The development of worksheet oriented by visual learning style to measure geometry problem-solving skills

A Shofyan1, Sunardi1, N Yuliati1, Nuryami1, P Rizkika1

1 Department of Mathematics Education, University of Jember, East Java, Indonesia

Email: 190220101016@students.unej.ac.id

Abstract. Based on information from the math teacher at MTs. Nurul Islam Pasirian-Lumajang (East Java, Indonesia) which has 150 students of grade VII, there is a phenomenon was interesting. Many students like geometry lesson, this can be seen when the learning takes place with the media used interesting and many students like to draw flat shapes. However, when dealing with geometry problems, many students have difficulty determining the solution method. This study aims to develop teaching materials in the form of student worksheets on the circumference and area of a rectangle oriented towards students' visual learning styles and visual perception skills. Next students will be given a test to analyze the ability to solve problems and in accordance with Polya's problem solving steps that must be carried out sequentially, namely: understanding the problem, compiling a settlement plan, implementing the settlement plan, and checking the solutions that have been obtained. The development model used is the ADDIE model which includes: (1) Analysis, (2) Design, (3) Development or Production, (4) Implementation, and (5) Evaluation. Geometry material taken in this research is the perimeter and area of the rectangle. The results obtained from the analysis stage, that 50% of students have a visual learning style and for task analysis, the results obtained, of the 10 students who answered correctly there were only 2 students who answered correctly. After students read the material and worked on worksheets oriented to visual learning styles, there was a relatively significant change, out of 10 students there was only 1 student who did not understand in solving geometry problems.

1. Introduction
Mathematics is not just arithmetic [5], when talking about mathematics, people often view it narrowly, namely only as a collection of numeracy skills such as addition, subtraction, multiplication, and number division. In fact, if we look further, mathematics contains broader skills than just counting. Mathematics is essentially a way of thinking and contains related ideas. In mathematics learning activities, basically children will face two things, namely what problems may arise or be raised from a number of facts faced (problem posing) and how to solve these problems (problem solving). So that students are required to be able to solve these problems.

There is a phenomenon that occurs at MTs. Nurul Islam Pasirian-Lumajang, which has 150 students grade 7. Many students like geometry. This can be seen when the learning takes place with the media used interesting and many students like to draw flat shapes. However, when dealing with geometry problems, many students have difficulty determining the solution method. Basically geometry has a greater chance of being understood by students compared to other branches of mathematics [4]. This is because in fact the concepts of geometry are already known to students before they enter school, for example lines, fields and spaces. Many research journals reveal that the level of student success regarding geometry is lower than other branches of mathematics [6]. There are more than several
variables that affect the level of success, one of which is the teaching materials used, namely in the form of student worksheets.

During the pandemic-covid 19, the world of education has to advance, not be stagnant, had to be flexible and dynamic. Conventional learning turns into digital learning, so that educational teaching materials must follow these things, one of which is a worksheet. Worksheets that are suitable during this pandemic are more oriented towards visual learning styles. If a teacher pays attention to the characteristics of these students, learning will be fun and students are not easily bored in the teaching and learning process. By paying attention to teaching materials in the form of worksheet and visual learning styles possessed by students, it is hoped that the ability to solve problems will grow and increase.

2. Literature Review
Research and Development (R & D) is currently a type of research that is being developed. The definition of development research according to Borg and Gall in Sugiyono (2010) is a process used to develop and validate educational products. What is meant by product in this context is not always in the form of hardware (books, modules, learning aids in class and laboratory), but it can also be software such as programs for data processing, classroom learning, libraries or laboratories, or models - educational models, training learning, guidance, evaluation, management, etc.

The process carried out to design or design according to [8] is carried out using a design model or design that has been developed by several experts, for example the Borg and Gall Model, 4-D Model, Dick and Carey Model, IDI Model, ADDIE Model, Kemp Model and others. In this research, the model used in development is the ADDIE model. Because, the ADDIE model is a simple and systematically structured model, this development model will fit the characteristics of structured and systematic mathematics.

2.1. ADDIE Model
The ADDIE model stands for: (1) Analysis, (2) Design, (3) Development or Production, (4) Implementation, and (5) Evaluation. This model is more rational and this model can be used for various forms of product development such as models, learning strategies, learning methods, media, and teaching materials. The ADDIE model was developed by Dick and Carry (1996) to design a learning system. According to [2] the model itself is a concept for developing a product. The ADDIE model has the application of student-centered learning that is innovative, authentic and inspirational. The resulting product will have a systematic concept in development that is costumized to the learning styles of students.

2.1.1. Analysis. The analysis stage is a process of defining what learners will learn, namely conducting a need assessment, identifying problems, and carrying out a task analysis. Therefore, the output that we will produce is in the form of characteristics or profiles of prospective learners, identification of gaps, identification of needs and detailed task analysis based on needs [1].

2.1.2. Design. In this second stage, a design is needed to achieve learning objectives. The first step that must be done is to analyze and also study the problem and find alternatives that will be used to overcome the required needs.

2.1.3. Development. Developing at this stage enters the stage of making, giving, and also modifying teaching materials that will be used in the learning process and also used to achieve competency demands. The development process of this teaching material itself is adjusted to the steps of the development design, namely developing a teaching material of its own. Developing teaching materials by modifying the learning resources relevant to the material to be developed.
2.1.4. **Implementation.** This stage is a real stage, because this stage itself means the delivery of learning materials or teaching materials that will be developed in direct use [1]. At this stage, it is the stage where the implementation of the stages that have been developed previously is carried out.

2.1.5. **Evaluation.** Evaluation itself is a process of giving value to the steps that were developed previously because the stages are interconnected with one another. The evaluation process can be done by clarifying the competencies that students must have after using the teaching materials developed.

2.2. **Visual Learning Style**

Emphasizes visual acuity. This means that concrete evidence must be shown first so that they understand [11]. This learning style relies on seeing or seeing the evidence first and then being able to believe it. There are several characteristics that are unique to students who have a visual learning style, namely: (1) the need to see something (information / lesson) visually to find out or understand it; (2) has a strong sensitivity to color; (3) have sufficient understanding of artistic issues; (4) having difficulties in direct dialogue; (5) too reactive to sound; (6) difficulty following verbal recommendations; and (7) often misinterpret words or speech.

The characteristics of students / individuals with visual learning styles, namely: (a) The position of the head raised upwards towards the person who is talking; (b) Eye accessing looking up; (c) breath on the upper chest, thin; (d) The position of the neck straight and upright; (e) Neat appearance, matching color, orderly; (f) Remember with pictures; (g) Prefer reading rather than being read; (h) Requires a comprehensive picture and purpose; (i) Capturing details; (j) Remember what was seen; (k) Always make eye contact; (l) Speak fast, almost without semicolons; (m) Keeping a distance from other people so that they can see more clearly; (n) Always think "the big picture".

2.3. **Ability to Solve Geometry Problems**

Problem solving is a very important part of learning mathematics because in the learning process and its solution, students may gain experience using the knowledge they already have. One of the problem-solving methods is to use the problem-solving method according to Polya. According to Polya [12] solving problems in mathematics consists of four main steps that must be carried out sequentially, namely: understanding the problem, compiling a solution plan, implementing the solution plan, and checking the solutions that have been obtained.

Suggested Steps in Approaching a Problem (1) First, understand the problem; ask yourself, what is the unknown, what has to be proved? (2) Make a plan. (3) Carry out the plan. (4) Look back on your work. Ask yourself: How could it be better? For part 2 (making a plan), Polya suggests numerous heuristics: guess and check; make an orderly list (the order matters, so plan it out); eliminate possibilities; use analogies; look for symmetry; consider special cases; look for a pattern; solve a simpler problem. Various questions are suggested: (i) Can you find a problem analogous to yours and solve that? (ii) Can you find a more general problem? (iii) Can you solve your problem by deriving a generalization from some examples? Can you vary or change your problem to create a new problem whose solution will
help solve the original one? And so on. Polya even introduces a variational ‘upper bound’ element: If you can't solve a problem, then there is an easier problem you can solve: find it! " [9].

3. Research Method
This type of research is a development research (Development Research) with the aim of producing a specific product that will be tested for its validity, where the development process is described as accurately as possible and then evaluated. In this research, the product developed was a teaching material in the form of student worksheets (student worksheets) with a visual learning style oriented to measure the ability to solve geometric problems. The development model used is the ADDIE model which stands for: (1) Analysis, (2) Design, (3) Development or Production, (4) Implementation, and (5) Evaluation. In [2] the ADDIE model is a concept for developing a product. So that this model can be used for various forms of product development such as teaching materials in the form of worksheets. The following is an adaptation of the ADDIE development model diagram:

![Adaptation of ADDIE model](image)

**Figure 1.** Adaptation of ADDIE model
Learning material taken in this research is the perimeter and area of the rectangle. The subjects of this study were students of grade 7 MTs. Nurul Islam Pasirian-Lumajang because a similar research has never been conducted. In addition, the teaching materials used are only in the form of textbooks, and the learning style of each grade 7 student is not known. Grade 7 students will be given a learning style questionnaire to determine their learning styles. Then students with visual learning styles were taken randomly by 10 students who would be the research subjects.

3.1. Research procedure
The elaboration of the stages of the research procedure is as follows:

3.1.1. Analysis Stage. analyze student learning styles by providing a learning style questionnaire. After knowing the learning style of each class grade 7 student, then identified the need by taking 10 students randomly who have a visual learning style. In this case, the teaching material is in the form of Worksheet which is in accordance with the student's visual learning style. And the last stage of the analysis is to do a task analysis, in this research, task analysis is carried out by analyzing the material around the circumference and area of the rectangle. Therefore, the resulting output is a specification of the objectives for developing teaching materials based on the results of the analysis. Before entering the design stage, it is evaluated and consulted with the supervisor. If revision is needed, the researcher completes the revision first. If you don't need revision, you can go to the next stage, namely the design stage.

3.1.2. Design. This stage is also known as making a design. The first step, formulating learning objectives. Furthermore, compiling the test, where the test must be based on the learning objectives that have been formulated earlier, the test in question is student worksheets material perimeter and rectangular area that is in accordance with the student's visual learning style. This worksheets aims to improve students' ability to solve geometric problems. The second step, determine the right worksheets to achieve these goals. In addition, also consider other supporting sources, such as relevant learning resources, what kind of learning environment should be. The resulting output is a prototype I worksheets. Furthermore, it is evaluated and consulted with the supervisor. If revision is needed, the researcher completes the revision first. If you don't need revision, you can go to the next stage, namely the development stage.

3.1.3. Development. Development is the process of making that design a reality. The development stage was carried out to produce a revised worksheets based on input from experts and data obtained from the trial. These activities include: (a) Expert validation, The results of the expert validation were used as the basis for revising and perfecting the prototype I worksheets. The validator consists of two lecturers of the Jember University FKIP education study program of mathematics. (b) Testing or Trial, the worksheets that has been produced by prototype II worksheets is then tested on students who are the research subjects. The results of these trials will be analyzed to determine the ability to solve geometric problems. Furthermore, it is evaluated and consulted with the supervisor.

3.1.4. Implementation. This stage is carried out after the student worksheet (student worksheet) is tested and has met the validity level. Activities at this stage, student worksheets will be implemented in schools that have the appropriate level, namely grade 7, circumference and rectangular area.

3.1.5. Evaluation. Evaluation is a process to see whether the teaching materials in the form of worksheets being built are successful, according to initial expectations or not. Actually the evaluation stage can occur at any of the four stages above. Evaluation that occurs in each of the four stages above is called formative evaluation, because its purpose is for revision needs. For example, at the design
stage, it requires a form of evaluation in the form of a review by the supervisor to provide input on the design that is being made. At the development stage, it requires validation from experts and trials of the product being developed.

3.2. Method of collecting data
Data collection is intended to obtain relevant and accurate information in accordance with research objectives. The methods used in this research are (a) test method; (b) observation methods and (c) questionnaire and interview methods.

3.3. Data analysis technique
The data obtained were analyzed to answer whether the instrument developed had met the criteria of validity or not.

3.3.1. Data Analysis of Learning Style Questionnaire Results. A learning style questionnaire is given to select students with a visual learning style. Analyzing the learning styles of grade 7 students MTs. Nurul Islam Pasirian - Lumajang and taken 10 students with a visual learning style to serve as research subjects. The provisions for determining the type of student learning style are as follows; (1) Students are classified as the type of visual learning style, if the highest total score is obtained from questions for visual learning styles; (2) Students are classified as the type of auditory learning style, if the highest total score is obtained from the questions for the auditory learning style; (3) Students are classified as the type of kinesthetic learning style, if the highest total score is obtained from the questions for the kinesthetic learning style.

3.3.2. Data Analysis of the Validation Results of worksheet. Based on the results of the assessment of the validity of learning tools from several competent experts in the field of developing mathematics learning models, the average value of the indicators given by each validator is determined. The activity of analyzing the validity of the worksheet used in this study follows the following steps:
a. Recapitulate the model validity assessment data into a table that includes: aspect ($A_i$), indicator ($I_i$), and value ($V_{ji}$) for each validator.
b. Determine the average value of the validation results from all validators for each indicator with the formula:

$$I_i = \frac{\sum_{j=1}^{n} V_{ji}}{n}$$

Information:
- $I_i$ = The average value of the validation results from all validators for each indicator.
- $V_{ji}$ = Data of the value of the $j$-validator against the $i$-th indicator.
- $n$ = Number of validators.
c. Determine the average value for each aspect using the formula:

$$A_i = \frac{\sum_{j=1}^{n} I_{ji}}{m}$$

Information:
- $A_i$ = Average aspect value $ke - i$.
- $I_{ji}$ = Average for the aspect $ke - j$ indicator $ke - i$.
- $m$ = Many indicators in the aspect $ke - i$.
d. Determine the value of $V_a$ or the average total of the average values for all aspects using the formula:

$$V_a = \frac{\sum_{i=1}^{n} A_i}{n}$$
Information:

\(V_a\) = Total average for all aspects.
\(A_i\) = Average for the indicator aspect \(k_e - i\).
\(n\) = Many aspects.

According to [3], to determine the validity predicate of the model and validated teaching materials or learning devices, the total average value \((V_a)\) referenced at the interval of interpretation of the validity of the teaching material model or device learning is presented in table 1.

| Amount of value | Interpretation    |
|-----------------|-------------------|
| \(V_a \leq 1,5\) | Invalid           |
| 1,5 \(\leq V_a < 2,5\) | quite valid       |
| 2,5 \(\leq V_a < 3,5\) | Valid             |
| 3,5 \(\leq V_a \leq 4\) | very valid        |

The criterion states that it is good, if a minimum level of validity is achieved is a valid level.

4. Result And Discussion

The development model used in the development of this worksheet is the ADDIE Model, which is a systematic development research design model. This model consists of five steps, namely: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation.

4.1. Analysis

At this stage of the analysis, grade 7 students were given a learning style questionnaire via google form, the results were:

---

**Figure 2.** Results of learning style questionnaire per grade
Students with visual learning styles reached 50%, auditory learning styles reached 8%, kinesthetic learning styles reached 3%, visual auditory learning styles reached 10%, visual kinesthetic learning styles reached 6%, auditory kinesthetic learning styles reached 0%, and students were not filling questionnaire reached 23%, this is because there are many students in the Islamic boarding school so they are not allowed to bring cellphones. And then, 10 students with visual learning styles were taken randomly. Of the 10 research subjects, it was found that 4 children answered correctly but did not apply the steps to solving from POLYA.

4.2. Design
The second stage is design activities which include: teaching materials preparation activities. Activities to collect materials / teaching materials, making illustration pictures, typing, and other coloring activities at this stage of design. Compile worksheets oriented to visual learning styles on the subject of perimeter and rectangular area in measuring problem-solving skills based on POLYA steps. This worksheet for grade 7 students junior high school MTs. Nurul Islam Pasirian – Lumajang.

4.3. Development
The development stage was carried out to produce a revised worksheet based on input from experts and data obtained from the trial. The experts appointed as validators consisted of two lecturers of the Jember University FKIP Education study program. As for the revisions made on teaching materials based on Expert input on course content is: on page 2, it must include specific learning objectives and indicators. on page 3, the material around the rectangle must be accompanied by a picture. At this stage, obtained result of value is 3,6 it means very valid. after the worksheet was tested on 10 students as research subjects, there was an increase in skills in solving geometry problems. 10 students have been able to apply the POLYA completion steps. However, at the time of the interview. There are 2 students said that it was difficult to solve the problem of finding the area with known circumference. And the problem of finding the perimeter and area with a combined rectangular image.
4.4. Implementation
This implementation stage is carried out on all students at MTs. Nurul Islam Pasirian-Lumajang grade 7. Because only one sub-topic was tested in a field test and was constrained by a pandemic situation. So in this implementation step was can’t fully implemented.

4.5. Evaluation
The last stage is to conduct an evaluation which includes formative evaluation and summative evaluation. Formative evaluation is carried out for collect data at each stage that is used for improvement and summative evaluation is carried out at the end of the program to find out the effect on student learning outcomes and the quality of learning large. In this research only formative evaluation was carried out, because of the type of evaluation This relates to the stages of research development to improve the resulting development product.

5. Conclusion
Based on research result, worksheet validation level reached 3,6 it means very valid. In an effort to developed this worksheet, researchers experienced obstacles in the data obtained from the research subjects was less than optimal. This is due to several factors at pandemic Covid-19, including: (a) the internet network in the research area is not good enough, thus influencing communication; (b) there are many students in the Islamic boarding school so they are not allowed to bring cellphones and laptop.

Acknowledgements
We thank Dr. Susanto, M. Pd (head of research group) for support, we thank Prof. Sunardi, M. Pd and Dr. Nanik Yuliati, M. Pd for guidance, we thank Dr. Erfan Yudianto, M. Pd for help, we thank M Safiq (Head of MTs. Nurul Islam Pasirian-Lumajang) for provide a place for research.

References
[1] Botturi L 2003 Instructional design and learning technology standards IceF - Quadermidell’ Institutto.
[2] Branch R M 2009 Instructional Desingn: The ADDIE Approach (USA: Univesity Of Geogia)
[3] Hobri 2010 Metodologi Penelitian Pengembangan (Aplikasi Pada Penelitian Pendidikan Matematika) (Jember : Pena Salsabila)
[4] Khotimah H 2013 Meningkatkan Hasil Belajar Geometri dengan Teori van Hiele (Yogyakarta: Mathematics Education, Faculty of Mathematics and Natural Sciences, Yogyakarta State University)
[5] Riedesel,Schwartz, and Clement 1996 Teaching Elementary School Mathematics (Boston: Allyn and Bacon)
[6] Saglam Y, Türker B, and Umay A 2011 Geometry anxiety scale for secondary school students Procedia Social and Behavioral Sciences 15(2011) 966–970.
[7] Schoenfeld A H 1987 Pólya, problem solving, and education Mathematics Magazine 60(5) 283.
[8] Setyorini P 2013 Metode Penelitian Pendidikan Dan Pengembagan (Jakarta: Kencana)
[9] Shirali S A 2014 George Pólya & problem solving An appreciation Resonance 19(4) 310–322.
[10] Sugiyono 2014 Metode Penelitian Kualitatif, Kuantitatif, Dan R&D (Bandung: Alfabeta)
[11] Widayanti F D 2010 Pengaruh Pengelompokan Siswa Berdasarkan Gaya Belajar dan Multiple Intelligences pada Model Pembelajaran Learning Cycle terhadap Hasil Belajar Kimia Siswa Kelas XI IPA SMAN 3 Lumajang (Malang: Pascasarjana Universitas Negeri Malang)
[12] Utami Rini 2013 Model Pembelajaran Berbasis Masalah dengan Langkah Penyelesaian Berdasarkan Poly dan Krulik-Rudnick Ditinjau dari Kreativitas Siswa 1 20303-3983.