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Evaluation of Learning Media (Textbooks) in Area of Square and Rectangle to Prepare Student in Problem Solving: Praxeological Analysis

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ABSTRAK

Buku teks adalah salah satu media pembelajaran yang perlu dievaluasi secara objektif karena buku teks merupakan salah satu bentuk implementasi kurikulum yang biasa digunakan guru di dalam kelas. Banyak negara maju lebih memperhatikan studi ini seperti Jepang, Amerika, Belanda, sehingga studi buku teks telah diakui secara luas sebagai bidang penelitian ilmiah. Menurut Teori Situasi Didaktis, isi materi yang diajarkan harus memungkinkan siswa berpikir. Peneliti menggunakan Praksiologi dalam penelitian ini. Hal ini agar hasil evaluasi berjalan secara objektif. Praksiologi, diprakarsai oleh Chevallard, membantu peneliti melihat alasan di balik tindakan manusia dalam buku teks dan matematika. Berdasarkan analisis praksiologis, diperoleh hasil bahwa desain buku ajar tidak memberikan teknik yang memfasilitasi siswa untuk memperoleh teori secara mandiri. Selain itu, situasi dan tindakan yang harus dilalui siswa perlu diakomodasi dengan baik. Hal ini memandu peneliti untuk membuat desain alternatif untuk memberikan pengalaman belajar yang bermakna pada materi datar luas yang mengacu pada Teori Situasi Didaktik.

Kata Kunci : buku teks matematika; media pembelajaran matematika; persegi dan persegi panjang; praksiologi

ABSTRACT

Textbooks are one of the learning media that need to be evaluated objectively because textbooks are a form of curriculum implementation that teachers usually use in the classroom. Many developed countries pay more attention to this study such as Japan, America, Holland, so textbook studies have been widely recognized as a field of scientific research. According to the Theory of Didactical Situations, the content of the material being taught must allow students to think. to make an objective analysis of the book, Researchers used Praxeology in this study. Praxeology, initiated by Chevallard, helps researchers see the reasons behind human action in textbooks and math. Based on the praxiological analysis, the result is that the design of the textbook does not provide techniques that facilitate students to acquire theory independently. In addition, the situations and actions students should go through need to be properly accommodated. This guides researchers to create alternative designs to provide meaningful learning experiences on broad flat material referring to the Theory of Didactic Situations.

Keywords: mathematics textbooks; media learning mathematics praxeology; square and rectangle area

INTRODUCTION

Mathematics teachers have the challenge on doing preparation for teaching. Specially, Mathematics teacher. A student does not do mathematics unless he asks himself questions and solves problems (Brousseau, 2002; Widodo et al., 2020). Mathematics is about creativity and problem solving (Fulco, 2022). Difficulty what students face in solving problems is not

understanding the concept, difficult to determine the problem-solving plan, difficult to determine the formula to use, difficult complete the calculation process, and never double-check the answers obtained (Gumanti et al., 2022; Septian et al., 2021). Students should be encouraged to explore their problem-solving abilities creatively through productive struggles (Zuliyanti & Pujiastuti, 2020). The productive struggle refers to learning mathematical concepts, procedures, and ideas to have a meaningful understanding of mathematics. One effort that can be done is to provide opportunities for students to construct their knowledge.

Piaget and Vygotsky agreed that a child does not sit passively absorbing knowledge but actively builds knowledge. Constructivism views knowledge as the result of cognitive construction through one's activities (Mulyono, 2011; Septian & Rahayu, 2021). There are many roles to develop. One of them is the role of textbooks in supporting constructivist student learning. Existing textbooks must provide opportunities for students to think.

Textbooks are human actions, so that they can be analyzed through Praxeology. Praxeology is an analytical tool initiated by Chevallard. He argues that there are no human actions whose reasons cannot be questioned (Chevallard, 2019). On this occasion, the author analyzes Mathematics textbooks in Plane Figures because this topic is essential basic material before entering into more complex geometry lessons. On the other hand, The results showed students' ability in indicators 3 and 4 of the problem-solving questions is still relatively low on a plane figure (Bernard et al., 2018).

From the results of the book analysis, teachers can decide to use the material or create alternative designs that are in accordance with one of the learning theories. The theory used is Theory of Didactical Situation (TDS). A theory that describes how students can construct their knowledge. In this study the researchers also made an alternative material design, which was implemented directly in one of the West Bandung Regency Lower Secondary Schools. This study shows the results of alternative designs made by researchers.

METHODS

The primary data analyzed were taken from lower secondary school mathematics textbook. The analytical technique used in this study is Praxeology. Praxeology sees the feasibility of presenting textbooks referring to four components, namely the type of task (T), technique (τ), technology (θ) and theory (Θ). Researchers also interpret the results of this analysis with TDS. To see the level of epistemic design of textbooks.

Yves Chevallard Professor in France, developed praxeology. In principle, it states that there is no human action without being, meaning that no human action is carried out without a thought behind it (Bosch et al., 2017; Chevallard et al., 2022). Praxeology as an epistemological approach has been widely used in educational research such as on book analysis (Takeuchi & Shinno, 2020), lesson planning (Kilhamn et al., 2022), or on other educational issues (Wijayanti & Winslow, 2017). A praxeology consists of two blocks—praxis and logos—and each block consists of two elements, as shown in Table 1.

Table 1. A Praxeology Consists of Two Blocks—Praxis and Logos—and Each Block Consists of Two Elements

Praxis blocks		Block logos	
Type of Task	technique	Technology	Theory
Problems of a given type	A way of performing this type of task	A way of explaining and justifying (or designing) the technique	To explain, justify, or generate whatever part of the technology that may sound unclear or missing

In Table 1, there are four stages of Praxeology. The first type of task is the assignment presented in the book. Second, technique, namely the consequences and orders of what can be done based on the type of task. Third, technology comes from the words technics and logic. This relates to the motives or reasons behind the technique by the author of the book. The last one is the theory. At this stage, it will analyze whether the type of assignment is in accordance with the theory.

RESULTS AND DISCUSSION

Material Design of Rectangle Formulas on Textbooks of Indonesia

Table 2. Type of Task (T1)

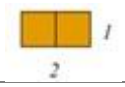
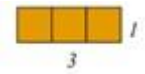
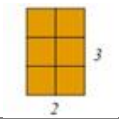
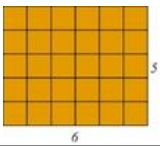
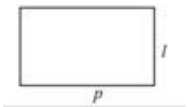
Rectangular Image	Long Side	Short Side	Circumference	Area (Number of Squares)
	2	1	2 (2+1)	2 x 1 = 2
	3	1	2 (3+1)	3 x 1 = 3
	3	2	2 (3+2)	3 x 2 = 6
	6	5	2 (6+5)	6 x 5 = 30
	…	…	…	…

Table 3. Technique, Technology, And Theory On Text Books

technique	Technology	theory
Write down the rectangle formula.	A pattern has been given to arrive at the rectangle formula.	The formula for a rectangle is length times width.

Table 4. Type of Task 2 - 6

Type of Task	Technique
T2: formulate formula rectangle Example: conclude connection Among side length and sides wide with around	operational
T3: connecting linkages square and rectangular Example: is every wide area rectangle long always could stated with wide area square? Explain	Physical
T4: count wide rectangle Example: Area of a rectangle long same with wide long square side 20 cm. If wide rectangle long is 10 cm, then define long rectangle length and circumference rectangle long	Physical
T5: count wide linked rectangle with context Mr. Amal has a plot land empty shaped area rectangle long on the side his house. The length of the land is 50 m and the width is 30 m. Determine wide Pak Amal 's land unit cm2 b. Decide wide Pak Amal 's land are unit.	Physical
T6: count wide rectangle with various method Something rectangle shared Becomes four part same big and same shape. Go around each section is 16cm. Define wide area the original square (draw 3 or 4 ways divide it and count each respectively breadth)	Physical

T_{1-6} is regional praxeology. Students are not allowed to construct their knowledge. Students are only asked to follow the appropriate example and get the general formulation. The formulation obtained is the formula for the area of a rectangle. In addition, the justification characteristics of the techniques used need to consider the fact that students have a variety of academic abilities, knowledge, and learning experiences (ontogenic obstacles).

Alternative Design for Rectangle Formulas

Table 5. Type Of Task On Alternative Design

Rectangular Image	Questions
Formulate the Rectangle formula in many ways.	The sum of the four sides is called the perimeter and the area bounded by the four sides is called the area. It is known that the perimeter of the rectangle is 22 units and the area of a square is equal to the number of squares, namely 30 squares. 1) How do you calculate the perimeter of a rectangle so that the perimeter is 22 units?

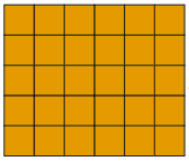
Rectangular Image	Questions
	2) How do you calculate the area of the rectangle so that the sum of the squares is 30?

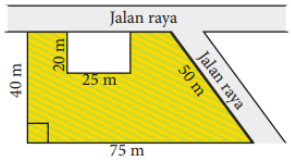
Table 6. Technique, Technology, and Alternative Design

Technique	Technology	theory
Possible student answers 1) Students count the number of small lines that surround the rectangle to calculate the perimeter of the rectangle 2) Students number the squares one by one to calculate the area of the square. 3) Students carry out multiplication operations. The number of boxes in the bottom row of the rectangle is 6, and the number of boxes on the sides of the rectangle is 5. Students perform multiplication 6 x 5 = 30	Given commands to find the rectangle formula in various ways.	The formula for a rectangle is length times width.

There are several steps to calculate the circumference and area. There are even students who may need to be correct in answering them. However, this design aims to provide opportunities for students to think in order to get formulas based on their experience in order to get meaningful learning. If there is an error, it is a common process to go through. In the end, the teacher as a facilitator is expected to provide the expected validation of student answers. Validation can be done in the form of correction if wrong and justification if the answer is correct.

Design on the Material of Calculating Land Area on Textbooks of Indonesia

Table 7. Type of Task on Textbooks

Figures	**Questions**
Calculating land area. 	The shaded area is a sketch of the cultivated land. What is the area of the grass?

Students are allowed to construct their knowledge. However, We need to create problems that open students' minds to think differently and creatively. The open-ended approach is one of the first attempts to innovate mathematics education by Japanese mathematics education experts. open-ended capable provide a stimulus to learners to use abilities that have been It has in solving open problems. The application of the open-ended approach is effective in terms of students' mathematical problem-solving abilities (Dewi, 2018).

Alternative Design for Calculating Land Area

Table 8. Type of Task on Alternative Design

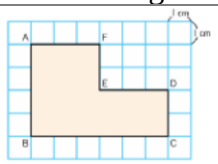
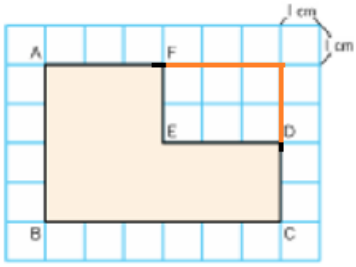
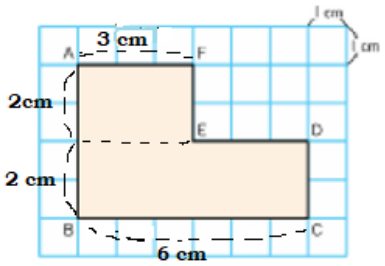
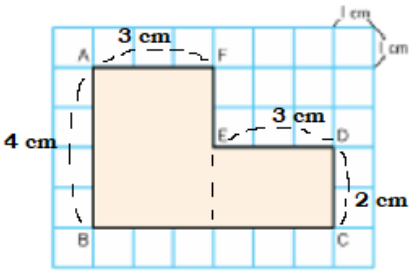
Figures	Questions
	Find the area of shape below in several different ways !

Table 9. Technique, Technology, and Alternative Design

Technique	Technology	theory
Possible student answers 1.  $4 \times 6 - 2 \times 3 = 24 - 6 = 18\ cm$ 2.  $2 \times 3 + 2 \times 6 = 6 + 12 = 18\ cm$ 3.  $4 \times 3 + 3 \times 2 = 12 + 6 = 18\ cm$ There are many ways that students might write.	provide opportunities for students to think further	Calculating land area in various ways according to his understanding

The design above is made specifically to train students in understanding meaningful material. It refers to constructivism. One theory that supports constructivism is Theory of Didactical Situation (TDS). There are four situations in this TDS, namely action situations, formulation situations, validation situations and institutionalization situations.

This design's action situation is calculating a rectangle 's area to get thirty squares. This question stimulates students to carry out independent interactions. TDS theory explains that the action situation or problem chosen by the teacher is an important part of a broader situation in which the teacher tries to devote to students a didactical situation that provides the most independent and most beneficial interaction (Brousseau, 1997). When students carry out this action situation students produce a formulation situation.

The situation formulation will result in a conceptual and memorial process. Conceptual is what is observed and what is read. Students are asked to observe the number of boxes and how to get that number. Students will use a frame of reference for thinking built on experience and previous knowledge, so there is a conceptual and memorial process. Prior knowledge required in this lesson is multiplication, the definition of perimeter and area definition. When the children have found and formulated the perimeter and area of rectangles, they produce their respective findings. Then it can be brought into the discussion, which is a validation situation.

Each finding is validated in a social context, such as a class or group discussion. This will give birth to various situations. There will be a shift in his view of knowledge. He may become more confident because other people also believe in what students find, or it may be that students realize their mistakes so that their knowledge shifts to believing in what other parties have produced. In this situation, there is introfection, namely a situation of validation. In addition to validation situations, an a priori process is required. The learning design in the last alternative design brings students into the a priori process of how the broad formulation can be applied to different contexts. In this process, an institutional situation occurs. So the mathematical object he has constructed has already initiated it into him. So students are ready to use it in any situation. This provides new good habits for students because in a study students said they did not understand the problem because they had never received questions in the form of non-routine or closely related to daily life or the surrounding environment and were accustomed to being given questions and doing them as exemplified by the teacher (Setyaningsih & Firmansyah, 2022; Widodo & Kartikasari, 2017). In the end, this praxeological analysis provides an overview to teachers or other education practitioners regarding the characteristics of the material in textbooks and provides alternative designs that become recommendations that are adapted to TDS theory which hopes can be a provision to prepare students in problem solving because after all TDS emphasizes understanding concepts. meaningful mathematics as based on previous research that an understanding of mathematical concepts is needed to be able to solve problem solving abilities (Widodo & Kartikasari, 2017).

CONCLUSSION

The types of task given to T1-T6 have not optimally provided students with the opportunity to form their own knowledge, because the designs presented in the book still contain many instructions that lead students to the expected answers. So that a new

alternative design is needed to accommodate the needs of the students that the author has created and alternative forms of learning designs. Alternative designs are made based on TDS theory which accommodates students to gain meaningful understanding so that they are expected to be able to help them later when dealing with problem solving problems.

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