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The Practicality of Plane and Space Geometry Textbook as Teaching Materials in Mathematics Education Department of UMRAH

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Abstract

This study aims to produce teaching materials in the Geometry of Plane and Space course integrated with the maritime context of the Riau Islands. This research is a solution to problems arising from a need for teaching materials to the characteristics of students in the Mathematics Education Department of UMRAH. The 4D model (Define, Design, Development, and Disseminate) is used as the research development model. The research has reached the final activity of the Development stage, namely the practicality test of textbooks produced. The instrument used in the practicality test is a practicality questionnaire with a Likert scale. The evaluation results show that the textbooks produced through this development research have met the applicable criteria for use as teaching materials, with an achievement level of 72,85%. Thus, the textbook produced with the title Plane and Space Geometry Textbook has met the practical to use as teaching material in the Geometry of Plane and Space course. Integrating the maritime context of the Riau Islands helps students connect the content of teaching materials with their daily life. It helps them more easily understand the new knowledge.

Keywords: practicality test; maritime context; geometry textbook; plane and space geometry textbook

I. Introduction

Learning media is a component that must be addressed in developing a quality teaching system. Hamalik (2002) states that learning media is a supporting element in the learning process so that learning runs smoothly and effectively. The use of learning media can help the effectiveness of achieving learning objectives.

Gagne and Briggs stated that media is a physical tool, including books, tape recorders, cassettes, video cameras, video recorders, films, slides, photos, images, graphics, television, and computers (Arsyad, 2011). Furthermore, Ramadhona (2017) mentioned that media in education encompasses everything, including people and objects, used to convey messages to learners to create conditions that enable learners to acquire knowledge, skills, and attitudes. Previous studies have shown that the use of instructional media designed according to learners' needs can enhance learning interest (Sababalat et al., 2021), learning outcomes (Affandi et al., 2020), and problem-solving abilities (Ambarwati, 2019; Susanti et al., 2022).

Teaching materials are one example of instructional media systematically prepared and used by educators and learners in the learning process. According to Prastowo (2015), teaching

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materials encompass everything used for learning, including media/tools, information, texts, and more, systematically organized to achieve complete learning competencies. In addition to being a source of learning, teaching materials can facilitate interaction between learners and teachers, among learners themselves, and between learners and other media in the learning process. Therefore, teaching materials are not limited to written media but can also include natural objects, artificial objects, activities, books, brochures, etc.

Well-designed teaching materials developed according to learners' needs and appropriately utilized in the learning process can be a crucial factor in improving the quality of education (Kaswar & Nurjannah, 2021). Properly designed teaching materials can replace the teacher's role as the primary source of learning. Learners can be directed to become active learners by studying the content provided in the teaching materials before participating in classroom instruction.

A textbook is a teaching material developed explicitly as a learning resource for a specific subject within a certain time frame (Nikmah et al., 2019). According to Susanto et al. (2023), textbooks can provide information on the subject matter and guide learning activities. Textbooks can be integrated with specific content relevant to the material and learning objectives. Textbooks can also be developed based on approaches or learning models that enhance students' competencies (Asy'ari et al., 2019; Toybah et al., 2021).

Based on observations conducted at the Mathematics Education Department of Raja Ali Haji Maritime University (UMRAH), it was found that there is currently no available textbook specifically developed by lectures for the Geometry Plane and Space course. The lectures so far have relied on instructional materials such as reference books available in the library, teaching materials found on the internet, and brief presentation materials developed by the instructors. Furthermore, based on the evaluation of initial questionnaires distributed to the students, it was indicated that these instructional materials have yet to be successful in helping them understand the course material for Geometry of Plane and Space. Therefore, there is a need for teaching material that can effectively assist students in understanding the Geometry of Plane and Space course.

Raja Ali Haji Maritime University (UMRAH) is a maritime-oriented university located in a maritime region which is Riau Islands. Generally, students studying in the study programs within the UMRAH environment come from the scattered islands in the Riau Islands Province. The maritime atmosphere as a local culture has great potential to be used as a context for teaching materials.

The local context can strengthen students' cognitive structures (Gazali, 2016). Students can understand how new knowledge connects with their experiences, contributing to more accessible exploration and assimilation of new knowledge. As a result, the learning process, as proposed by Ausubel, becomes more meaningful for the students (Rahmah, 2018). Furthermore, the incorporation of local culture as part of the learning content is believed to enhance students' effectiveness in understanding the material. This is supported by the research findings by Ilma & Wijarini (Ilma & Wijarini, 2018), which showed that using an integrated textbook with local potential in Tarakan effectively improved students' learning outcomes.

Based on the explanation above, the research team consists of three lectures from the Mathematics Education Department of Raja Ali Haji Maritime University is interested in research to develop a textbook for the Geometry of Plane and Space course. The textbook developed is integrated with the maritime context of the Riau Islands region, which is related to the student's daily lives.

The research title for this study is "Development of Plane and Space Geometry Textbook with the Integration of the maritime context of the Riau Islands Region." The

objective of this research is to produce a valid and practical textbook for the Geometry of Plane and Space course, which can be used as teaching material in the classroom.

The textbook developed through this research was titled Plane and Space Geometry Textbook. Currently, the developed textbook has passed the validation process by experts, indicating that the textbook developed is valid as teaching material. The next step is to conduct a practicality test for the textbook.

The practicality test aims to determine the textbook's practicality level as a teaching material. Sugiyono (2015), states that teaching material is practical if students easily understand it. This article will discuss the practicality of Plane and Space Geometry Textbook as a teaching material for the Geometry of Plane and Space course in the Mathematics Education Department of UMRAH.

II. Research Method

The development research utilized the 4-D model research design. The 4-D model research design was developed by Thiagarajan et al. and consisted of four stages: define, design, development, and disseminate (Elvi et al., 2021; Julfianto et al., 2022). The research has reached the final step of the development stage, which is the practicality test of the textbook produced. The practicality test is conducted after the expert validation of the product.

The practicality test assesses whether the textbook is practical for students to use as teaching material in the classroom. The practicality of the textbook can be evaluated based on three aspects: product appeal, ease of understanding the material, and learning efficiency. The subjects for the practicality test of the textbook are students from the Mathematics Education Department at Raja Ali Haji Maritime University (UMRAH) who are taking the Geometry of Plane and Space course.

Data on practicality were collected using a Likert-scale questionnaire instrument consisting of 12 statements. Each statement was provided with four answer choices and assigned scores as follows: Strongly Agree (S.A.) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (S.D.) = 1. The twelve statements were used to gather data on practicality assessed from three evaluation aspects, namely: (1) product appeal, assessed by item numbers 1 to 6; (2) ease of understanding the material, assessed by item numbers 7 to 9; and (3) learning efficiency, assessed by item numbers 10 to 12. The indicators for the three evaluation aspects are presented in Table 2.1.

Table 2.1
Indicators of the practicality test

No	Aspect Assessed	Indicator	Item
1	Product appeal	Showing interest in textbook design and content material	1,2,3,4,5,6
2	Ease of understanding	Content material is easily understood	7,8,9
3	Learning efficiency	Learning becomes more efficient	10,11,12

The data obtained from the questionnaire distribution is in the ordinal scale. Therefore, the data needs to be transformed into interval scale data. According to Boone, ordinal data does not have the same linear scale between its orderings, making it unsuitable for statistical analysis (Siregar et al., 2021).

The data transformation method used in this research is the Method of Summated Ratings (MSR). The MSR method can transform qualitative data with an ordinal scale into quantitative data with an interval scale (Ridwan, 2013). The steps for data transformation using the MSR method, according to Setiawati et al. (2013), are as follows:

1. Calculate the frequency score (*f*), which is the number of response frequencies in each category for each statement.
2. Convert the frequency score (*f*) into proportion score (*p*) by dividing the frequency (*f*) by the total number of respondents.

3. Calculate the cumulative proportion (*pk*) for each category for each statement.
4. Calculate the midpoint of cumulative proportion, obtained by adding the proportion value in the category to the previous cumulative proportion.
5. Calculate the deviation value (z) by converting the midpoint of the cumulative proportion score into a z-score using the standard curve as a reference.

To obtain the practicality score of the textbook, frequency data analysis technique is conducted using Ridwan's formula (2013) below:

$$p = \frac{total\ score\ obtained}{maximum\ score} \times 100\%$$

The respondents are then categorized according to the classification rules of product practicality in Table 2.2 (Arikunto & Jabar, 2018).

Table 2.2
Categories of textbooks practicality

No	Achievement Levels	Categories
1	81 – 100	Very Practical
2	61 – 80	Practical
3	41 – 60	Quite Practical
4	21 – 40	Less Practical
5	0 – 20	Not Practical

Based on the classification above, conclusions can be drawn regarding the developed textbook's practicality level.

III. Results and Discussion

The practicality test is conducted in the third stage of the 4-D model development research, the Development stage. This test aims to determine the instructional book's practicality level when used as a teaching aid.

The practicality test of the Plane and Space Geometry Textbook as teaching material was conducted in the Mathematics Education Department, Faculty of Teacher Training and Education, Raja Ali Haji Maritime University. The test subjects were 64 students taking the Geometry of Plane and Space course. A questionnaire instrument consisting of 10 statements using a Likert scale was used to collect data on practicality, assessed from three aspects: (1) product appeal, (2) ease of understanding the material, and (3) learning efficiency. The questionnaire instrument was distributed at the end of the class.

The collected data from the student responses using the questionnaire instrument were then transformed into interval data using the Method of Summated Ratings (MSR). The transformed data results are presented in Table 3.1.

Table 3.1
Results score by MSR methods

Aspect Assessed	item	Students respond			
		Score z			
		SD	D	A	SA
Product appeal	1	-3,49	0,00	3,49	3,49
	2	-3,49	-2,42	-0,36	1,04
	3	-3,49	-1,47	-0,06	1,32
	4	-3,49	-2,42	-0,49	0,86
	5	-3,49	-3,49	-0,34	1,11
	6	-3,49	-1,99	-0,22	1,23
Ease of understanding	7	-3,49	-2,42	-0,30	1,15
	8	-3,49	-1,53	-0,08	1,32
	9	-3,49	-1,86	-0,12	1,42
Learning efficiency	10	-3,49	-1,60	-0,18	1,15
	11	-3,49	-3,49	-0,58	0,78
	12	-3,49	-3,49	-0,40	1,01

Referring to the research by Setawati et al. (2013), adjusting the MSR result score can be done by adding up the absolute value of the lowest response score per item with each response on the item. This method generates a zero as the lowest score, denoted as z+. The adjustment score z+ is presented in Table 3.2 below.

Table 3.2
Adjustment score z+

Aspect Assessed	item	Students respond			
		Score z+			
		SD	D	A	SA
Product appeal	1	0,00	3,49	6,98	6,98
	2	0,00	1,07	3,13	4,53
	3	0,00	2,02	3,43	4,81
	4	0,00	1,07	3,00	4,35
	5	0,00	0,00	3,15	4,60
	6	0,00	1,50	3,27	4,72
Ease of understanding	7	0,00	1,07	3,19	4,64
	8	0,00	1,96	3,41	4,81
	9	0,00	1,63	3,37	4,91
Learning efficiency	10	0,00	1,89	3,31	4,64
	11	0,00	0,00	2,91	4,27
	12	0,00	0,00	3,09	4,50

The data from the transformation in Table 3.2 has already been converted into an interval scale for statistical analysis (Setiawati et al., 2013). The next step is to calculate the attainment and maximum scores for each aspect of the practicality assessment of the instructional book. The total attainment and maximum scores for each aspect of the practicality assessment are presented in Figure 3.1.

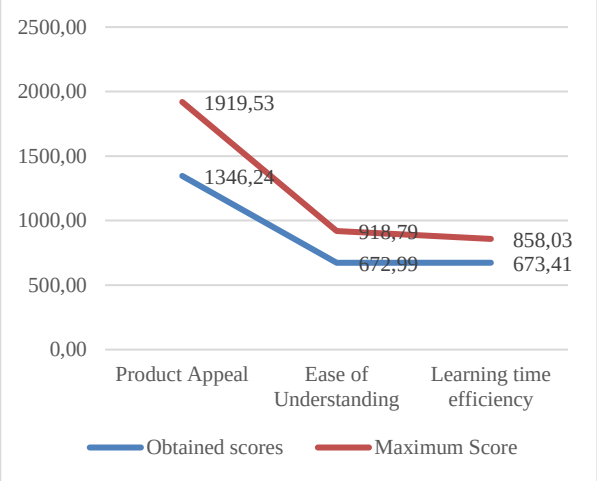


Figure 3.1 Total scores on each aspect of the practicality assessment

To assess the practicality of the instructional book, a frequency analysis technique is applied to the attainment scores for each aspect of the assessment. The results of the frequency analysis for the practicality data are presented in Table 3.3.

Table 3.3
Textbook practicality result

No	Aspect Assessed	Achievement Levels	Categories
1	Product appeal	70,13%	Practical
2	Ease of understanding	73,25%	Practical
3	Learning time efficiency	78,48%	Practical
Practicality result		72,85%	Practical

Based on the information in Table 3.2, the analysis of student responses regarding the product appeal aspect shows an attainment level of 70,13%. Based on the respondents' evaluation, the Plane and Space Geometry Textbook developed through research and development has reached the practical category as teaching material. The developed instructional book has a consistent design with a reasonable layout, proportional object placement and size, varied yet harmonious use of colors for objects, and appropriate typography that supports readability.

Integrating the maritime context of the Riau Islands region in the developed instructional book adds attractiveness for the respondents. This is because the maritime context of the Riau Islands region is local in the respondents' daily lives. Mvududu & Kanyogo (2011) said that using real-life examples makes the course more attractive and helps students have fun learning. This finding is supported by the research of Pratama et al. (2022), which states that integrating local contexts can attract students' interest in the developed instructional materials. In this research, the local context is the Maritime Riau Islands, while Pratama et al. used the Malay cultural context of the Riau Islands.

Based on the information in Table 3.2, the evaluation results of the practicality test for the ease of understanding the material aspect indicate an achievement level 73,25%. This means that the students can easily understand the material's content. According to the respondents, contextual maritime elements in the developed textbook

helps them make connections between the subject matter and their daily lives. This impacts the process of association and assimilation of new knowledge, making it more accessible. This finding is supported by Ilma & Wijarini (2018) found in their research that students find it easier to understand the material presented in a textbook when it is connected to their everyday life context. Using real-life context helps students understand the concept (Dewi & Primayana, 2019; Mvududu & Kanyongo, 2011).

The integration of contextual maritime elements from the Riau Islands at the beginning of each chapter (Figure 3.2) is an effort to invite students to see firsthand how the material to be learned is applied in the real world. This could have directed them to see that the new knowledge connected to their daily life. Furthermore, real-life problems can generate student motivation and interest in how the new knowledge connects to their daily life and its usage in everyday life (Premadasa & Bhatia, 2013). Therefore, the textbook was also designed using several problems based on maritime as the context presented as examples and practice exercises.

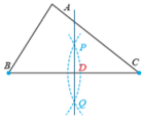
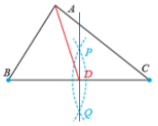
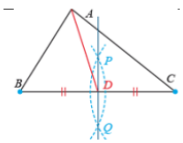
Source: kumparan.com

Sailboat Jong is a legendary Malay folk game in the Riau Archipelago. This sailboat relies on strong winds to bring it out of the sea. The participants placed their sailboats by the seawater to be carried by winds out to sea. The colorful sails of the sailboat make the ocean view looks cheerful. The sails of these boats usually are made of cloth or plastic materials. Can you determine the minimum area of material needed to make Jong's sails?

Figure 3.2 Example of maritime contextual problems presented at the beginning of chapter 3

According to Ausubel, using students' real-life environments as contexts in the instructional material can support meaningful learning for students (Rahmah, 2018). This is because the contextual problems presented are part of their daily life which concept is familiar to them. It could enable them to connect with new knowledge and acquire the meaning of new information (Agra et al., 2019). The new knowledge could help them make sense of the world and solve their real-life problems.

The material described in the textbook is accompanied by tasks that require students to engage in learning, as shown in Figure 3.3. Students are asked to work and think actively in solving the given tasks or problems. Through active learning activities in completing learning tasks, students enhance the process of new knowledge acquisition. This is because students' active engagement in learning positively impacts their learning outcomes (Errey & Wood, 2011).

Drawing Steps	Expected Results
Gambarlah segitiga ABC sebarang Draw a triangle ABC	
Buatlah garis sumbu pada garis BC yang memotong sisi BC di titik D Draw an axis line that intersects side BC at point D	
Hubungkan titik A dengan titik D Draw a line to connect point A to point D	
Garis AD merupakan garis berat, sehingga Panjang BD = DC. Straight line AD is known as a median of a triangle, the length BD = DC	

Please try to draw the medians of the triangle on the other sides!

Figure 3.3 The median of the triangle

Based on the information in Table 3.2, the evaluation of the practicality test of the instructional book in terms of the learning efficiency aspect shows an achievement rate of 78,48%, categorizing it as practical. This means

that the Plane and Space Geometry Textbook developed in this research can optimize learning efficiency. This finding aligns with Umar's et al. (2019) statement that one of the significant roles of instructional materials is to help students grasp lesson ideas more effectively and faster.

The textbook developed through this research serves as a solution to the problem of the need for instructional materials for the Geometry of Plane and Space course in the Mathematics Education Department of UMRAH. The course used to have reference books authored by lecturers or non-lecturer experts at UMRAH or other instructional materials available on the internet. However, not all topics covered in those books or instructional materials are relevant to the subject matter or learning outcomes of the Geometry of Plane and Space course in the Mathematics Education Department of UMRAH. As a result, students need more time to analyze various sources to find sufficient references for the subject matter. With the availability of this research-based instructional book, students can directly access appropriate study materials for the Geometry of Plane and Space course.

Additionally, the maritime context, which is the everyday context of the students, highlighted in the Plane and Space Geometry Textbook, can help students understand the subject matter more efficiently, thus improving learning time efficiency. Furthermore, students can download the e-book version provided by the authors. The textbook can be accessed using digital devices such as handphones, laptops, etc.

Table 3.2 shows that the overall practicality level of the instructional book is 72,85%, categorizing it as practical (Arikunto & Jabar, 2018). This indicates that the Plane and Space Geometry Textbook developed through this research, meets the practicality criteria for use as instructional material. As suggested by Sugiyono (2015) the implication is that the textbook developed through this research is practical for understanding the subject matter in the Geometry of Plane and Space course. Integrating the maritime context of the Riau Islands in the instructional book can help students better comprehend the course material.

Conclusion

The development research went through three stages of the 4D model: the define, design, and development stages. The results of the practicality test showed that the instructional book achieved practicality levels of 70,13% and 73,25% in terms of attractiveness and understanding of the subject matter, respectively, meeting the practicality criteria. Regarding time efficiency, the book achieved a practicality level of 78,48%, categorized as practical.

The evaluation results indicated that the instructional book developed through this research met the criteria for practical use as instructional material, with an achievement level of 72,85%. Therefore, it can be concluded that the instructional book titled the Plane and Space Geometry Textbook has met the practicality criteria for use as instructional material in the Plane and Space Geometry course. Integrating the maritime context of the Riau Islands can help students establish connections between new knowledge and their daily lives, facilitating the association and elaboration of new knowledge. This contributes to making the understanding of new material easier.

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