Electronic Journal of Education, Social Economics and Technology
Vol. 6, No. 1, (2025), pp. 690-702
ISSN 2723-6250 (online)
DOI: https://doi.org/10.33122/ejeset.v6i1.658

SAINTIS publishing

Research Article

Development of the Geo-Food Board Game to Improve Geometry Skills Based on Van Hiele's Levels of Thinking in Fourth Grade Elementary Students

Laurencia Lucia Rosok Klau Muti*, Dani Kusuma

Elementary School Teacher Education Study Program, Universitas Kristen Satya Wacana, Salatiga, Indonesia, 50711
*Corresponding Author: laurenluciaaa@gmail.com | Phone: 08953832260004

ABSTRACT

The lack of interactive learning media in mathematics education, particularly in geometry, often makes it difficult for students to understand the material and leads to boredom during learning. Therefore, there is a need for game-based media that engages students and encourages active participation in classroom learning. This study aims to examine the development process, validity, effectiveness, and practicality of the "GEO-Food" board game in improving geometry skills based on Van Hiele's levels of thinking in fourth-grade elementary students. This research is a type of Research and Development (R&D) using the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). Data were collected through expert validation questionnaires, teacher and student response questionnaires, and pre-test and post-test on quadrilateral material. The trial results showed that the media validity score was 100% by media experts and 96% by material experts, both categorized as "very valid." The media was considered moderately effective, with an N-Gain score of 70.73%, and an average score increase from 38.07% (pre-test) to 80.67% (post-test). The practicality of the media was rated at 93% by teachers and 88% by students, both categorized as "very practical." It can be concluded that the "GEO-Food" board game is valid, effective, and practical for improving geometry skills based on Van Hiele's levels of thinking in fourth-grade elementary students.

Keywords: Board Game; Geometry Skills; Quadrilaterals; Van Hiele

1. INTRODUCTION

One of the compulsory subjects taught at the elementary school level is mathematics. According to Masita and Nur in Nordiana et al. (2024), in mathematics learning, teachers and students engage in teaching and learning activities to understand shapes, measurements, and various interconnected concepts through students' reasoning. These concepts are later applied in students' daily lives, enabling them to acquire new knowledge that can influence their actions. Mathematics is considered an independent discipline that is also essential to other fields of study (Kamarullah, 2017). While it does not rely on other sciences, its presence is fundamental across nearly all disciplines. In other words, many fields of study require mathematics for their application. A strong mathematical ability in students is often used as a benchmark for their success in learning other disciplines. Therefore, teachers must pay close attention to students' cognitive mathematical abilities at the elementary level. However, in reality, various problems in elementary mathematics learning are still frequently found. First, a previous study conducted at SD X Simawang, Rambatan District, found that teachers did not use any learning media while teaching mathematics due to a lack of technological proficiency, which hindered their creativity in developing instructional materials (Silvi et al., 2023). As a result, students became bored during lessons because the teaching approach relied solely on conventional methods such as lecturing, Q&A sessions, and storytelling. Students interviewed in the study expressed a desire for more engaging mathematics lessons, such as those involving educational games. Furthermore, a study by Mustika et al. (2018) revealed low learning outcomes in mathematics among third-grade students at SDN 1 Lambheu, Aceh Besar. This was attributed to the teacher's inaccurate use of media, which caused students to focus solely on images rather than the subject matter itself. Additionally, the researcher conducted observations during an internship at several elementary schools in Salatiga. At SDN Mangunsari 06, students were observed to be passive and disinterested during mathematics lessons due to the monotonous teaching approach, which lacked the support of instructional media. This negatively impacted students' interest in learning mathematics. More critically, it led to a lack of meaningful learning and rapid forgetting of the material due to conceptual misunderstandings in geometry.

One of the branches of mathematics learning is geometry, which has been introduced to students since kindergarten—or even earlier by their parents before entering formal education. At the elementary level, students are expected to acquire a strong foundational understanding of geometry so they can apply these basic concepts continuously at higher levels of education. This is essential because geometry becomes increasingly complex over time, while still relying on its fundamental

principles. Geometry is closely related to the understanding of points, lines, planes, and three-dimensional objects, as well as their properties, measurements, and interrelationships, all of which are applicable to students' daily lives (Batubara, 2017). Such understanding can be achieved through proficient geometry skills. Hoffer identified several essential geometry skills that individuals should possess, including visual, verbal, drawing, logical, and applied skills. These skills align with the stages of thinking in Van Hiele's theory (Hayati, 2017). The levels of thinking must be implemented progressively according to their structure when learning geometry. These levels consist of five stages: level 0 (visualization), level 1 (analysis), level 2 (informal deduction), level 3 (deduction), and level 4 (rigor).

Based on various research findings, elementary school students' geometry skills are still at a low level according to Van Hiele's levels of thinking. According to Soedjoko (as cited in Rahimah & Asy'ari, 2017), most elementary students remain at level 0 and 1, without reaching the minimum standard that should be mastered. Nuraeni (as cited in Batubara, 2017) stated that around 95% of fifth-grade students still perceive quadrilaterals only as squares and triangles only as right-angled triangles, with many unable to correctly identify the names of plane shapes. Similarly, Salsabilah et al. (2023) found that students struggle to solve problems involving composite plane figures. Safarudin et al. (2025) also discovered that students are only able to recognize shapes from images without understanding their underlying concepts and relationships. Research by Ma'rifah et al. (2019) supports this, showing that 60% of junior high school students are still at the visualization level, and logical errors in geometry reached 65.45%. Hasanah (2024) emphasized that the failure to grasp geometric concepts in junior high school is rooted in poor understanding developed during elementary school. The low level of geometry skills is not solely caused by students' cognitive factors but also by the lack of appropriate instructional media. Rahmadini & Alim (2023) revealed that unappealing and abstract learning media contribute to students' low motivation to learn geometry. Nurrita (2018) explained that instructional media assist teachers in delivering material in an engaging and meaningful way for students. One promising type of media is the board game, which, according to Wibawanto (as cited in Nordiana et al., 2024), can incorporate various educational game components and has been shown to improve students' understanding and skills (Maryanti et al., 2021). However, several studies have highlighted limitations in existing board game media, such as weak design (Nurhayani et al., 2021), easily damaged materials (Aji et al., 2020), and inappropriate visual content (Lestari et al., 2024). Therefore, the researcher developed *GEO-Food*, a board game designed to concretely and engagingly enhance fourth-grade students' geometry skills in alignment with Van Hiele's levels of thinking.

2. RESEARCH METHOD

This research is a Research and Development (R&D) study aimed at developing the "GEO-Food" board game as a learning media to enhance geometry skills based on Van Hiele's levels of thinking among fourth-grade elementary school students. The development model used is the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. In the analysis stage, the researcher conducted observations and interviews with a fourth-grade teacher at SDN Randuacir 01 to identify student characteristics, the implementation of mathematics learning, and the need for instructional media. The design stage involved aligning the material with learning objectives, designing the board game components, and formulating the rules of the game. The development stage included the creation of the product and validation by subject matter and media experts. After validation, the implementation stage was carried out through a limited trial at SDN Mangunsari 06 (10 students) and a wider trial at SDN Randuacir 01 (15 students). The final stage, evaluation, was conducted by analyzing the validity, practicality, and effectiveness of the media. The instruments used included validation sheets, teacher and student response questionnaires, as well as pre-test and post-test items developed based on the indicators of Van Hiele's geometry skills. Data analysis was conducted quantitatively using SPSS 22, including validity and reliability tests, difficulty and discrimination index analysis, as well as normality, homogeneity, paired sample t-test, and N-Gain tests to measure the media's effectiveness.

3. RESULTS AND DISCUSSION

The research conducted is a development study or Research and Development (R&D), which focuses on developing a learning media and evaluating the outcomes of that development. In this study, the product developed is an instructional media in the form of a board game called "GEO-Food," which covers the topic of the characteristics of quadrilaterals and aims to improve geometry skills based on Van Hiele's levels of thinking among fourth-grade elementary students. The development followed the ADDIE model, which consists of the stages of Analysis, Design, Development, Implementation, and Evaluation. The following is an explanation of the results from each of these stages.

3.1 Analysis Stage

The analysis stage was carried out through observations and interviews with the fourth-grade teacher at SDN Randuacir 01 to explore students' characteristics, the implementation of mathematics instruction, and content analysis. The results indicated that students had difficulty understanding the concept of plane figures, particularly in distinguishing between types of quadrilaterals and recognizing their components such as sides, angles, and diagonals. Moreover, the limited use of instructional media resulted in passive learning, which was predominantly lecture-based and reliant on student worksheets. Students demonstrated a high level of interest in game-based learning that is both contextual and enjoyable. The content analysis referred to the Learning Outcomes (Capaian Pembelajaran – CP) of Phase B in the *Kurikulum Merdeka*, focusing on introducing the characteristics of quadrilaterals (square, rectangle, rhombus, kite, parallelogram, and trapezoid). The material was adapted based on the teacher's guidebook, student textbook, and other references to support the development of instructional media aligned with students' needs and levels of thinking.

3.2 Design Stage

In the design stage, the researcher developed the "GEO-Food" board game based on the results of the previous analysis, aiming to enhance the geometry skills of fourth-grade elementary students in accordance with Van Hiele's levels of thinking (visualization and analysis). The media was designed to cover five types of geometry skills—visual, verbal, drawing, logical, and applied—with a total of ten indicators. The learning material focused on quadrilateral shapes, aligned with the Learning Outcomes of the *Kurikulum Merdeka*. The researcher created a design outline that included the product name "GEO-Food" (an acronym for *Get and Eat Our Food*), which features a food theme and game concept where students collect points through analyzing geometric shapes. The media was developed in the form of a foldable board game consisting of 100 squares (50 for level 0 and 50 for level 1). Supporting components such as question cards, the game board, and tokens were designed to match the theme and capture students' interest through an engaging and enjoyable educational game mechanism.

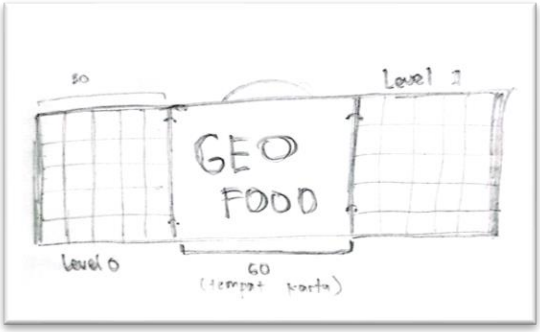

Figure 1. "GEO-FOOD" Game Board Sketch

The board is made of plywood coated with high-pressure laminate, measuring 120 x 30 cm and divided into two sections. It can be folded on the left and right sides like a chessboard—when in use, it can be opened outward to both sides, and when finished, it can be folded inward toward the center. The production process took approximately two weeks, resulting in the following outcome.

Table 1. Components of the "GEO-FOOD" Game Board

No	Image	Description
1		The first component consists of small square boxes that determine the questions (located on the left and right sides). The left side contains question codes for level 0, and the right side for level 1. Each square measures 5x5 cm. The squares feature vinyl stickers with glossy lamination; the codes and colors are matched with the corresponding question cards. The stickers are designed in circular shapes with the code placed in the center, created using the Canva application.
2		The second component is the center area of the board, used to place other components such as question and answer cards in an organized manner. This part also serves as a visual display for students related to the game's theme and title. It has a rectangular shape measuring 60 x 30 cm. The sticker used here is also vinyl with glossy lamination, designed using the Canva application.
3	 (a) (b)	a) A suitcase handle to make the board easy to carry. b) Side latches on the right and left to prevent the board from opening while being carried..

The "GEO-Food" media was designed as an educational game with a food theme to enhance geometry skills based on Van Hiele's levels of thinking. The media design involved aligning the content with the indicators of geometry skills (visual, verbal, drawing, logical, and applied) across two levels: visualization and analysis. The media consists of several integrated

components, including: a double-sided game board containing 100 question boxes, colored group tokens, question and answer cards coded and color-labeled according to the skill indicators, and a laminated answer board. The instructional guidebook used for this media is as follows:

Table 2. Components of the Guidebook

No	Description	Book Section
1	Front Cover	
2	Content	
3	Back Cover and Printed Guidebook	

The "GEO-Food" game is played in groups (up to 4 groups) and consists of two levels. Each group uses tokens, an answer board, and participates within a set time (15 minutes for Level 0 and 20 minutes for Level 1). Players take turns tossing a coin onto the board and answering questions based on the color and code of the square where the coin lands. Answers are written on the answer board and checked using the answer cards. Each correct or incorrect answer earns points, marked with star-shaped tokens in different colors and point values depending on the level. At the end of the game, points are calculated and the group with the highest score receives a reward in the form of food coins. The game rules emphasize teamwork, honesty, and prohibit interference with other groups. Each question may only be answered once by a group, and participants must check their answers before moving on to the next turn. These rules are intended to create an active, orderly, and enjoyable learning experience while improving students' geometry skills.

3.3 Development Stage

At this stage, validation of the developed product was conducted by media and content experts. Both experts are lecturers from the Primary School Teacher Education Department, Faculty of Teacher Training and Education, Satya Wacana Christian University. The following are the validation results provided by the two validators.

Table 3. Media Expert Validation

Indicators	Statement	Score
Media Design Aspect		
Attractiveness	1. The attractiveness of the board game as a learning medium.	5
	2. The appeal of the selected images or illustrations for students.	5
	3. The attractiveness of the game theme and storyline.	5
Aesthetic Appearance	4. The appropriateness of the image and text size.	5
	5. The clarity of printed images and text.	5
	6. The harmony of color combinations used for students.	5
	7. The appropriateness and neatness of component placement in the design.	5
Media Presentation Aspect		
Durability	8. The durability of the media over time (sturdy and not easily damaged materials).	5

Safety	9. The safety of the media's physical form for students.	5
Component Completeness	10. The completeness of the components provided.	5
	11. The compatibility and functionality between components.	5
Media Usability Aspect		
Relevance in Learning	12. The usefulness of the media in increasing students' interest and engagement in learning plane geometry.	5
	13. The function of the media in assisting teachers in delivering engaging geometry lessons.	5
Ease of Use	14. The ease of understanding the instructions provided in the guidebook.	5
	15. The ease of using the media in the classroom.	5
	Total Score	75
	Percentage	100%

Based on the validation results from the media expert, the "GEO-Food" instructional media received a score of 75 out of a maximum score of 75, resulting in a feasibility percentage of 100%. This percentage indicates that the media falls into the "very valid" category (80% < Va ≤ 100%). Therefore, the media is considered to have met all feasibility assessment aspects, including design, presentation, and usability. The validator also concluded that the media is suitable for use without the need for revision.

Table 4. Validation Results by Content Expert

Indicator	Statement	Score
Content Aspect		
Relevance	1. The relevance of the material to geometry skill indicators based on Van Hiele's levels of thinking.	5
	2. The appropriateness of the material for students' developmental level.	4
	3. The alignment of the material with the Phase B learning outcomes.	5
Accuracy	4. Scientific accuracy of the presented content.	5
	5. The accuracy of questions and illustrations in relation to students' real-life contexts.	5
Depth	6. The depth of material supporting higher-level learning.	5
	7. The appropriateness of difficulty level in relation to students' abilities.	5
Material Presentation Aspect		
Function in Learning	8. Its usefulness in stimulating students' curiosity.	4
	9. Its usefulness in encouraging student interaction.	5
	10. Its usefulness in promoting group-based learning.	5
	11. Its usefulness in encouraging students to construct their own knowledge.	5
Use of Illustrations	12. Ease of understanding images or illustrations.	5
	13. Relevance of images or illustrations to the concepts or material presented.	5
Use of Language	14. Language clarity and ease of understanding for students.	4
	15. Accuracy of word usage and absence of typos.	5
	Total Score	72
	Percentage	96%

The validation results from the content expert for the "GEO-Food" media showed a score of 72 out of a maximum of 75, resulting in a feasibility percentage of 96%, which falls into the "very valid" category (80% < Va ≤ 100%). Therefore, the developed material was deemed suitable for use in learning. However, the validator suggested minor revisions to several questions on the question cards to better align the expected answers and avoid semantic bias. These revisions were made prior to the media's implementation in school trials.

Based on the validation results by the content expert, revisions were made to 12 items on the "GEO-Food" question cards. The revisions involved modifying the shapes of the answer choices and the phrasing of statements to better reflect the characteristics of plane figures and avoid misinterpretation by students. Changes included adjustments such as replacing rhombus with trapezoid, rectangle with triangle, and refining descriptive sentences for accuracy. These adjustments were made to enhance the clarity of concepts and the precision of geometric understanding, ensuring that students could respond to the questions in line with the intended answers. These revisions emphasize the importance of visual and verbal accuracy in instructional media related to plane geometry.

3.4 Implementation Stage

The implementation stage in the development of the "GEO-Food" media was carried out in two phases: a limited trial and a large-scale trial, to measure the effectiveness of the media in teaching plane geometry in mathematics. The limited trial was conducted at SDN Mangunsari 06 Salatiga with 10 fourth-grade students over the course of three days. Activities included administering a pre-test, introducing and using the media, and conducting a post-test. This trial aimed to evaluate the quality of the test instruments (validity, reliability, difficulty level, and discrimination index) and to obtain initial data on the effectiveness of the media. The large-scale trial was conducted at SDN Randuacir 01 Salatiga with 15 fourth-grade students, following similar procedures. The researcher used pre-test and post-test questions that had been validated during the limited trial. In addition to measuring instructional effectiveness, the large-scale trial also collected data on the practicality of the media through response questionnaires from both teachers and students. All activities were aligned with the teaching module and observed by both the researcher and the classroom teacher to evaluate the use of the media within a comprehensive classroom context.

3.5 Evaluation Stage

The final stage in the ADDIE model is the evaluation stage. In this stage, the researcher processed and interpreted various assessment results related to the "GEO-Food" media that had been developed. The first evaluation involved revising the media based on expert suggestions during the validation process to ensure that it would be feasible for use during the implementation stage. In addition, the researcher evaluated the media based on the results of the large-scale trial, in line with the research objectives, namely to determine the effectiveness and practicality of the media. The following is an explanation of the data analysis conducted to assess the effectiveness and practicality of the "GEO-Food" media in classroom learning.

3.5.1 Effectiveness of the "GEO-Food" Board Game Media

Table 5. Normality Test Results

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre_test	.128	15	.200*	.966	15	.794
Post_test	.179	15	.200*	.927	15	.247

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Normality testing was conducted using the Shapiro-Wilk test, as the number of subjects was fewer than 50. The test results showed that the pre-test had a significance value of 0.794 and the post-test 0.247. Both values are greater than 0.05, indicating that the data are normally distributed. Therefore, the data meet the assumptions required to proceed with homogeneity testing and the paired sample mean difference test.

Table 6. Homogeneity Test Results

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	2.687	1	28	.112
	Based on Median	2.540	1	28	.122
	Based on Median and with adjusted df	2.540	1	28.000	.122
	Based on trimmed mean	2.827	1	28	.104

The test result based on the mean showed a significance value of 0.112 (> 0.05), indicating that the null hypothesis (H_0) is accepted. This means that the data come from a homogeneous population. Therefore, the data meet the requirements to proceed to the next stage of analysis using the paired sample t-test.

Table 7. Paired Samples Test Results

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre_test - Post_test	-42.600	7.089	1.830	-46.526	-38.674	-23.273	14	.000

The results of the paired samples t-test show a significant difference between the pre-test and post-test scores after the use of the "GEO-Food" media. The obtained significance value (Sig. 2-tailed) was 0.000 (< 0.05), indicating that the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. This means that the use of the media has a significant impact on improving students' learning outcomes.

Table 8. Paired Sample Test Statistics

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre_test	38.07	15	14.978	3.867
	Post_test	80.67	15	10.702	2.763

After the prerequisite tests were fulfilled, a paired sample t-test was conducted to examine the effectiveness of the "GEO-Food" media on students' learning outcomes. The analysis results showed that the average pre-test score was 38.07, while the average post-test score increased to 80.67. This improvement indicates a significant difference between the results before and after using the instructional media. Therefore, it can be concluded that the "GEO-Food" media has a positive impact on enhancing students' learning outcomes.

Table 9. N-Gain Result

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	15	.48	.91	.7073	.10427
Valid N (listwise)	15				

The descriptive analysis showed that the average N-Gain score of students after using the "GEO-Food" media was 0.7073. According to the N-Gain interpretation criteria, this score falls within the "moderately effective" category (0.55 < N-Gain ≤ 0.75). This indicates that the use of the media meaningfully improved students' geometry skills, although there is still room for further optimization.

3.5.2 Practicality of the GEO-Food Board Game Media

Table 10. Teacher Response Questionnaire Results

Indicators	Statements	Score
Media Aspects		
Appearance	1. 1. The media's appearance attracts students' attention.	5
	2. 2. Images and illustrations are clearly presented and match the theme.	4
	3. 3. The printed components are neat.	5
	4. 4. The font size and type are easy to read.	4
Media Usability	5. 5. The media is easy for students to use.	5
	6. 6. The media is safe for students to use.	5
	7. 7. The media is durable for long-term use.	5

Benefit	8. 8. The media helps improve students' geometry skills.	5
	9. 9. The media creates an enjoyable and interactive learning environment.	5
	10. 10. The media encourages student interaction.	4
	11. 11. The media increases students' motivation to learn.	4
	12. 12. The media supports teachers in delivering geometry lessons on plane figures.	5
Content Aspect		
Presentation	13. 13. The material is presented comprehensively.	4
	14. 14. The material aligns with Phase B learning outcomes.	5
	15. 15. The material is adapted to the intended learning indicators.	5
	Total Score	70
	Percentage	93%

The practicality assessment of the "GEO-Food" media by the fourth-grade teacher at SDN Randuacir 01 resulted in a score of 93%, which falls into the "very practical" category (80% < Va ≤ 100%). This indicates that the media has fulfilled aspects of ease of use, usefulness, and functionality in the learning process. The teacher also noted that the learning process went well and was engaging, and suggested improvements in classroom management.

.

Table 11. Student Response Questionnaire Score Assessment

No	Name	Score
1	Student 1	6
2	Student 2	10
3	Student 3	7
4	Student 4	10
5	Student 5	9
6	Student 6	10
7	Student 7	10
8	Student 8	10
9	Student 9	8
10	Student 10	6
11	Student 11	8
12	Student 12	10
13	Student 13	10
14	Student 14	10
15	Student 15	8
	Total	**132**
	Percentage	**88%**

The practicality assessment of the "GEO-Food" media by 15 fourth-grade students at SDN Randuacir 01 resulted in a score of 88%, which falls into the "very practical" category (80% < Va ≤ 100%). This indicates that the media is easy to use, enjoyable, and effectively supports students' understanding of the material.

3.6 Discussion

This study produced an instructional media in the form of a board game called "GEO-Food," designed to improve the geometry skills of fourth-grade students based on Van Hiele's levels of thinking. The development process followed the five stages of the ADDIE model: Analysis, Design, Development, Implementation, and Evaluation. In the analysis stage, it was found that most students had not yet reached level 1 (analysis) of Van Hiele's thinking levels and were still at level 0 (visualization). Common errors included misnaming plane shapes and failing to identify their characteristics, such as sides, angles, and diagonals. The lack of concrete learning media and the dominance of lecture-based methods led to low student motivation and poor understanding of geometric concepts. In the design stage, the researcher formulated indicators based on five geometry skills—visual, verbal, drawing, logical, and applied—across two Van Hiele levels (visualization and analysis), resulting in a total of 10 indicators. These were used to develop 50 questions (25 for each level). The media was designed with a food theme to make it contextual and engaging for students. Media components include a game board, question and answer cards, group tokens, star-shaped score markers, answer boards, a timer, food coins, a guidebook, and a storage box. The game is played in two levels with a point system for scoring and rewards in the form of food coins. Game rules and flow were also designed to promote group collaboration and maintain an orderly gameplay experience.

In the development stage, the validation results from the media expert showed a score of 100% (very valid), while the content expert gave a score of 96% (very valid), with minor revisions suggested for some questions that could potentially

cause bias. Revisions were made to answer choices that confused students in distinguishing between types of quadrilaterals. After the revisions, the media was deemed suitable for classroom implementation. The implementation stage was carried out through a limited trial at SDN Mangunsari 06 (10 students) and a large-scale trial at SDN Randuacir 01 (15 students). The limited trial was used to test the validity and reliability of the test items, resulting in 12 valid pre-test items and 11 valid post-test items. The large-scale trial was conducted to measure the effectiveness and practicality of the media. The results of the paired sample t-test showed a significant difference between the pre-test scores (average 38.07) and post-test scores (average 80.67), with a significance value of $0.000 < 0.05$. The correlation between pre-test and post-test scores was also high ($r = 0.900$). The N-Gain score of 0.7073 indicates an improvement in geometry skills categorized as "moderately effective."

In the evaluation stage, the effectiveness of the "GEO-Food" media was evident from the significant improvement across all indicators of students' geometry skills. In terms of visual skills, students demonstrated better ability in recognizing and distinguishing various quadrilateral shapes accurately based on the images provided. For verbal skills, students began to correctly name the plane figures and describe their characteristics using clearer language aligned with mathematical concepts. Drawing skills also improved, as shown by more accurate sketches that reflected both the instructions and the defining traits of each shape. In the logical domain, students were able to compare and classify plane figures based on similarities and differences in their properties, indicating deeper conceptual understanding. Lastly, in applied skills, students began to connect geometric knowledge to real-life contexts by identifying shapes in everyday objects and applying them to solve simple problems. These findings confirm that the instructional media effectively supports the comprehensive development of students' geometry skills in accordance with Van Hiele's levels of thinking. The study by Kriswandani and Kusuma (2023) also demonstrated that board game media integrated with the Adaptive Problem-Based Learning (APBL) model is effective in improving students' mathematical reasoning skills. In their research, the implementation of a board game based on local wisdom—validated by experts—showed very high feasibility, with a significant gain of 35.48% from pretest to posttest. These findings were supported by highly positive responses from both teachers and students, achieving a practicality score of 92%. This aligns with the development of the Geo-Food board game in the present study, which also aims to improve students' geometry skills through the Van Hiele's levels of thinking. Both studies emphasize the importance of using contextual and engaging media such as board games to enhance students' higher-order thinking skills, whether in reasoning or geometry.

The practicality of the "GEO-Food" media was demonstrated through teacher response scores of 93% and student response scores of 88%, both of which fall into the "very practical" category. Teachers stated that the use of this media made learning more engaging, less monotonous, and created an enjoyable atmosphere for students. Students also reported feeling happy and active during gameplay, as the media is game-based and involves interaction among group members, which supports collaborative learning processes. Additionally, the questions and content presented are closely related to students' daily lives, making the learning experience more contextual and easier to understand. However, some limitations were identified during the implementation of the media. First, there was no detailed regulation regarding the distribution of roles within the groups, leading to imbalanced participation among group members. Second, the variety of food items used as objects in the questions was limited, resulting in repetition and potentially reducing students' interest. Third, the implementation trial was conducted in only one school, thus further testing in schools with different student backgrounds is needed to strengthen the generalizability of the research findings. In conclusion, the "GEO-Food" media has proven to be moderately effective and highly practical in enhancing the geometry skills of fourth-grade elementary students. This media has strong potential to be further developed as an alternative thematic learning tool that is fun, interactive, and relevant to the everyday context of elementary school students.

.

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded that the *GEO-Food* instructional media in the form of a board game is proven to be valid, effective, and practical for improving geometry skills based on Van Hiele's levels of thinking among fourth-grade elementary students. The development process followed the five stages of the ADDIE model: analysis, design, development, implementation, and evaluation. This media was designed with attention to students' characteristics and developed using a context familiar to their daily lives—food—so that quadrilateral concepts would be easier to understand and more enjoyable to learn. Validation from content and media experts indicated that *GEO-Food* is highly suitable for use in the classroom. Its effectiveness was evident in the significant improvement in students' learning outcomes after using the media, demonstrating that game-based learning can effectively stimulate geometry thinking skills in alignment with the Van Hiele stages. Additionally, teacher and student responses showed that the media is very practical for classroom learning activities. Based on these findings, it is recommended that future researchers further develop this board game media not only for quadrilateral topics but also for other geometry materials, adapted to different education levels and Van Hiele thinking stages. For teachers, using three-dimensional learning media such as board games can serve as an alternative to create a more interactive, contextual, and enjoyable learning environment for elementary students. Teachers are also encouraged to continuously develop contextual materials and questions that reflect students' real-life environments. For students, this media is expected to serve as a fun and beneficial learning tool that supports the gradual and in-depth development of geometry skills through play-based learning that strengthens conceptual understanding in a concrete way.

REFERENCES

Aji, R. B., Sudiana, R., & Pamungkas, A. S. (2020). Pengembangan Papan Permainan Go-Kumath 3D Sebagai Media Pembelajaran Matematika. *WILANGAN: Jurnal Inovasi Dan Riset Pendidikan Matematika*, *1*(3), 318–330. http://www.jurnal.untirta.ac.id/index.php/wilangan.

Alpian, R., & Anggoro, B. S. (2020). Analisis Penalaran Matematis Peserta Didik Berdasarkan Teori Van Hiele. *Indonesian Journal of Science and Mathematics Education*, *3*(1), 96–105. https://doi.org/10.24042/ijsme.v3i1.4761.

Anggreani, S. N., & Hasanudin, C. (2024). *Pengenalan Jenis-jenis Bangun Datar dalam Pembelajaran Matematika di Sekolah Dasar Selvia*. 255–262.

Azzahro, F., Mawarsari, V. D., & Aziz, A. (2025). Media BERUANG (Belajar Bangun Ruang): Pendekatan Pembelajaran Van Hiele. *JagoMIPA: Jurnal Pendidikan Matematika Dan IPA*, *5*(1), 196–209. https://doi.org/10.53299/jagomipa.v5i1.1239 Media.

Batubara, H. H. (2017). Pengembangan Media Pembelajaran Matematika berbasis Android untuk Siswa SD/MI [Development of Android-based Mathematics Learning Media for Elementary/MI Students]. *Muallimuna; Jurnal Madrasah Ibtidaiyah*, *3*(1), 12–27. https://ojs.uniska-bjm.ac.id/index.php/jurnalmuallimuna/article/view/952.

Fadilah, A., Nurzakiyah, K. R., Kanya, N. A., Hidayat, S. P., & Setiawan, U. (2023). Pengertian Media, Tujuan, Fungsi, Manfaat dan Urgensi Media Pembelajaran. *Journal of Student Research (JSR)*, *1*(2), 1–17.

Fiisyatirrodliyah, Latifah Nuraini, & Fira Nadliratul Afrida. (2024). Permainan Berbasis Geoboard dalam Meningkatkan Hasil Belajar Kognitif Materi Bangun Datar. *TA'DIBAN: Journal of Islamic Education*, *4*(2), 64–73. https://doi.org/10.61456/tjie.v4i2.166.

Fitri, Y., & Yudhi, P. (2021). Pembuktian Ketegaklurusan Garis terhadap Bidang pada Kubus dan Balok. *Journal of Science and Technology*, *1*(1), 105–114. https://ejournal.uinib.ac.id/jurnal/index.php/jostech.

Fitriani, I., Fitriyah, C. Z., & Hutama, F. S. (2019). Pengembangan Media Pembelajaran "Monopoli Keberagaman" Tema Indahnya Keragaman di Negeriku untuk Peserta Didik Kelas IV. *Jurnal Profesi Keguruan*, *5*(1), 76–82. https://eprints.uny.ac.id/69346/.%0Ahttps://journal.unnes.ac.id/nju.index.php/jpk.

Hadijah, R., & Siswoyo, A. A. (2024). Efektivitas Media Hidden Box Of Creatifical Geometry 3D Terhadap Kemampuan Numerasi Kelas 5 SDN Gempolpendowo Lamongan. *Educatio: Jurnal Ilmu Kependidikan*, *19*(2), 345–351. https://doi.org/10.29408/edc.v19i2.26339.

Hasanah, N. F. (2024). *Level Berpikir Geometri Siswa Sekolah Dasar Kelas V Berdasarkan Teori Van Hiele*. Universitas Borneo Tarakan.

Hayati, P. (2017). *Analisis Tingkat Keterampilan Geometri Berdasarkan Tahap Berpikir Van Hiele Ditinjau dari Kecerdasan Spasial Siswa Kelas IX SMP Negeri 4 Bandar Lampung*. Universitas Islam Negeri Raden Intan Lampung.

Hidayat, F., & Nizar, M. (2021). Model Addie (Analysis, Design, Development, Implementation and Evaluation) Dalam Pembelajaran Pendidikan Agama Islam Addie (Analysis, Design, Development, Implementation and Evaluation) Model in Islamic Education Learning. *Jurnal UIN*, *1*(1), 28–37.

Hikmayani, J., Tahir, M., & Rosyidah, A. N. K. (2023). Analisis Kemampuan Pemahaman Konsep Geometri Siswa Kelas IV Menurut Teori Van Hiele di SDN 06 Cakranegara. *Jurnal Ilmiah Profesi Pendidikan*, *8*(1), 133–141. https://doi.org/10.29303/jipp.v8i1.1111.

Hobri, Susanto, Fatahillah, A. I., Fatahillah, A., Waluyo, E., Alfarisi, R., Budi, H. S., & Helmi, M. I. (2022). *Matematika SD/ MI KELAS IV* (E. Nurelah (ed.); 1st ed.). Pusat Perbukuan Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. https://buku.kemdikbud.go.id.

Hobri, Susanto, Kristiana, A. I., Fatahillah, A., Waluyo, E., Alfarisi, R., Budi, H. S., & Helmi, M. I. (2022). *Buku Panduan Guru Matematika untuk SD/MI Kelas IV* (E. Nurelah (ed.)). Pusat Perbukuan Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. https://buku.kemdikbud.go.id.

Kamarullah, K. (2017). Pendidikan Matematika di Sekolah Kita. *Al Khawarizmi: Jurnal Pendidikan Dan Pembelajaran Matematika*, *1*(1), 21–32. https://doi.org/10.22373/jppm.v1i1.1729.

Kartika, Y., Wahyuni, R., Sinaga, B., & Rajagukguk, J. (2020). Design Adventure Education Mathematics Game to Improve The Ability of Creative Thinking in Mathematics. *International Journal for Educational and Vocational Studies*, *2*(12), 1042–1048. https://doi.org/10.29103/ijevs.v2i12.3475.

Khoirina, A., & Arsanti, M. (2022). Pemanfaatan Media Pembelajaran untuk Meningkatkan Hasil Belajar Siswa. *Prosiding Senada (Seminar Nasional Daring)*, 992–997.

Komang Sri, A. P., & Anadhi, I. M. G. (2023). Pengenalan Bangun Datar dalam Mengembangkan Aspek Kognitif Melalui Permainan Papan Geometri Pintar (Papingeo) pada Anak Usia Dini 5-6 Tahun di TK Pratama Widya Pasraman Gurukula. *Indonesian Journal of Early Childhood: Jurnal Dunia Anak Usia Dini*, *5*(2), 270–282. https://doi.org/10.35473/ijec.v5i1.2368.

Kriswandani & Kusuma, D. (2025). Enchaning Mathematical Reasoning Skills Through Board Game Media and the Adaptive Problem-Based Learning Model. *Al-Ishlah: Jurnal Pendidikan, 17(1),* 602-613, : 10.35445/alishlah.v17i1.6340

Kusmayanti, V., Zaimah, H., Yasri, Setiawati, E., & Ulya, N. (2020). *Keliling dan Luas Bangun Datar*.

Leoni, V., Hananto, B. A., & Indrajaya, F. (2022). Identifikasi Permasalahan Desain Board Game "Kurir Kompleks." *Prosiding Konferensi Mahasiswa Desain Komunikasi Visual*, 372–380.

Lestari, T. N., Nugroho, A. S., & Alfiansyah, I. (2024). Pengembangan Media Snake Board Game pada Materi Macam-macam Pekerjaan untuk Siswa Kelas IV MI Muhammadiyah Doudo. *Sindoro Cendekia Pendidikan*, *6*(11), 101–112.

Limantara, D., Waluyanto, H. D., & Zacky, A. (2015). Perancangan Board Game untuk Menumbuhkan Nilai-Nilai Moral pada Remaja. *Jurnal Desain Komunikasi Visual Adiwarna*, *1*(6), 1–9.

Lisa. (2022). Inovasi Pembelajaran Matematika SD/MI dengan Pendekatan Matematika Realistik. *Genderang Asa: Journal of Primary Education*, *3*(1), 44–63. https://doi.org/https://doi.org/10.47766/ga.v3i1.489.

Ma'rifah, N., Junaedi, I., & Mulyono. (2019). Tingkat Kemampuan Berpikir Geometri Siswa Kelas VIII. *Seminar Nasional Pascasarjana UNNES 2019*, 251–254. https://proceeding.unnes.ac.id/index.php/snpasca/article/download/283/252/

Maryanti, E., Egok, A. S., & Febriandi, R. (2021). Pengembangan Media Board Games Berbasis Permainan Tradisional Egrang Batok untuk Siswa Sekolah Dasar. *Jurnal Basicedu*, *5*(5), 4212–4226. https://doi.org/10.31004/basicedu.v5i5.1486.

Mulyasari, D. W., Abdussakir, & Rosikhoh, D. (2021). Efektivitas Pembelajaran Etnomatematika Menggunakan Permainan Sikidoka Terhadap Pemahaman Konsep Geometri Bagi Siswa Sekolah Dasar. *Jurnal Tadris Matematika*, *4*(1), 1–14. https://doi.org/10.21274/jtm.2021.4.1.1-14.

Mustika, S., Hajidin, & Elly, R. (2018). Penyebab Rendahnya Hasil Belajar Matematika Siswa Kelas III di SD Negeri 1 Lambheu Aceh Besar. *Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, *3*(3), 134–141.

Nasihudin, & Hariyadin. (2021). Pengembangan Keterampilan dalam Pembelajaran. *Jurnal Pendidikan Indonesia*, *2*(4), 733–743. https://doi.org/10.59141/japendi.v2i04.150.

Nordiana, S., Meilina, F., & Islamyati, A. Z. (2024). Pengembangan Media Board Game LUMAT (Ludo Matematika) pada Materi Pecahan untuk Siswa Kelas III Sekolah Dasar. *Jurnal Basicedu*, *8*(4), 3383–3389.

Nurhayani, D., Supriadi, D., & , M. (2021). Pengembangan Media Board Games Pada Mata Pelajaran Ipa Tema 1 Kelas Iv Sdn Sindang Rasa Bogor. *Educate : Jurnal Teknologi Pendidikan*, *6*(2), 83. https://doi.org/10.32832/educate.v6i2.5108.

Nurrita, T. (2018). Pengembangan Media Pembelajaran untuk Meningkatkan Hasil Belajar Siswa. *MISYKAT: Jurnal Ilmu-Ilmu Al-Quran, Hadist, Syari'ah Dan Tarbiyah*, *3*(1), 171–187. https://doi.org/10.33511/misykat.v3n1.171.

Pai'pinan, M., & Kho, R. (2018). Analisis Keterampilan Geometris Siswa SMP Berdasarkan Gaya Kognitif dalam Menyelesaikan Masalah Geometri Tiga Dimensi. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, *2*(3), 186–190. https://doi.org/10.58258/jisip.v2i3.560.

Rahimah, N., & Asy'ari. (2017). Keterampilan Dasar Geometri Siswa Kelas V dalam Kemampuan Matematika di Mi Al Istiqomah Banjarmasin. *Math Didactic: Jurnal Pendidikan Matematika*, *3*(1), 55–63.

Rahmadini, A., & Alim, J. A. (2023). Analisis Kesulitan Belajar Siswa Kelas IV Sekolah Dasar pada Materi Bangun Datar dan Bangun Ruang. *Guruku: Jurnal Pendidikan Dan Sosial Humaniora*, *1*(3), 15–25. https://doi.org/10.59061/guruku.v1i3.188.

Safarudin, Kusnadi, D., & Adiasti, N. (2025). Deskripsi kemampuan geometri siswa SMP berdasarkan teori van hiele. *JIIP (Jurnal Ilmiah Ilmu Pendidikan)*, *8*(1), 1091–1097.

Salsabilah, A. S., Nur Afifah, N. P., & Putri Herdiansyah, R. F. (2023). Analisis Kesulitan dalam Menyelesaikan Soal Luas Bangun Datar Gabungan Siswa Kelas IV SD. *Journal on Education*, *6*(1), 2601–2608. https://doi.org/10.31004/joe.v6i1.3290.

SC, P., Maimunah, M., & Hutapea, N. M. (2020). Pengembangan Perangkat Pembelajaran Matematika Menggunakan Pembelajaran Berbasis Masalah Untuk Memfasilitasi Pemahaman Matematis Peserta Didik. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *4*(2), 800–812. https://doi.org/10.31004/cendekia.v4i2.286.

Setiawan, L., Nurhasanah, F., & Pramudya, I. (2023). Pemanfaatan Boardgame Geometry At Home Untuk Meningkatkan Hasil Belajar Geometri Siswa SMP. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *7*(1), 44–54. https://doi.org/10.33603/jnpm.v7i1.7495.

Silahuddin, A. (2022). Pengenalan Klasifikasi, Karakteristik, dan Fungsi Media Pembelajaran MA Al-Huda Karang Melati. *Idaarotul Ulum (Jurnal Prodi MPI)*, *4*(2), 162–175. https://jurnal.insanprimamu.ac.id/index.php/idaarotul/article/view/244.

Silvi, M., Safrizal, & Zulhendri. (2023). Analisis Permasalahan Pelaksanaan Pembelajaran Matematika di Kelas V SD X Simawang Kecamatan Rambatan. *Auladuna: Jurnal Prodi Pendidikan Guru Madrasah Ibtidaiyah*, 39–51.

Sintawati, M., Rudiyanta, M., & Nuryanto, M. (2020). Pengembangan Media Magic Geometry pada Materi Bangun Ruang Kelas IV Sekolah Dasar. *Jurnal Tadris Matematika*, *3*(1), 77–88. https://doi.org/10.21274/jtm.2020.3.1.77-88.

Sofnidar, & Yuliana, R. (2018). Pengembangan Media Melalui Aplikasi Adobe Flash dan Photoshop Berbasis Pendekatan Saintifik. *Jurnal Gentala Pendidikan Dasar*, *3*(2), 257–275. https://doi.org/https://doi.org/10.22437/gentala.v3i2.6761.

Suherman, N. (2016). Upaya Meningkatkan Kemampuan Berpikir Geometri Van Hiele Siswa SMP Melalui Model Pembelajaran Example Non Examples. *Jurnal Analisa*, *2*(4), 69–80. https://doi.org/10.15575/ja.v2i2.5379.

Sukarelawan, M. I., Indratno, T. K., & Ayu, S. M. (2024). *N-Gain vs Stacking*.

Sulung, U., & Muspawi, M. (2024). Memahami Sumber Data Penelitian: Primer, Sekunder, dan Tersier. *Jurnal Edu Research : Indonesian Institute For Corporate Learning And Studies (IICLS)*, *5*(3), 110–116.

Tirtouotomo, S. (2015). Perancangan Media Board Game untuk Remaja Tentang Perilaku Baik dan Buruk. *Jurnal Desain Komunikasi Visual Adiwarna*, *1*(6), 1–12. https://www.neliti.com/publications/77949/perancangan-media-board-game-untuk-remaja-tentang-perilaku-baik-dan-buruk.

Ulfa, F. N., Hafidah, R., & Dewi, N. K. (2020). Mengenal Bentuk Geometri Melalui Pembelajaran Kooperatif Tipe Talking Stick Pada Anak Usia Dini. *Jurnal Kumara Cendekia*, *8*(1), 82–96.

Unaenah, E., Anggraini, I. A., Aprianti, I., Aini, W. N., Utami, D. C., Khoiriah, S., & Refando, A. (2020). Teori Van Hiele dalam Pembelajaran Bangun Datar. *Jurnal Pendidikan Dan Ilmu Sosial*, *2*(2), 365–374. https://ejournal.stitpn.ac.id/index.php/nusantara.

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. *Jurnal Pendidikan Dan Ilmu Sosial*, *2*(2), 327–349. https://ejournal.stitpn.ac.id/index.php/nusantara.

Waluyo, M., & Nawfa, Z. (2024). PATOGE geometry transformation board: A teaching aid to enhance junior high school students' conceptual understanding. *Indonesian Journal of Science and Mathematics Education*, *7*(2), 223–233. https://doi.org/10.24042/ijsme.v7i2.21017.

Wandini, R. R., Sari, P. Z., Harahap, E. Y., Ramadani, R., & Adila, N. A. (2021). Upaya Meningkatkan Proses Pembelajaran Matematika di SDN 34 Batang Nadenggan. *Edu Society: Jurnal Pendidikan, Ilmu Sosial Dan Pengabdian Kepada Masyarakat*, *1*(3), 384–391. https://doi.org/10.56832/edu.v1i3.143.

Warinta, Y., Oktria, K., Zarah, J. A., R, A., Rahmayuni, & Wismanto. (2024). Analisis Pengembangan Pemilihan Media Bahan Ajar. *Inspirasi Dunia: Jurnal Riset Pendidikan Dan Bahasa*, *3*(2), 32–40. https://doi.org/10.58192/insdun.v3i2.2064.

Waruwu, M. (2024). Metode Penelitian dan Pengembangan (R&D): Konsep, Jenis, Tahapan dan Kelebihan. *Jurnal Ilmiah Profesi Pendidikan*, *9*(2), 1220–1230. https://doi.org/10.29303/jipp.v9i2.2141.

Wulandari, A. P., Salsabila, A. A., Cahyani, K., Nurazizah, T. S., & Ulfiah, Z. (2023). Pentingnya Media Pembelajaran dalam Proses Belajar Mengajar. *Journal on Education*, *5*(2), 3928–3936. https://doi.org/10.31004/joe.v5i2.1074.

Yaumi, M. (2017). *Media Pembelajaran: Pengertian, Fungsi, dan Urgensinya bagi Anak Milenial*. *11*, 1–21.

Zikrillah, A., & Humardhiana, A. (2021). Perancangan Media Pembelajaran Board Game Edumaze Untuk Jenjang Pendidikan Sekolah Dasar. *Magelaran: Jurnal Pendidikan Seni*, *4*(2), 163–174. https://doi.org/10.35568/magelaran.v4i2.1695.