave, which represents the average of all I-CVI values, and S-CVI/UA, which is obtained by dividing the number of items with Universal Agreement (UA = 1) by the total number of items. These S-CVI values provide an overall measure of the instrument's validity.

The results of the validation test indicate that the module obtained an S-CVI score of 0.8, which falls within the high validity category. This score demonstrates that both the content and media within the module are deemed appropriate and meet the necessary quality criteria to effectively support the learning process.

The next step in the implementation stage was the module development test to ensure that the design and interactive features functioned optimally. A small-scale trial was conducted with three eighth-grade students to identify technical errors, usability challenges, and the overall effectiveness of the interface and navigation. The trial revealed several areas for improvement, including the font size on page 6, which was too small, the background color on page 17, which was too bright, and the color-text combination on page 8, which lacked contrast and reduced readability.

Additionally, students suggested improving text readability and providing an offline version of the module for easier access. Based on this feedback, revisions were made by adjusting the font size and contrast to enhance readability, modifying the color scheme for better visual clarity, and adding an offline version of the module in PDF format to increase accessibility. These refinements ensure that the module is more user-friendly, accessible, and effective in supporting students' learning experiences.

Next, a validation test was conducted in an eighth-grade class at MTs Negeri Pacitan through direct observation and questionnaires as an evaluation of the developed digital module. The observation assessed students' interactions with the module, while the questionnaire evaluated user experience, material effectiveness, and accessibility. The results of the student response questionnaire are presented in the following table.

Table 4. Results of the Practicality Questionnaire

No	Aspect	Average Score	Category
1	Presentation	4,48	Highly Practical
2	Engagement	4,59	Highly Practical
3	Ease of Use	4,54	Highly Practical

Based on Table 4, the overall score exceeds 4.2, indicating that the module falls into the highly practical category. The high validity scores from experts contribute to the module's practicality, as the refined design and content facilitate students' understanding of the material. Therefore, this module not only meets academic standards but is also user-friendly and effective in supporting the learning process.

Discussion

This study developed a digital module based on Realistic Mathematics Education (RME) through five key stages of the ADDIE model: analysis, design, development, implementation, and evaluation.

In the analysis stage, a thorough examination was conducted on teacher needs, student characteristics, learning materials, and relevant literature. The findings revealed that teachers often

struggle to convey the concept of congruence effectively, highlighting the necessity for more innovative learning media. The study by St. Goar & Lai (2021) emphasized that a contextual approach in geometry enhances students' understanding, supporting the notion that the RME approach is more effective in connecting mathematics to real-life experiences.

In the design stage, the module was developed using Canva due to its flexibility in creating visually appealing, engaging, and interactive learning media. Studies by Rahmasari & Yogananti (2021) and Kharissidqi & Firmansyah (2022) indicate that attractive graphic design enhances students' attention and motivation, aligning with multimedia learning theory, which emphasizes the importance of combining text, images, and colors to improve comprehension.To enhance accessibility, the module was packaged in a flipbook format using Heyzine, allowing students to access materials easily without the need to download large files. Research by Fitriyah & Sahda (2023) and Erawati et al. (2022) suggests that digital flipbooks can boost learning motivation due to their dynamic and interactive presentation.

The uniqueness of this module compared to other learning media lies in the integration of interactive Liveworksheet features, allowing students to directly complete exercises within the module with automatic feedback. This sets it apart from PDF-based modules or digital textbooks, which are static in nature. This approach aligns with trends in digital learning innovation, emphasizing interactivity, gamification, and flexible self-directed learning. With a combination of visually appealing design, easy access through flipbook format, and direct practice features, this module offers a more engaging learning experience compared to conventional educational media.

Implication of Research

This study has important implications for educators, researchers, and policymakers. For educators, the interactive digital module based on Realistic Mathematics Education (RME) offers an engaging tool to enhance students' understanding of congruence, supporting self-paced and contextual learning. Researchers can build on this work by exploring its effectiveness in different settings or integrating advanced technologies for adaptive learning. For policymakers, the study highlights the need for digital resources in curricula and teacher training to maximize technology-enhanced instruction. Overall, this research contributes to the advancement of innovative and student-centered mathematics education.

Limitation

This study has several limitations. The small sample size of eight students from an accelerated class limits generalizability. Additionally, the study focuses only on congruence, leaving the module's effectiveness for other topics untested. Lastly, the controlled learning environment may not fully reflect real classroom dynamics. Future research should explore the module's impact on a larger and more diverse student population.

CONCLUSION

The interactive digital module based on Realistic Mathematics Education (RME) was successfully developed to meet the learning needs of teachers and students at MTs Negeri 1 Pacitan. This module demonstrates a high level of validity and falls into the "highly practical" category, as evidenced by validation and practicality test results. Its uniqueness lies in the integration of interactive features through Liveworksheet, allowing students to complete exercises directly within the module with automatic feedback, making it more dynamic compared to conventional modules.

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