Heyzine-Based interactive media for teaching plane geometry in elementary schools

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Abstract

Geometry learning, particularly plane geometry topics at the elementary school level, still faces various challenges, especially related to students' understanding of abstract concepts and low learning motivation. Conventional instructional media that rely mainly on textbooks and verbal explanations are often insufficient to accommodate the learning characteristics of elementary school students who require concrete visualization and direct interaction. This study aims to examine students' responses to the use of Heyzine flipbook-based interactive media in plane geometry learning at the elementary school level. This study employed a descriptive survey design involving a single class of second-grade elementary school students to evaluate students' responses toward the implementation of Heyzine-based interactive media in plane geometry learning.The research instrument was a student response questionnaire covering aspects of presentation, content, and language. Data were analyzed using descriptive percentage techniques. The results showed that the Heyzine-based interactive media obtained a feasibility percentage of 93.33%, which was categorized as very feasible. Overall, these findings indicate that Heyzine flipbook-based interactive media can effectively support plane geometry learning and enhance students' interest and conceptual understanding, future studies are recommended to investigate the effectiveness of Heyzine-based media on students' learning outcomes through experimental research designs involving larger samples and different educational levels.

Keywords: elementary school, heyzine, interactive media, mathematics learning, plane geometry

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INTRODUCTION

Geometry is one of the fundamental branches of mathematics education at the elementary school level because it plays an essential role in developing students' spatial, logical, and visual thinking skills. Through geometry learning, students are trained to recognize shapes, understand spatial relationships, and develop visualization abilities that form the basis for solving both mathematical and non-mathematical problems (Van de Walle, Karp, & Bay-Williams, 2019). At the elementary level, plane geometry topics such as squares, rectangles, triangles, and simple circles represent foundational concepts that students must master before learning more complex geometry at higher levels of education

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(Clements & Sarama, 2018).

Understanding plane geometry concepts is not limited to the ability to recognize and name shapes, but also includes understanding their properties, relationships among shapes, and the ability to connect these concepts to real-life situations (NCTM, 2020). Students with strong geometric understanding tend to develop better mathematical reasoning, mathematical communication, and higher-order thinking skills from an early age (Battista, 2018). Therefore, plane geometry instruction at the elementary school level should be designed to be meaningful, contextual, and aligned with students' cognitive development.

However, both research findings and classroom practices indicate that teaching plane geometry in elementary schools still encounters several difficulties. Students often struggle to distinguish between plane shapes with similar characteristics, understand basic mathematical terms such as sides, angles, and vertices, and connect abstract geometric representations with concrete objects in their surrounding environment (Nurhayati & Hadi, 2021; Yusuf & Widyaningsih, 2020). These difficulties frequently result in low learning interest in geometry and negatively affect students' overall mathematics achievement. Despite the increasing availability of digital learning resources, interactive instructional media specifically designed to support early-grade plane geometry learning remain limited, particularly those that integrate visualization, interactivity, and accessibility within a single platform. This gap highlights the need for innovative, child-friendly, and technology-based media that can effectively facilitate students' conceptual understanding and engagement in plane geometry learning.

One of the main factors contributing to these problems is the dominance of conventional, teacher-centered learning approaches and the limited use of varied instructional media (Suryani, Setiawan, & Putria, 2018). Learning activities that rely solely on textbooks and verbal explanations are often unable to meet the learning needs of elementary school students who are in the concrete operational stage, as proposed by Piaget (Slavin, 2020). At this stage, students require learning experiences involving visualization, object manipulation, and direct interaction to optimally understand mathematical concepts.

Along with rapid technological advancements and changes in student characteristics as digital natives, the demand for innovative instructional media has become increasingly significant. Today's students grow up in environments closely connected to technology, dynamic visuals, and digital interaction, making traditional instructional approaches less relevant and less engaging for them (Prensky, 2018). Interactive learning media are considered a strategic solution to address these challenges because they can present learning materials in a visual, dynamic, and contextual manner while encouraging active student engagement (Mayer, 2020).

Interactive media offer advantages in supporting students' meaningful conceptual understanding through the integration of text, images, animations, audio, and interactive exercises (Arsyad, 2020). In the context of geometry learning, interactive media can help concretize abstract concepts, visualize the properties of plane shapes, and strengthen the connections between visual and symbolic representations (Wahyudi & Anugraheni, 2017). This study contributes scientifically by providing empirical evidence on the feasibility and acceptance of Heyzine-based interactive flipbook media for early-grade plane geometry learning, and practically by offering teachers a flexible, accessible, and user-friendly digital instructional resource that can enhance student engagement and conceptual understanding in elementary mathematics classrooms.

One digital medium with strong potential to support elementary mathematics learning is Heyzine Flipbook. Heyzine is a digital platform that allows instructional materials to be presented in the form of interactive digital books enriched with images, animations, audio, videos, and linked practice activities.

Digital flipbook-based media are considered effective because they combine the reading experience of printed books with the advantages of interactive multimedia (Kurniawan & Purnomo, 2022). In addition, Heyzine can be accessed via various devices, including computers, tablets, and smartphones, offering high flexibility for both teachers and students.

The use of Heyzine in mathematics instruction, particularly for early-grade plane geometry topics, represents a specific novelty because it integrates interactive digital flipbook features, child-friendly visual design, and cross-device accessibility within a single learning platform. Unlike previous studies that mainly focused on the development or effectiveness of general digital flipbooks in mathematics learning (Putri & Sari, 2021; Rahmawati et al., 2022), this study specifically investigates the implementation of the Heyzine platform for second-grade plane geometry instruction and emphasizes students' responses as indicators of media feasibility. Previous research reported improvements in learning motivation and conceptual understanding through digital flipbooks; however, limited attention has been given to early-grade geometry topics and the systematic evaluation of student acceptance toward platform-based interactive flipbooks. Therefore, this study fills this gap by providing focused empirical evidence on the feasibility of Heyzine-based interactive media in elementary plane geometry learning.

Based on the above discussion, it can be concluded that innovative instructional media are needed to address challenges in teaching plane geometry at the elementary school level while aligning with technological developments and student characteristics. Therefore, this study aims to describe the implementation of Heyzine-based interactive media in teaching plane geometry at elementary schools and to analyze students' responses to its use as a basis for developing more effective and meaningful mathematics learning.

METHODS

This study employed a quantitative approach using a descriptive survey design to describe the implementation and students' responses toward the use of Heyzine-based interactive media in learning plane geometry at the elementary school level. A descriptive survey design was selected because the primary objective of the research was not to test hypotheses or examine causal relationships, but to systematically portray students' perceptions, acceptance, and responses toward the implemented learning media based on measurable indicators. This design is appropriate for evaluating educational innovations, particularly media feasibility and user responses, through numerical data presented in the form of percentages and descriptive statistics (Sugiyono, 2021).

The research was conducted in an elementary school during mathematics instruction on plane geometry material. The participants of this study consisted of 23 second-grade elementary school students. The selection of participants used a total sampling technique, in which all students in the class were involved as research subjects. This technique was chosen because the population size was relatively small and homogeneous, allowing the researcher to obtain comprehensive data from the entire group without sampling bias (Fraenkel, Wallen, & Hyun, 2019). All participants followed the same curriculum and had similar learning experiences, and none had previously used Heyzine-based interactive media in geometry learning, ensuring that their responses reflected authentic first-time experiences.

The learning media implemented in this study was an interactive digital flipbook developed using the Heyzine platform. The media was designed to support plane geometry learning by presenting

concepts such as squares, rectangles, triangles, and circles through visual illustrations, simple explanations, audio narration, and interactive exercises. The media emphasized colorful layouts, child-friendly language, and visual representations to align with the cognitive characteristics of elementary school students in the concrete operational stage. During implementation, the teacher used the media as the main instructional resource, while students interacted directly with the flipbook through guided classroom activities.

Data collection in this study was conducted using a student response questionnaire administered after the learning activities were completed. The questionnaire was designed to measure students' perceptions of the learning media based on three main aspects: presentation, content/material, and language. The instrument employed a Likert-type scale ranging from 1 to 5, where higher scores indicated more positive responses toward the media. The questionnaire items were developed based on media evaluation criteria commonly used in educational research, ensuring that each item reflected observable and measurable indicators relevant to elementary school learners. The indicators used in the student response questionnaire are presented in Table 1.

Table 1. Indicators of Student Response Questionnaire

Aspect	Indicators
Presentation	Visual attractiveness of the media, clarity of images and illustrations, ease of navigation, use of colors and layout, interactivity of features
Content/Material	Relevance of material to learning objectives, clarity of concept explanation, suitability of material with students' level, usefulness of examples and exercises
Language	Simplicity of language, clarity of sentences, readability for elementary students, appropriateness of terms used

Based on these indicators, the questionnaire was then elaborated into several statement items. The distribution of questionnaire items across aspects and indicators is shown in Table 2.

Table 2. Questionnaire Blueprint (Instrument Grid)

Aspect	Indikator	Item Number
Presentation	Attractive appearance	1
	Easy navigation	2
	Clear illustrations	3
Content/Material	Easy-to-understand explanations	4
	Relevance to learning objectives	5
	Helpful examples and exercises	6
Language	Simple and clear language	7
	Appropriate vocabulary	8
	Easy to read and understand	9

Before being administered to students, the questionnaire was validated by two elementary school teachers with experience in mathematics instruction for lower-grade students. The validation process focused on the clarity of language, readability, and suitability of the questionnaire items for second-grade elementary school students. The validators assessed each item using a five-point scale ranging from 1 (very inappropriate) to 5 (very appropriate). The average validation score obtained was 4.6 out of 5, indicating that the instrument was categorized as highly valid and appropriate for use in this study. Suggestions provided by the validators were used to refine the wording and simplify several statements to ensure that all items could be easily understood by young learners.

The procedure of the research was conducted in several stages. First, the researcher prepared the Heyzine-based interactive media and aligned the content with the plane geometry material in the elementary school curriculum. Second, the media was implemented during mathematics learning activities, where students interacted directly with the flipbook under the teacher's guidance. Third, after the learning session was completed, students were asked to fill out the response questionnaire with assistance from the teacher to ensure accurate understanding of each statement. Fourth, the collected data were compiled and analyzed quantitatively.

Data analysis was carried out using descriptive percentage analysis. Each student's response score was summed and converted into a percentage using the following formula:

$$\text{Percentage} = \frac{\text{Obtained Score}}{\text{Maximum Score}} \times 100\%$$

The resulting percentages were then interpreted using predetermined feasibility criteria. The classification of feasibility levels is shown in Table 3.

Table 3. Feasibility Criteria Based on Percentage Scores

Percentage Range	Category
81% – 100%	Very Feasible
61% – 80%	Feasible
41% – 60%	Moderately Feasible
21% – 40%	Less Feasible
0% – 20%	Not Feasible

The percentage scores were calculated for each aspect (presentation, content, and language) as well as for the overall media evaluation. The final results were presented in the form of tables and descriptive explanations to provide a comprehensive overview of students' responses toward the Heyzine-based interactive media.

Through this methodological approach, the study aimed to obtain valid and systematic data regarding students' acceptance and perceptions of the implemented learning media, thereby providing empirical evidence on the feasibility of Heyzine-based interactive media for teaching plane geometry in elementary schools.

RESULTS AND DISCUSSION

The results of this study were obtained from the analysis of student response questionnaires administered after the implementation of Heyzine-based interactive media in learning plane geometry. The questionnaire aimed to capture students' perceptions of the media across three main aspects: presentation, content/material, and language. The analysis focused on descriptive statistics in the form of mean scores and percentage values to determine the feasibility level of the media.

The overall results of student responses indicate a very positive perception of the Heyzine-based interactive media. Table 4 presents the recapitulation of student response scores across all aspects. During the implementation process, students actively interacted with the Heyzine-based interactive flipbook during classroom learning activities. The teacher first introduced the plane geometry material using the digital flipbook displayed through a projector, followed by guided student interaction with the media. Students were observed exploring the flipbook pages, identifying geometric shapes, listening to audio explanations, and completing interactive exercises embedded within the media. Most students showed enthusiasm and active participation during the learning process, particularly when answering practice questions and matching geometric shapes with objects found in their daily environment.

The implementation process also revealed that the interactive features of the Heyzine media helped students maintain attention and participate more confidently during classroom discussions. Several students were able to correctly identify shapes such as squares, rectangles, triangles, and circles after interacting with the visual illustrations and exercises provided in the flipbook. These observations indicate that the Heyzine-based interactive media not only attracted students' interest but also facilitated active engagement during the learning process.

Table 4. Recapitulation of Student Response Scores

No	Aspect	Obtained Score	Maximum Score	Percentage (%)	Category
1	Presentation	331	368	90.00	Very feasible
2	Content	346	368	94.00	Very feasible
3	Language	353	368	96.00	Very feasible
	Average	1,030	1,104	93.33	

Based on Table 4, the Heyzine-based interactive media achieved an average feasibility percentage of 93.33%, categorized as very feasible, indicating that the media was highly accepted by students. The presentation aspect included visual attractiveness, clarity of illustrations, ease of navigation, and the level of interactivity of the media.

Table 5. Students' Responses on the Presentation Aspect

No	Indikator	Obtained Score	Maximum Score	Percentage (%)	Category
1	Attractive visual appearance	85	92	92.4	Very Feasible
2	Clear images and illustrations	82	92	89.1	Very Feasible
3	Ease of flipbook navigation	80	92	87.0	Very Feasible
4	Media interactivity	84	92	91.3	Very Feasible
	Average	331	368	90.0	Very Feasible

These results indicate that most students were interested in the visual design of the media and found the Heyzine flipbook easy to use during learning activities. The content aspect covered the clarity of plane geometry concepts, suitability to students' developmental levels, relevance to learning objectives, and the usefulness of examples and exercises.

Table 6. Students' Responses on the Content Aspect

No	Indikator	Obtained Score	Maximum Score	Percentage (%)	Category
1	Clear explanation of concepts	87	92	94.6	Very Feasible
2	Content suitability to students' level	85	92	92.4	Very Feasible
3	Alignment with learning objectives	88	92	95.7	Very Feasible
4	Examples and exercises support understanding	86	92	93.5	Very Feasible

Average	346	368	94.0	Very Feasible

Table 6 show that the Heyzine-based media strongly supported students' understanding of plane geometry concepts in a systematic and concrete manner. The language aspect included simplicity of language, clarity of sentences, text readability, and appropriateness of mathematical terminology.

Table 7. Students' Responses on the Language Aspect

No	Indicator	Obtained Score	Maximum Score	Percentage (%)	Category
1	Language is easy to understand	89	92	96.7	Very Feasible
2	Sentences are clear and simple	88	92	95.7	Very Feasible
3	Text is easy to read	87	92	94.6	Very Feasible
4	Appropriate mathematical terminology	89	92	96.7	Very Feasible
	Average	353	368	96.0	Very Feasible

The findings of this study indicate that the implementation of Heyzine-based interactive media in teaching plane geometry at the elementary school level was perceived as highly feasible by students, as evidenced by an overall feasibility percentage of 93.33%. For second-grade elementary students who are in the concrete operational stage, this result demonstrates that visual, colorful, and interactive learning media are highly effective in supporting their need for concrete representations of abstract mathematical concepts. At this developmental stage, students require direct visual experiences and simple interactions to understand geometric properties, shapes, and relationships (Slavin, 2020; Clements & Sarama, 2014). Therefore, the use of Heyzine-based interactive media is particularly suitable for early-grade learners, as it facilitates conceptual understanding while maintaining high learning motivation (Hidayat & Irawan, 2021; Yusuf & Widyaningsih, 2020).

The high score obtained in the presentation aspect highlights the importance of visual and interactive elements in elementary mathematics instruction. According to Mayer (2020), multimedia learning theory emphasizes that students learn more effectively when information is presented through a combination of words and visuals rather than text alone. The use of colorful illustrations, dynamic layouts, and interactive flipbook navigation in Heyzine aligns with this principle and helps reduce cognitive load while enhancing students' engagement. Similar findings were reported by Putri and Sari (2021), who found that visually attractive digital media significantly increased students' motivation and attention during mathematics learning (Rizal & Yusof, 2018).

The content/material aspect also achieved a very high percentage, indicating that the media effectively facilitated students' understanding of plane geometry concepts. This finding supports the view that geometry learning should emphasize conceptual understanding rather than rote memorization (Battista, 2018). By presenting plane shapes through visual representations and contextual examples, the Heyzine-based media helped students connect abstract geometric concepts with concrete objects in their environment. Clements and Sarama (2018) largue that such visual-conceptual connections are essential for developing early geometric thinking in children.

Moreover, the high score in the language aspect underscores the critical role of language clarity in elementary mathematics learning. Elementary school students often struggle with mathematical terminology, which can hinder their conceptual understanding (Van de Walle et al., 2019). The use of simple, clear, and age-appropriate language in the Heyzine-based media contributed to students' positive responses and facilitated smoother comprehension of geometric concepts. This result is consistent with

the findings of Wahyudi and Anugraheni (2017), who reported that student-friendly language in instructional media significantly improves learning effectiveness.

The overall positive student responses also indicate that Heyzine-based interactive media can enhance students' learning motivation. Motivation is a key factor influencing students' engagement and achievement in mathematics (Slavin, 2020). Interactive features such as animations, clickable pages, and embedded exercises create a learning environment that is more enjoyable and less intimidating for young learners. Prensky (2010) emphasizes that digital-native students are more responsive to interactive and technology-enhanced learning environments than to traditional instructional approaches.

Furthermore, the findings of this study align with previous research demonstrating the effectiveness of digital flipbook-based media in mathematics education. Rahmawati et al. (2022) found that interactive flipbooks improved students' conceptual understanding and learning independence. Similarly, Kurniawan and Purnomo (2022) reported that flipbook-based learning media increased student engagement and facilitated self-paced learning. The consistency of these findings suggests that Heyzine-based media share similar advantages and can be effectively integrated into elementary mathematics instruction.

From a pedagogical perspective, the use of Heyzine-based interactive media supports student-centered learning by allowing students to actively interact with learning content rather than passively receiving information. This approach aligns with constructivist learning theory, which emphasizes that knowledge is actively constructed by learners through interaction and experience (Fosnot, 2013). By engaging with visual representations and interactive elements, students are encouraged to explore and internalize geometric concepts more deeply. Practically, teachers can integrate Heyzine into plane geometry lessons by using the flipbook as a main instructional medium during classroom explanations, guided practice, and independent learning activities. Teachers may display the flipbook using projectors or interactive whiteboards while simultaneously allowing students to access it individually through tablets or smartphones. The embedded visuals, animations, and exercises can be used to demonstrate geometric properties, provide examples, and reinforce understanding through interactive tasks, thereby creating a more engaging and meaningful learning experience for second-grade students.

Despite the positive findings, it is important to note that this study focused on student responses rather than direct measurements of learning outcomes. Therefore, while the results indicate high feasibility and acceptance, further research is needed to examine the impact of Heyzine-based interactive media on students' achievement and long-term conceptual understanding. Experimental or quasi-experimental studies comparing learning outcomes between students using interactive media and those using conventional methods would provide more comprehensive evidence of effectiveness (Fraenkel et al., 2019).

The findings of this study are consistent with the research objective, namely to describe the implementation of Heyzine-based interactive media and students' responses toward its use in plane geometry learning at the elementary school level. The results demonstrate that students responded positively to the media across the aspects of presentation, content, and language, indicating that the media was well accepted and appropriate for classroom implementation. In addition, observations during the learning activities showed that students actively engaged with the interactive features and participated enthusiastically in geometry exercises provided through the flipbook.

In summary, the results and discussion demonstrate that Heyzine-based interactive media are highly feasible for teaching plane geometry at the elementary school level. The media effectively support visual learning, conceptual understanding, language clarity, and student engagement. These findings are

supported by multimedia learning theory proposed by Richard E. Mayer, which emphasizes that students learn more effectively when verbal explanations are integrated with visual and interactive representations (Mayer, 2020). Furthermore, the findings align with constructivist learning theory, which states that students construct knowledge actively through interaction and learning experiences (Fosnot, 2013). Therefore, the Heyzine-based interactive flipbook can serve as an innovative and pedagogically appropriate instructional medium for elementary mathematics learning, particularly in plane geometry topics.

CONCLUSION

This study concludes that the implementation of Heyzine-based interactive media in teaching plane geometry at the elementary school level was positively received by students and can support mathematics learning in a more interactive and meaningful manner. The use of visual, interactive, and technology-enhanced media provides learning experiences that are appropriate for elementary school students, particularly those in the concrete operational stage who require visual representations and active engagement to understand abstract mathematical concepts.

The findings indicate that Heyzine-based interactive media can facilitate classroom learning by creating a more engaging learning environment and supporting students' participation during learning activities. The integration of visual illustrations, interactive exercises, and simple language within the digital flipbook helped students interact more actively with plane geometry material and encouraged greater learning interest during classroom instruction. From a pedagogical perspective, this study highlights the importance of integrating interactive digital media into elementary mathematics instruction to support student-centered learning. The use of multimedia elements and interactive activities aligns with multimedia learning theory and constructivist learning principles, which emphasize that students learn more effectively through visual representations, interaction, and active knowledge construction.

Practically, Heyzine-based interactive media can serve as an alternative instructional resource for elementary school teachers in teaching plane geometry topics. Teachers may utilize the digital flipbook during classroom explanations, guided activities, and independent learning to create more innovative and meaningful mathematics learning experiences. Therefore, this study contributes to the development of technology-based instructional media in elementary mathematics education and provides a reference for future implementation of interactive learning media in primary classrooms.

Overall, the results confirm that Heyzine-based interactive media is an effective instructional tool for teaching plane geometry in elementary schools. The integration of multimedia elements within a digital flipbook format provides an engaging, accessible, and pedagogically sound learning environment. From an academic perspective, this study contributes to the growing body of literature on interactive digital learning media by providing empirical evidence on the feasibility and acceptance of platform-based flipbooks specifically for early-grade geometry instruction. Furthermore, this research extends previous studies by focusing on student responses as a key indicator of instructional media effectiveness in elementary mathematics education.

Practically, Heyzine can be utilized by teachers as an alternative to traditional textbooks by serving as a primary learning resource during classroom instruction, guided practice, and independent learning activities. Teachers can integrate the flipbook into daily lessons using projectors or interactive displays while allowing students to access it individually through digital devices. The interactive features,

visual illustrations, and embedded exercises can help teachers explain geometric concepts more concretely, provide immediate reinforcement, and create a more engaging and student-centered learning environment. Therefore, Heyzine-based interactive media offer a practical and innovative solution to enhance the quality of plane geometry instruction in elementary schools.

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REFERENCES

Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*, 20, 1–11. https://doi.org/10.1016/j.edurev.2016.11.002

Arsyad, A. (2020). *Media pembelajaran* (Revised ed.). Jakarta: Rajawali Pers.

Battista, M. T. (2018). The development of geometric and spatial thinking. In F. K. Lester (Ed.), Second handbook of research on mathematics teaching and learning (pp. 843–908). Charlotte, NC: Information Age Publishing.

Clements, D. H., & Sarama, J. (2018) Learning and teaching early math: The learning trajectories approach (2nd ed.). New York, NY: Routledge.

Çetin, E., & Demircan, H. Ö. (2020). The effect of interactive digital learning materials on elementary students' mathematics achievement and motivation. *International Journal of Instruction*, 13(3), 109–126.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). How to design and evaluate research in education (10th ed.). New York, NY: McGraw-Hill Education.

Fosnot, C. T. (2018) Constructivism: Theory, perspectives, and practice (2nd ed.). New York, NY: Teachers College Press.

Hidayat, R., & Irawan, A. (2021). Students' responses toward interactive digital learning media in elementary schools. *Journal of Primary Education*, 10(2), 98–107.

Huang, Y. M., & Chiu, P. S. (2021). The effectiveness of interactive digital learning environments on students' conceptual understanding. Computers & Education, 164, 104121. https://doi.org/10.1016/j.compedu.2021.104121

Hwang, G. J., Wu, P. H., & Ke, H. R. (2018). An interactive concept map approach to supporting mobile learning activities. Computers & Education, 57(4), 2272–2280.

Kervin, L., & Mantei, J. (2021). Digital tools and children's learning: A critical review. Computers & Education, 165, 104149.

Kurniawan, D., & Purnomo, E. A. (2022). Digital flipbook-based learning media development to improve elementary students' learning motivation. Journal of Educational Technology, 16(2), 145–156.

Lai, C. L., & Hwang, G. J. (2020). A self-regulated flipped classroom approach to improving students' learning performance in mathematics. Computers & Education, 160, 104034.

Mayer, R. E. (2020). Multimedia learning (3rd ed.). Cambridge: Cambridge University Press.

Moreno, R., & Mayer, R. E. (2018) Interactive multimodal learning environments. Educational Psychology Review, 19(3), 309–326.

National Council of Teachers of Mathematics (NCTM). (2020). Principles to actions: Ensuring mathematical success for all. Reston, VA: Author.

Nikou, S., & Economides, A. A. (2019). Mobile-based interactive learning: Effects on students' motivation and achievement. Educational Technology & Society, 22(2), 78–91.

Nurhayati, S., & Hadi, S. (2021). Analysis of elementary students' difficulties in learning plane geometry. Jurnal Pendidikan Matematika, 15(1), 33–44.

OECD. (2019). Innovating education and educating for innovation: The power of digital technologies and skills. Paris: OECD Publishing.

Prensky, M. (2018). Teaching digital natives: Partnering for real learning. Thousand Oaks, CA: Corwin.

Putri, R. I. I., & Sari, P. R. (2021). The effectiveness of digital flipbook media in mathematics learning. Journal on Mathematics Education, 12(3), 457–470.

Rahmawati, D., Lestari, I., & Fitria, Y. (2022). Interactive learning media based on digital flipbooks to enhance students' conceptual understanding. International Journal of Instruction, 15(2), 123–138.

Rizal, S., & Yusof, Y. M. (2018). Digital learning materials and students' engagement in mathematics learning. International Journal of Academic Research in Business and Social Sciences, 8(12), 1120–1132.

Sanjaya, W. (2019). Perencanaan dan desain sistem pembelajaran. Jakarta: Kencana.

Schindler, L. A., et al. (2017). Computers in education: A meta-analysis. International Journal of Educational Technology in Higher Education, 14(1), 25.

Slavin, R. E. (2020). Educational psychology: Theory and practice (13th ed.). Boston, MA: Pearson Education.

Sugiyono. (2021). Metode penelitian kuantitatif, kualitatif, dan R&D. Bandung: Alfabeta.

Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning. Computers & Education, 94, 252–275.

Suryani, N., Setiawan, A., & Putria, A. (2018). Media pembelajaran inovatif dan pengembangannya. Bandung: Remaja Rosdakarya.

Teo, T., Fan, X., & Du, J. (2021). Technology acceptance among primary students. Educational Technology Research and Development, 69, 2675–2695.

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2019). Elementary and middle school mathematics: Teaching developmentally (10th ed.). New York, NY: Pearson.

Wahyudi, & Anugraheni, I. (2017). Strategy to improve students' mathematical understanding using interactive learning media. International Journal of Science and Research, 6(8), 1114–1119.

Wu, T. T., & Huang, Y. M. (2022). Interactive digital media in elementary mathematics learning. Journal of Educational Computing Research, 60(3), 743–769.

Yusuf, I., & Widyaningsih, S. W. (2020). Implementing e-learning-based virtual laboratory media to students' metacognitive skills. International Journal of Emerging Technologies in Learning (iJET), 15(5), 63-74. Akses Artikel di iJET

Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker, J. F. (20018) Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. Information & Management, 43(1), 15–27.