# A Worksheet Characterized By Open-Ended Approach To Support Student's Mathematical Literacy

**Anis Farida Jamil, Arif Hidayatul Khusna**

**Abstract:** Mathematics is related to a daily life problem solving. Mathematics learning must be implemented meaningfully, so that students can understand mathematics as knowledge that can be applied in everyday life. Mathematical literacy is an ability to understand a problem and solve it using mathematics. Thus, it is important for students to have a good mathematical literacy ability. This study aim to develop a student worksheet characterized by open-ended approach to support student's mathematical literacy ability that it's categorized by validity and practical. This student worksheet use in discrete mathematics course. This reasearch used 3D model that is Define, Design, and, Develop. The instruments in this study were validation sheet and student questionnnaire. The validation sheet is used to determine the validity of the worksheet and the questionnaire is used to determine the practically of the worksheet.The result of this reasearch is developing worksheet that valid and practical chategorized.

**Index Terms**: Mathematical Literacy, Open-Ended Approach, Worksheet.

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## 1. INTRODUCTION

Mathematics is still a phobia for some people [1]. This happens because mathematics is still considered as a knowledge that can not contribute directly to everyday life. Students still perceive mathematics as calculus, algebra, analysis, not as an understanding that can be applied to daily life problems. It is related to mathematical literacy. Mathematics literacy is a knowledge to know and apply basic mathematics in our everyday living [1]. But in Indonesia, student's mathematical literacy ability is in low category [2]. This fact is also supported by data from PISA that Indonesia ranked 3rd in the bottom of all participant countries in terms of student's mathematical literacy ability. According to the Organization for Economic Corporation and Development (OECD) defines mathematical literacy as the ability to recognize and understand the role of mathematics in the world to be the basis for using and engaging with mathematics in accordance with the needs of students as constructive, caring and reflective citizens. The Indonesian mathematics literacy survey showing the ability of students in Indonesia have not been able to compete with other countries in the world [3]. Mathematical literacy is related to real problems where problems arise in a situation [4]. Students must be able to solve real word problems that require them to use competencies and abilities that have been obtained through daily experience [5]. Therefore, mathematics literacy ability is very important for students. Teacher plays a role in providing student's mathematical literacy [6]. Teacher must have a good conception of mathematical literacy thus teacher can use a right learning strategies. In a learning strategies, student worksheet is one of the teaching materials that can be used in learning mathematics. This study uses student worksheet in supporting student mathematical literacy. This worksheet characterized by open-ended approach. An open-ended approach give student a freedom expression of their opinian

and idea to improve their mathematics skill [7]. The type of problem used in learning with open-ended approach is not routine and open problem [8]. Students are given problems in everyday life related to mathematics as outlined in the worksheet. Real word problem are given using an open-ended approach with characteristics: 1) problems that are solved in a variety of ways, 2) problems that have varied answers, and 3) problems that can be developed by changing the conditions of the previous problem [9]. The developing worksheet can be a reference of teaching materials that can be used by lecturers in learning discrete mathematics, especially number theory material. Mathematical literacy skills that are expected to increase after the use of worksheet in order to make students a problem solver to problems in the daily lives of students.

## 2 MEHTOD

This research is a research and development study using 3D models. This 3D model is a 4D development model by Thiagarajan that has been modified where the Disseminate stage is not carried out. Stages of 3D models consists of 1) Define, 2) Design, and 3) Develop.

### Research Instruments

The instruments used in this study were validation sheets and student questionnaire sheets. The validation sheet is used to validate whether the worksheet is feasible to be used in a trial. Student response questionnaire sheets are used to obtain practicality data from the worksheet. In this case it means whether worksheet can be used in learning and get positive responses from students.

### Research Procedure

The research procedures carried out in accordance with the 3D model are:

### 1. Define

This defining phase aims to determine the worksheet design requirements that will be developed to suit the learning objectives of supporting student mathematical literacy. The first step taken is the concept analysis of analyzing the material used in the study, namely the Numerical Rules, Permutations, Combinations, Pigeon Hole Principles and Inclusive-Exclusive. Next is the task analysis by formulating

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problems that will be given to students in the form of problems in daily life related to the Numerator, Permutation, Combination, Pigeon Hole and Inclusive-Exclusive Principles using an open-ended approach. The open-ended approach is characterized by assignments that have more than one solution, more than one way, or problem development by students. The final step is the formulation of learning objectives in the worksheet to support students' mathematical literacy abilities.

## 2. Design

The activity carried out at the design stage is to create a format of the worksheet. The planned worksheet format consists of 1) explanation of the numerator, permutation, combination, Pigeon Hole and Inclusive-Exclusive principles using examples of application in daily life, 2) practice questions in the form of open-ended problems related to problems in daily life- days related to the Numbering, Permutation, Combination, Pigeon Hole and Inclusive-Exclusive Rules.

## 3. Develop

The development phase is carried out after designing the worksheet format. Worksheet are developed in accordance with the plan and validated to expert validators to determine the feasibility of the worksheet to be tested in learning. After the worksheet has been declared valid, a trial run is then given a student response questionnaire.

## Data Analysis Techniques

Data obtained in this study will be analyzed in the following way.

## 1. Worksheet validity analysis

The data analyzed are quantitative data in the form of the results of the worksheet validation scores obtained from the validator. The worksheet can be tested when validator assessment results show a valid category. The following is the formula for evaluating the results of LKM validation.

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

Note: $v$ is a validation value

**Table 1.** *Validation Assessment Category*

| Validity value acquisituion (v) in (%) | Category |
|---|---|
| $75 \leq v < 100$ | Valid |
| $50 \leq v < 75$ | Quite Valid |
| $25 \leq v < 50$ | Less Valid |
| $0 \leq v < 25$ | Invalid |

## 2. Worksheet practicality analysis

The practicality data of the worksheet was obtained from the analysis of student response questionnaires by summarizing each student's questionnaire response score, determining each student's response, calculating the percentage of many students who gave positive responses, and drawing conclusions about the results of student responses. The worksheet is said to be practical if more than 50% of the total students give a positive response.

# 3   RESULT AND DISCUSSION

The development of the worksheet is characterized by an Open-Ended approach to support the ability of students' mathematical literacy which were developed using a modified 3D development model of the Thiagarajan floating model. The 3D model consists of three stages, namely 1) Define, 2) Design, and 3) Develop. The following describes the results of developing the worksheet based on a 3D model.

## 3.1  Define

At this stage the researcher conducted 3 activities namely concept analysis, task analysis, and formulation of learning objectives. Concept analysis includes the selection of material to be used at the worksheet. The material chosen was the rules of enumeration, permutation and combination. This material was chosen because there are many applications in everyday life that use the concepts of the rules of enumeration, permutation and combination. In addition, this material has also been taught at the high school level, and there are several courses that also contain this material such as mathematics statistics courses. So, it is hoped that students will be easier to understand each guidance contained in the worksheet so that it can improve students' mathematical literacy skills. The next activity is task analysis. In this activity researchers determine the tasks that will be poured on the worksheet. In accordance with the material planned by this worksheet consists of three sub-chapters namely the rules of enumeration, permutation, and combination. Each section consists of three practice questions that are Open-Ended. This means that the exercise questions are (1) problems that can be solved in a variety of ways, (2) problems that have a variety of answers, and (3) problems that can be developed by changing the conditions of the previous problem. The final activity of the define stage is the formulation of learning objectives. The formulation of these learning objectives is based on the semester implementation plan and refers to the research objectives of improving mathematical literacy skills. There are two main abilities in each sub-section, namely the ability to understand and apply the material.

## 3.2  Design

The activities carried out at this stage are designing an open-ended worksheet format and developing research instruments. The worksheet that are designed consist of covers, table of contents, subsection rules, permutations, combinations. Each section contains learning outcomes, materials, real world problems, and practice questions [10]. Learning outcomes for the rules of enumeration are students understanding two basic principles of enumeration rules and applying the rules of numeracy in solving problems. Learning outcomes for permutations are students understand permutations and apply permutations in solving problems. The learning achievement of combination material is that students understand the combination and apply the combination in completing. Learning outcomes are based on indicators of mathematical literacy ability that students not only know the concepts but have the ability to solve problems in daily life. Material is provided simply in the form of basic principles and formulas for each section. For the subsection rules the material enumeration provided is in the form of the principle of addition and multiplication rules. The permutation section is given material about definitions of permutations and permutation formulas. This applies to the combined sub-chapters which are

given material about the definition of combinations and combination formulas. The real-world problem section shows examples of applications from each section. In the sub-section of the rules of enumerating the real-world problem consists of examples of the application of the concept of addition rules on the issue of book selection in the library and examples of the application of the concept of multiplication rules on the choice of participants participating in the competition activities. In the real-world problem permutation section, an example of the issue of committee selection for an organization is provided and in a combination section an example of a handshake problem is provided in a forum. Real world problems are given to make it easy for students to understand the definitions and principles contained in the material section. The last part of the worksheet is the question exercise. The exercises for each section consist of three problems that are open ended. The first problem students are asked to find problems in daily life related to sub-chapters that have been studied. This first problem is classified as open ended because it has many answers. The second problem is students are asked to prove the formula. This problem has various alternative stages of completion so that it is classified as an open-ended problem. The last problem students are given the topic of a problem then ask students to develop the topic into a problem with its completion. The last problem is a characteristic of open-ended problems that is developing a problem.

### 3.3 Development

The development phase begins with validating the worksheet that has been made to the expert validator. Based on the results of the validation, the value of 88% is included in the valid category. The worksheet can be tested when the validation results show a valid category. The next activity is to test the worksheet to students in learning discrete mathematics. The worksheet is characterized by an open-ended problem aimed at supporting students' mathematical literacy abilities. Mathematical literacy abilities that are expected to emerge in students include problem solving, modeling, and symbolization [11]. The following is an example of a student's work in working on mathematical problems at a developed the worksheet.
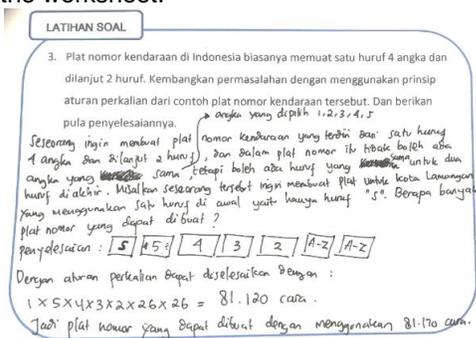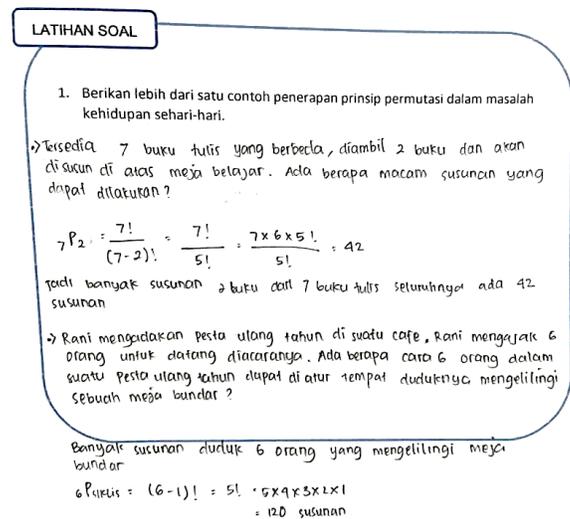


**Figure 1.** *Examples of Student Work Results in Problem Solving*

In Figure 1 above, it is shown that the question exercises given to students are open-ended problems where students are facilitated to be able to develop mathematical problems to a certain condition that is closely related to their daily lives. Also seen in solving the problem that the students gave is correct. So, in this case, they have also demonstrated their mathematical literacy abilities, namely problem solving [12].
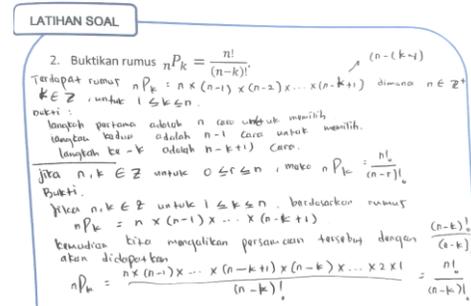


**Figure 2**. *Examples of Student Work in Applying Symbols*

In Figure 2, students are given a problem that requires them to apply mathematical symbols. The application of mathematical symbols is one indicator of the ability of mathematical literacy [13].



**Figure 3.** *Examples of Student Work Outcomes in Problem Development*

In example 3, students are asked to develop more than one problem related to daily life about permutation material. The answers of more than one student are one of the characteristics of an open-ended problem. The desired indicator of literacy ability in this problem is not only problem solving but also students can model problems so they can solve them [14]. Based on the three examples of student work in completing exercises given to the worksheet it can be concluded that the use of the worksheet is characterized by open-ended problems that can support students' mathematical literacy abilities. The last activity carried out at this stage of development was giving questionnaires to student responses after they used the worksheet in their learning. The results of the student response questionnaire analysis showed that all students gave positive responses to the use of this worksheet. Therefore, it can be concluded that the worksheet meets the practical category, which means it can be used in learning. This is also in line with research conducted by [9][15] which states that the modules developed can be said to be practical when the results of student questionnaires in the use of modules have a positive response. Research by [16] also shows that an open-ended approach is used in learning to describe mathematical literacy abilities.

## 4   CONCLUSION

The development of the worksheet is characterized by an open-ended problem to support students' mathematical literacy abilities carried out in three stages, namely the defining stage, the design stage, and the development stage. The worksheet that are developed are valid and practical. A valid category worksheet is indicated by the results of validation by the validator with a value of 88%. Practical of the worksheet are indicated by the results of the student response questionnaire shown by positive responses. The worksheet that is developed with the characteristics of open-ended problems can support students' mathematical literacy abilities. Suggestions for further research that want to discuss the development of the worksheet in supporting mathematical literacy skills is to broaden the discussion of other mathematical literacy abilities not only to the 3 indicators raised in this study namely problem solving, modeling, and symbolizing. There are still 5 other indicators related to students' mathematical literacy abilities.

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