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DEVELOPMENT OF MATHEMATICS LEARNING MEDIA CONCEPT BOARD (PAKELING BANDAR) FOR STUDENTS WITH SPECIAL NEEDS

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Abstract
The research aims to produce mathematics learning media that is valid, practical, and effective according to the student's needs, particularly in learning geometry for special needs students in Junior High School (phase D). The research method used is research and development with analysis flow; design, development, implementation, and evaluation. The study was conducted in a special school with a total of 3 students, namely 1 student with Autism Spectrum Disorder (ASD) and 2 students with intellectual disabilities. The data collection techniques used were questionnaires, observations, and test questions. The instruments used were validation questionnaires, teacher response questionnaires, student observation sheets, and sheets of pretest-posttest. The research results show that Pakeling Bandar media has valid criteria by the three validators with V-Aiken scores $\geq 0{,}61$ in all aspects of the assessment. The practicality test obtained an average score of 3,59. Media Pakeling Bandar was declared very effective based on the assessment results post-test with a completion percentage of 98,33%. Moreover, learning media has met the criteria of being valid, practical, and effective and has met the needs of phase D ASD and mentally retarded students in maximizing the learning of geometric elements in the material around triangles, squares, and rectangles. With Pakeling Bandar media, students can understand the concept of the perimeter of plane figures, and calculate the perimeter of plane figures, and students are actively involved in learning in class.

Keywords: ASD, mathematics learning media, special need

Introduction
Learning media is a tool that can help teachers transfer knowledge to students at school (Baysu et al., 2022; Fonger, 2019). Schijns (2021) also discusses the meaning of learning media as everything that is used in the learning process as a channel for messages and information that can stimulate students' thoughts, interests, and attention so that the process of learning interaction and communication between teachers and students can take place properly. With

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learning media, teachers can maximize the quality of the learning delivered (Munfarikhatin et al., 2020). According to Chahal and Rani (2022) in his book which states that the general benefits and specific benefits of teaching aids for mathematics learning media for students are that learning becomes more active because there is interaction between students and teachers, improving the learning process and outcomes, and teachers become more motivated to design better learning.

Pakeling Bandar media is a combination of tangram game media and geometry board which are combined and modified according to students' needs. This media is a combination of tangram media and geometric boards. The tangram game is a geometric puzzle game that consists of seven plane figures, namely two large triangles, one medium triangle, two small triangles, one square, and one parallelogram (Bofferding & Aqazade, 2023; Pohl & Richter, 2021). Meanwhile, according to Yamada et al. (2024), the tangram game is a game that originates from China puzzle geometry consists of seven plane figures and the seven pieces are arranged and attached to form various geometric patterns and can form shapes such as ships, houses, animals, etc.

Bofferding and Aqazade (2023) stated that the geometry board learning media is a medium for introducing plane figures, helping children learn about plane figures, and helping children calculate the circumference of plane figures easily and in fun. In his research, this geometric board media was not only used by normal students but also by students with special needs who could also use it, one of which was blind students who could be touched in how it was used. From this opinion, it can be concluded that the geoboard is a learning medium that can be used as a learning aid in geometry material. Furthermore, a geoboard can help students calculate the area and perimeter of plane figures. Uya (2023) explains the benefits of geometric board media (geoboard) to help students form various shapes of plane figures, helping students understand the concept of perimeter and area of plane figures.

Meanwhile, according to Trimurtini et al. (2020), the application of geometry board media can help students understand the concept of perimeter and area of abstract plane figures so that with the geometry board media, students become interested, challenged, and active in learning using geometric board media. The development of sparkling bandar media has aimed at students with special needs, in this case, the students with ASD and mental retardation in the D phase to help students in introducing plane figures, introducing the concept of the perimeter of incoming shapes, and calculating the perimeter of plane figures, triangles, squares, and rectangles of varying shapes and sizes. Benefits of dealer media for students with special needs include: can attract the focus or students' attention, students can understand plane figures in geometric material, students can understand the concept of the perimeter of a plane figure, calculate the circumference of a plane figure through the media and maximize learning on geometric elements.

Autism spectrum disorder (ASD) or what is often known as autism students with obstacles to the development of the brain's nerves (Martono et al., 2020; Munfarikhatin & Rachmat, 2021). This disorder can be recognized since the child is 18 months old with symptoms of shutting down, liking to play alone, and liking to do things repeatedly. So that causes sufferers to experience obstacles in communicating and interacting in social environments. According to Irfan et

al.(2020) and Munfarikhatin et al. (2021), apart from the obstacles these students have, it turns out that some of them have quite good memories, especially in the form of visuals and real objects, and have good potential in the field of numbers and calculations.

The application of media for students with special needs has been carried out by Baysu et al. (2022) with research results that using Tangram media can improve the ability to recognize plane figures in children with learning difficulties. Olsson and Granberg (2022) also concluded that the ability to calculate the circumference of plane figures can be increased through the use of learning media geoboard. These three research results indicate that the application of geometric learning media has a positive impact on students with special needs.

Based on the results of joint interviews with teachers, information was obtained that ASD students are students with limitations in communicating, interacting socially, and only focusing on themselves (Marotta et al., 2020). In learning, these students often do not focus due to repetitive activities (Zeidan et al., 2022). However, despite the obstacles they suffer, ASD students have a talent for counting. These students are very fast and precise when solving the counting problems given by the teacher, but are still guided when solving them. One of the materials in secondary school mathematics learning that requires media as an intermediary for learning is geometric elements. The teacher is only limited to providing an introduction to geometric shapes in the description on the blackboard. Considering the learning achievements in geometry material, at the end of the phase students can show and determine the perimeter of plane figures (triangles, squares, and rectangles). Therefore, it is important to develop a learning media that can help meet the needs of ASD students in secondary school.

Method

Research and development methods are applied using the flow of analysis, design, development, implementation, and evaluation (Karimi et al., 2021; Umbara et al., 2023). This research involved two ASD students from one of the special schools as research subjects. At the analysis stage, information is collected related to the problems students are facing at school. At this stage, the researcher carried out two analyses of needs namely, an analysis of student needs and an analysis of learning media needs. The design stage emphasizes designing and creating Pakeling Bandar products and teaching modules. Pakeling Bandar media is arranged manually and consists of three components, namely individual boards, tangram boards, tangram pieces, and letter and string accessories. Meanwhile, teaching modules are developed by developing learning objectives based on learning outcomes. As a cognitive evaluation tool, pretest and posttest questions were also created which were carried out before product implementation and at the end of product implementation. At the development stage, the product that has been completed is then validated. The validated products are dealer media, teaching modules, and test questions. Validation is carried out to determine the suitability of the product that has been made. Validation tests are carried out by three validators who provide assessments until the product is declared valid. After the product is declared valid and suitable for use, the next step is the implementation stage.

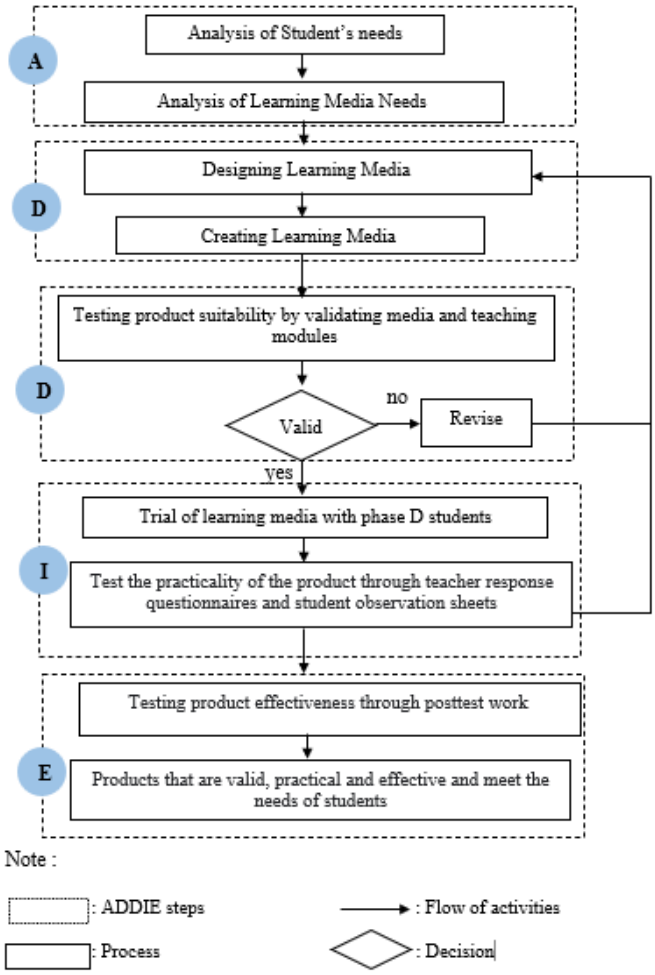


Figure 1. Learning media development flow

Product implementation is applied to learning for ASD students by conducting a pretest first. The Pakeling Bandar learning media was applied in two meetings, there are at the first meeting the students took part in the lesson with the learning objective indicator determining the perimeter of the triangular, square, and rectangular Plane figure by wrapping a rope around all sides of the Plane figure using Pakeling Bandar media. This aims to introduce the concept of the perimeter of a Plane figure. Furthermore, the learning objective at the second meeting was to calculate the perimeter of triangular, square, and rectangular shapes using Pakeling Bandar learning media. Assessment of the practicality of learning media is obtained from the results of teacher response questionnaires and student observations. A teacher response questionnaire was given to teachers to measure the practicality of the Pakeling Bandar media and teaching modules. Meanwhile, observation is used to see and measure the practicality of the dealer media that has been applied to students. Moreover, at the evaluation stage, an evaluation is carried out on the results of implementing the Pakeling Bandar learning media by giving a final test or posttest to determine the level of effectiveness of the media that has been developed. The dealer media is said to be effective if the students' posttest results are in the complete category. This stage is also the final stage to see whether the product created is successful, by initial expectations or not.

Findings and Discussion

Analysis

Based on the results of joint interviews with the homeroom teachers of ASD students, each type of student with special needs has its limitations, characteristics, and potential. This greatly influences learning activities at school. Therefore, it requires teachers to have skills in designing learning strategies that can facilitate students according to the limitations and characteristics of each type of student's disability. However, what happens is that schools still lack teachers and limited classroom space. This causes the types of impairment to be combined into one class. ASD has the characteristic of focusing on their activities without interacting with other people, but these students can count (Marotta et al., 2020). Minimal availability of learning media and lack of teacher skills in applying learning media. First, a lack of provision of media that can facilitate ASD students' phase D in learning. This is known from learning activities that still use the method of rewriting what the teacher said. Second, this obstacle is based on changes to the school curriculum. In implementing the independent curriculum, schools experienced changes, one of which was changes in teacher duties. Teachers who started as subject teachers now act as homeroom teachers who must have the ability to teach all subjects to students. The homeroom teacher for ASD phase D students was originally a science subject teacher but now must have the ability to teach other subjects, one of which is mathematics. So, teachers are required to be able to use mathematics learning media.

Table 1. Learning outcome in geometry content phase D

Element	Learning Outcomes
Geometry	At the end of phase D, students can show how to determine the perimeter, triangle, square, and rectangle using concrete objects (thread, rope, matches, sticks, and various objects that can be used as a unit of length), calculate the perimeter, triangle, square, and rectangle use concrete objects that can be used as a unit of length.

With the various limitations that students with special needs have, it becomes difficult for these students to learn the material without using the help of real objects or learning media (Andim & Aziz, 2021). One of the lessons that has not been maximized is on the geometric elements of phase D in the material on the circumference of triangles, squares, and rectangles. Therefore, the solution that can solve this problem is to develop learning media that suits the needs of students (Olsson & Granberg, 2022) so that learning objectives can be achieved. The learning outcomes that students must achieve in geometric elements can be seen in the table below.

Design

Pakeling Bandar unit board

Bandar Pakeling media is made manually and consists of 5 components namely individual boards, tangram board, tangram pieces, letter accessories, and rope. The unit board is the board used to arrange the tangram pieces to form the Plane figure being studied. Apart from that, the Bandar Pakeling unit board is also used to calculate the length units in the Plane figure killing.



Figure 2. Pakeling Bandar unit board

The Pakeling Bandar unit board has an overall size of 45 cm x 45 cm. The box lines measure 3 cm x 3 cm with a length of 12 squares and a width of 10 squares so the total measures 36 cm x 30 cm. At the top of the unit board, there is the writing "PAKELING BANDAR" and at the bottom, there is a place used to write the results of calculating the perimeter of a Plane figure. The Pakeling Bandar unit board is composed of plywood, zinc plate, and manila paper which has been made into individual checkered lines and thick plastic.

Tangram pieces board

The tangram board is a special board used to place tangram pieces. The tangram board has an overall size of 24 cm x 24 cm.

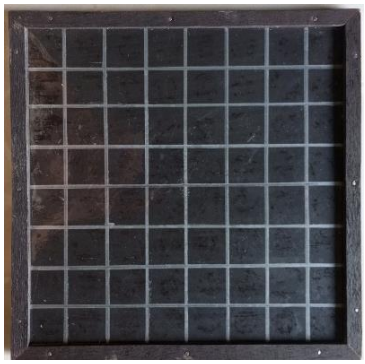


Figure 3. Pakeling Bandar pieces board

On the board, there are checkered lines to make it easier to arrange tangram patterns. The box lines measure 3 cm x 3 cm. The tangram board is composed of plywood, and zinc plate which has been lined with individual squares and thick plastic to avoid dirt and scratches on the individual square lines.

Tangram pieces

Tangram pieces are a tangram shape that has 7 plane figures, namely 2 large triangles, 1 medium triangle, 2 small triangles, 1 parallelogram, and 1 rhombus. The tangram pieces are modified into small pieces so that the size of the Plane figure becomes more varied. These tangram pieces are square and triangular pieces cut from the diagonal of the square.



Figure 4. Tangram pieces

Tangram pieces are used in preparing Plane figures whose circumferences will be calculated with shapes and sizes that can be adjusted to your wishes. These tangram pieces have a total size of 24 cm x 24 cm with each piece measuring 3 cm x 3 cm. Each piece is given a magnet or bold iron at the bottom to prevent it from easily shifting and falling when arranged to form a plane figure.

Letter and rope accessories

Letter and rope accessories are used as complements in arranging plane figures. Letter accessories are used to help students determine corner points and sides of flat figures. Meanwhile, rope accessories are used to help students show how to determine the circumference of flat shapes that have been arranged.



Figure 5. Letter and rope accessories

Teaching module

Teaching modules are a type of teaching tool to help direct the learning process to achieve learning outcomes (Damrongpanit, 2022). The teaching module consists of lesson plans, materials, LKPD, and assessment instruments (Uya, 2023). The teaching module consists of general information on teaching modules (identity of teaching modules, Pancasila student profiles, learning outcomes, learning objectives, learning models and methods, types of media used, number of students, initial competencies and target students), learning activities (composed of learning preparation and learning steps), formative assessment, remedial, teacher reflection, student reflection glossary and bibliography.

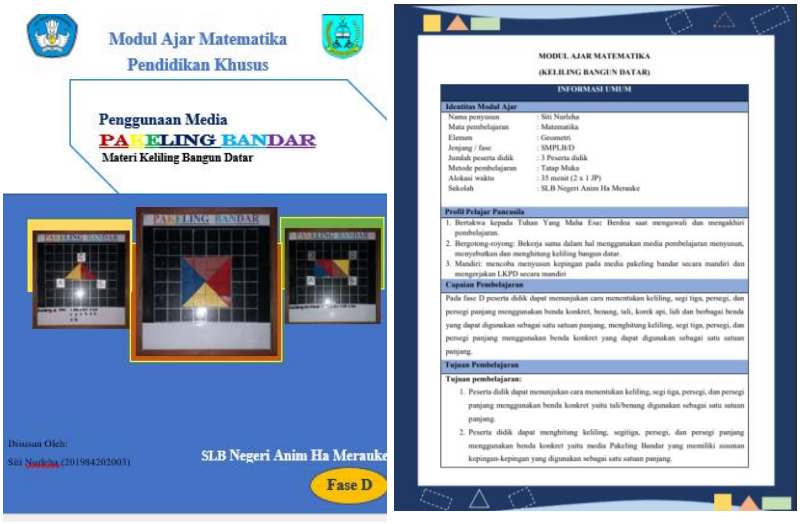


Figure 6. Pakeling Bandar teaching module

The material is arranged based on learning achievements and learning objectives in phase D geometry elements. The material shows how to determine the perimeter and calculate the perimeter of triangular, square, and rectangular shapes. Based on the learning objective indicators, the material is divided into two meetings. The first meeting shows how to determine the perimeter of triangles, squares, and rectangles. The second meeting calculates the perimeter of triangles, squares, and rectangles.

Develop

The media validation sheet for city packaging is given to 3 validators, namely validators I, II, and III. Urban packaging media is validated twice by validator I, twice by validator II, and once by validator III. Media Pakeling City is declared valid if all statements are on the V-Aiken score ≥ 0.61, that is with a value of. Media that has not been declared valid then the media needs to be revised until the media is declared valid.

Table 2. Learning outcome in geometry content phase D

Assessment Aspects	Item Number	Validator Results			n(c-1)	V-Aiken	Result
		I	II	III			
Content	1	5	4	4	12	0.83	Valid
	2	5	5	5	12	1.00	Valid
	3	5	5	5	12	1.00	Valid
	4	4	5	5	12	0.92	Valid
	5	4	5	5	12	0.92	Valid
	6	4	4	5	12	0.83	Valid
	7	5	4	5	12	0.92	Valid
Appearance	8	5	4	5	12	0.92	Valid
	9	5	4	5	12	0.92	Valid
Use and Presentation	10	4	4	5	12	0.83	Valid
	11	4	5	5	12	0.92	Valid
	12	5	4	5	12	0.92	Valid
	13	4	4	5	12	0.83	Valid

Assessment Aspects	Item Number	Validator Results			n(c-1)	V-Aiken	Result
		I	II	III			
	14	5	4	5	12	0.92	Valid
	15	5	5	5	12	1.00	Valid

Based on the validation results from the three validators, the score obtained from the V-Aiken calculation for all statement items is (valid). Thus, it can be concluded that the Pakeling Bandar media developed meets valid criteria and is suitable for use in mathematics learning in class VIII students with ASD phase D.

The teaching module validation sheet was given to 3 validators, namely validators I, II, and III. The teaching module was validated twice by validator I, twice by validator II, and one validation by validator III. The teaching module is declared valid if all the statement items are on the v-Aiken score, that is, if the teaching module value has not been declared valid, the media needs to be revised until the teaching module is declared valid.

Table 3. Data validation analysis of the teaching module

Assessment Aspects	Number of Statement	Validator Assessment			V-Aiken	Result
		I	II	III		
Learning Module Identity	1	5	4	5	0.92	Valid
	2	5	5	5	1.00	Valid
Implementation of P5	3	4	5	4	0.83	Valid
Learning Goals	4	4	4	5	0.83	Valid
Learning Equipment	5	5	4	5	0.92	Valid
	6	4	5	5	0.92	Valid
	7	4	4	4	0.75	Valid
Learning Material	8	5	5	5	1.00	Valid
	9	4	5	5	0.92	Valid
Learning Activity in Class	10	5	4	4	0.83	Valid
	11	5	4	4	0.83	Valid
	12	4	5	5	0.92	Valid
	13	5	5	5	1.00	Valid
LKPD	14	4	5	5	0.92	Valid
Language	15	5	5	5	1.00	Valid
	16	5	4	5	0.92	Valid
Appearance	17	4	5	5	0.92	Valid
	18	4	5	5	0.92	Valid

Based on the validation results from the three validators, the V-Aiken calculation score for all statement items is obtained, namely (valid). Thus, it can be concluded that the teaching module developed is valid and suitable for use in mathematics learning in class ASD phase D students.

Implementation

The practicality of learning media can be known after the learning media is applied to students in a class of ASD students. This is because conducting limited trials is difficult considering that these students are students with special needs, who find it difficult to get an immediate response without prior guidance (Luangrungruang & Kokaew, 2022; Marotta et al., 2020). So that the assessment of

the practicality of learning media is obtained from the results of teacher response questionnaires and the results of student observations when the Pakeling Bandar is applied in learning.



Figure 7. Students learning activity using Pakeling Bandar

A teacher response questionnaire was given to teachers to measure the practicality of the Pakeling Bandar and the teaching modules that have been implemented (Baanqud et al., 2020). Meanwhile, student observation aims to measure the practicality of the Pakeling Bandar in terms of the benefits and convenience of the media when implementing the media.

Table 4. Data analysis of teacher response questionnaires

Assessment Aspects	Question Number	Score
Learning material	1	4
	2	4
Learning Media	3	4
	4	3
	5	4
	6	4
	7	4
	8	4
	9	4
	10	4
Learning Module	11	4
	12	4
	13	4
Average Score	3.92	
Practicality Level	Very practical	

From the results of the teacher response analysis data, it can be seen that the results of the teacher responses were assessed with an average score of 3.92 in the very practical category.

Evaluation

To evaluate the product, an effectiveness test is carried out through the results of the test questions (pre-test and post-test) given to three students. Pakeling Bandar is declared effective if the student's test results are said to be complete by achieving the Minimum Completeness Criteria (KKM) that has been set at the school, namely 65.

Table 3. Pre-test and post-test data

Completeness Category	Pretest Result	Posttest Result
The Highest Score	70	100
Lowest Value	10	95
Average Value	39	98.3
The Number of Samples Completed	1	3
Many Samples are incomplete	2	0
Completion Percentage	33.3%	100%

Based on table data on the percentage of completeness pretest 33.33% have not reached the school KKM score. This data shows that students are not complete with an average score of 39, the highest score is 70, and the lowest score is 10. Meanwhile, the percentage score for completion post-test of 100%, students achieved the KKM score, namely 65 schools. This data shows that the three students completed it with an average score of 98.3 with the highest score being 100 and the lowest score being 95. Therefore, it can be concluded that the Pakeling Bandar media has been developed in the very effective category. The effectiveness of learning media was important for learning results particularly in mathematics class (Hwang, 2019). Moreover, the positive impact of using learning media can be shown by students' activities and enjoyment of learning (Munfarikhatin et al., 2019; Zeidan et al., 2022).

Conclusion

The resulting learning media development is Pakeling Bandar media which is equipped with teaching modules to facilitate the needs of students with ASD phase D special needs. Based on testing, the product was declared successful because it met the criteria of being valid, practical, and effective. As a result of the validation of the Pakeling Bandar media using the V-Aiken ≥ 0.61 calculation, scores were obtained for all aspects of the assessment, so that the Pakeling Bandar media was declared valid by the three validators and suitable for use in learning. The practicality criteria are based on the results of teacher response questionnaires and student observation sheets after the learning media is applied, with an average percentage of 89,1%, and are in the very practical category. With Pakeling Bandar media, learning in class will be more enjoyable and by students' needs so that the minimum completeness criteria for mathematics learning can be exceeded.

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