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Development of Mathematical Literacy Instruments to Improve 4C Thinking Skills

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Abstract*: Based on data from PISA in 2018, Indonesia's position was ranked 74 out of 79 countries and TIMSS reported that Indonesia's position in 2015 was 44 out of 49 countries. Mathematical literacy as cited in the 2012 PISA report is the individual's ability to formulate, apply and interpret mathematics in various contexts. This research is a type of development research. The research model used as a reference is the development stage of the R&D Model by Sugiyono (2015). These stages consist of product design, design validation, design revision, product testing, product revision, usage testing, product revision and mass production. The research is carried out only up to product revision after product testing, so that the last three stages will be carried out at the next research stage.*

Keywords: Mathematical literacy, test package, test instrument.

1. INTRODUCTION

Students around the world are expected to have the ability to face challenges in the future, so an organization was created to assess student literacy, namely TIMSS and PISA. TIMSS is an organization that assesses the achievement of literacy in the fields of science and mathematics at the junior high school level (age 13 years), which is held once every four years, starting in 1995. Indonesia has participated since 1999. Indonesian students in mathematics ability in 1999 only able to rank 34 out of 38 countries. In 2003 the mathematics ability of Indonesian students was ranked 35th out of 46 countries. Furthermore, in 2007 the achievement of Indonesian students did not show a significant increase, namely mathematics ability was ranked 36 out of 49 countries (Puspendik, 2012a).

PISA is an organization that assesses the achievement of scientific literacy of students at the junior high school level (age 15 years), which is held every three years, starting in 2000. Indonesia has participated since 2000. In 2000 the achievements of Indonesian students' mathematical literacy 15 years old was ranked 39 out of 41 participating countries. Students' mathematics literacy achievement remained low in the PISA held in 2003, which was ranked 38 out of 40 countries and ranked 50 out of 57 participating countries in 2006 (Puspendik, 2012b). Furthermore, at PISA 2012 the achievement of Indonesian students' mathematical literacy slumped to rank 64th out of 65 countries. In 2015,

These problems are not only caused by students' abilities but caused by various factors in the education system Indonesia. In line with the objectives of national education itself, it is to develop a nation that has the ability, character and civilization by increasing intellectual knowledge and developing students' human values so that the government makes fundamental changes to the education system, namely the curriculum. At this time, the prevailing curriculum in Indonesia is the 2013 Curriculum. The 2013 curriculum balances the development of attitudes, skills and knowledge, which is intended so that students can integrate a concept of knowledge with other knowledge, therefore it is the same as mathematical literacy, students can learn mathematics by looking at natural events and social events.

Think literally will make Indonesian students have broader knowledge, therefore it is highly recommended to learn to use mathematical literacy. The definition of mathematical literacy as cited in the 2012 PISA report is an individual's ability to formulate, apply, and interpret mathematics in various contexts. This ability includes mathematical reasoning and the ability to use mathematical concepts, procedures, facts and mathematical functions to describe, explain and predict a phenomenon (OECD, 2013). With mastery of mathematical literacy, each individual will be able to reflect on mathematical logic to play a role in his life, community, and society. Mathematical literacy enables individuals to make decisions based on a constructive mathematical mindset in accordance with the Industrial Revolution 4.0.

Based on TIMSS and PISA information, it can be concluded that the literacy skills of Indonesian students are still not satisfactory, so it takes a continuous effort to improve the literacy skills of Indonesian students. Because, the position of Malaysia, Singapore, the Philippines and Brunei is still above Indonesia. Based on data from NCESS, Indonesian students only have the ability to solve problems with low cognitive levels. We need to know that the goal of national education is to develop a nation that has the ability, character, and civilization by increasing intellectual knowledge, while the characteristics of the 2013 Curriculum are balancing knowledge, attitudes, and skills, which means that every mathematics learning must be linked to other knowledge concepts. ,

2. METHODS

This research is a type of development research. The research model used as a reference is the development stage

of the R&D Model by Sugiyono (2015). These stages consist of product design, design validation, design revision, product testing, product revision, usage testing, product revision and mass production. The research is carried out only up to product revision after product testing, so that the last three stages will be carried out at the next research stage. This research was conducted at the PGSD Study Program FKIP University of Jember with the subject of students of class 2020 odd semester of the academic year 2020/2021.

The device development design used in this study is the Thiagarajan, Semmel & Semmel development model (Hobri, 2010: 12) consisting of four stages known as the 4-D model (Four D Model). The four stages consist of the define stage, the design stage, the design stage, the develop stage, the dissemination stage.

3. RESULTS

Based on research on the mathematical literacy test instrument, geometry material that has been done, obtained the following results and discussion:

3.1 Analysis Phase

At this stage, two important analyzes are carried out before designing the appropriate preparation of test instruments, namely curriculum analysis and analysis of student characteristics

a. Curriculum Analysis

Curriculum analysis carried out by researchers is to analyze the expected competence (KAD) and learning indicators from the test instrument material developed, namely geometry material. This step aims to plan the development of the test instrument properly.

b. Analysis of student characteristics

The characteristics of the students analyzed were PGSD FKIP Jember University students in the odd semester of the 2020/2021 academic year. Analysis of student characteristics is carried out through literature review and direct observation in the classroom. The average semester 1 student is 18-19 years old. The age of the student is closely related to the adjustment of the level of maturity to solve problems related to everyday life. At this age, adolescents have completed their cognitive structures, so that they become an organized system of thinking and their ability to think is more logical, abstract and flexible. This means that students are able to reason with the relationship between objects in everyday life to be associated with a mathematical problem. Observations during learning activities strengthen the foundation for this research. The results of the analysis of student characteristics obtained from observations during learning activities show that students have difficulty solving math problems well. Students are not used to making mathematical modeling to solve problems, so learning activities really need the active role of lecturers or the use of media in learning activities. The difference in ability / intelligence possessed by students causes the level of understanding of learning material to be different. As a result, most students are slow in accepting material but there are also students who are fast in receiving and understanding material. Students are less accustomed to making mathematical modeling to solve problems, so learning activities really need an active role from lecturers or the use of media in learning activities. The difference in ability / intelligence possessed by students causes the level of understanding of learning material to be different. As a result, most students are slow in accepting material but there are also students who are fast in receiving and understanding material. Students are not used to making mathematical modeling to solve problems, so learning activities really need the active role of lecturers or the use of media in learning activities. The difference in ability / intelligence possessed by students causes the level of understanding of learning material to be different. As a result, most students are slow in accepting material but there are also students who are fast in receiving and understanding material.

Based on the study of these analyzes, a test instrument with an appropriate approach is needed to generate motivation in learning mathematics in the classroom. Development of test instruments in the form of test packages. Because in addition to students being able to study in class, 87 students can study independently at home, so it is hoped that students can achieve learning objectives that will be achieved well. Students' mathematical literacy can be improved by developing a test package.

3.2 Design Stage

a. Gathering References

After conducting a preliminary study, initial research is carried out and information gathering about the material. Researchers began to look for and collect relevant references (in the form of articles and books) which would be used to develop test instruments. Several books and articles that are used as references, including the following:

1. Rahayu, D. and U. Azizah. 2012. Development of Computer-Based Cognitive Assessment Instruments with Combination of the Game "Who Wants To Be A Chemist" on the Main Material of Atomic Structure for Class X RSBI Senior High School. Proceedings of the UNESA National Chemistry Seminar. Pp. 41-50.
2. Aeni, DN, Sugiarti, T., and Alfarisi, R. 2020, Mathematics Literacy Based On Mathematics Capability of Students at SDN Jember Lor 05, International Journal of Academic Multidisciplinary Research (IJAMR), Vol. 4 Issue 1, 8-12
3. UNESCO. (2011). UNESCO and Education; Everyone Has the Right to Education. Columbia: UNESCO

Researchers also collect pictures, illustrations, and collect relevant questions that will be used to compile and complete test instruments through various sources of literature such as books, magazines, the internet, and research journals.

b. Designing an Outline of Test Instruments

In this activity, material that will be used as material for making test instruments is formulated as a reference for further reference in developing test instruments. References are used as previously described. The explanation of each

stage of the formulation of the test instrument outline is as follows:

1. Design of test instruments
   The design of the test instrument consists of several parts, namely the instructions for working on the test questions, the core part, and the scoring rubric.
2. Preparation of test instruments in accordance with the Mathematical Literacy indicators
   The design of the test instrument is tailored to the indicators of mathematical illustration including formulating, applying, and interpreting mathematics in various contexts.

c. Preparation of Test Instrument Assessment Instruments

The preparation of the test instrument assessment instrument is based on the criteria for assessing a good test instrument according to BSNP which has been modified as necessary by the researcher. The test instrument assessment instrument is a test instrument quality assessment sheet for material experts and mathematics lecturers in order to provide a feasibility score before being tested in class. The test instrument assessment instrument is in the form of a questionnaire with a scale consisting of 4 answer choices, namely 1, 2, 3, and 4, each of which states "not good", "not good", "good", and "very good".

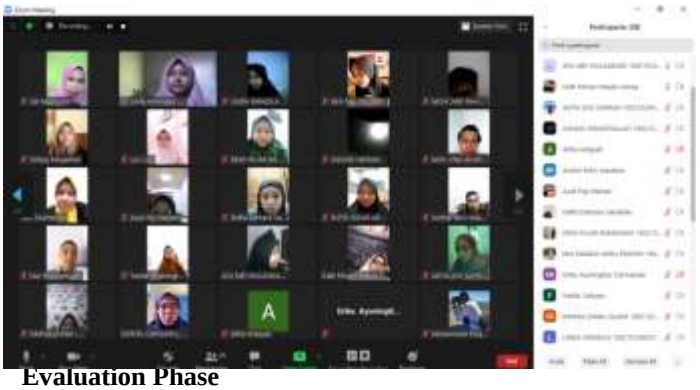
According to BSNP, a good test instrument meets the aspects of content feasibility, presentation feasibility, language feasibility, and graphic feasibility. The content feasibility aspect is developed in the test instrument assessment sheet for material expert lecturers. The assessment sheet for material expert lecturers consists of 9 statements which are divided into 3 validations, namely content validation, construction and language. The student response questionnaire consisted of 4 aspects with alternative answers "Strongly agree", "Agree", "Disagree", and "Strongly Disagree". Complete instruments can be seen in the appendix. After the instrument is finished, the research instrument is validated by the instrument validator lecturer. The validation of the test instrument assessment was carried out by an expert lecturer from the Mathematics Education Study Program, FKIP University of Jember, namely Dr. Arika Indah Kristiana, S.Si., M.Pd. After validation, several items of invalid instruments were found which were then revised by the researcher according to the validator's suggestions so that they can be used to assess the test instruments that have been developed. The results of the instrument validation are in the attachment.

d. Development Stage

The development stage is a follow-up to the design stage. The test instrument development stage consists of several development stages, namely the development of the test instrument, editing the test package, validating the test package, and revising the test package. The test package is in the appendix.

e. Implementation Stage

After it is declared fit for use in accordance with the advice of the material expert lecturer, the test instrument that has been developed can be implemented. The implementation is using instruments that have been developed in classroom learning activities. The trial was conducted on students of class 2020 PGSD FKIP Jember University Study Program. In online learning activities using zoom in online classes, the researcher acts as a facilitator. Students learn independently using the available modules. After the learning is carried out, an evaluation will be carried out with the test instrument that has been developed by the researcher.



f. Evaluation Phase

At this stage, the researcher analyzed the data obtained from the research results, namely from the analysis of the quality of the test instrument in terms of the feasibility of content, language, and construction. In addition, at this stage, data analysis was also carried out on the practicality of using the test instrument developed by the researcher. Analysis of the quality of the test instrument was obtained from the validation result data by the material expert lecturer, while the practicality analysis was obtained from the student response questionnaire data.

1. **Data Analysis of the Validity of Test Instruments**
   The results of the validation data from the material expert lecturer, namely Dr. Arika Indah Kristiana, S.Si., M.Pd. has a total average score of 3.43 with good qualitative criteria. Aspects of material expert judgment points are stated in the following table:

Table 3.1 Validation of Material Experts

No.	Assessment aspects	Average	Qualitative Criteria
1	Contents	3.33	Good
2	Construction	3.5	Good
3	Language	3.45	Good

2. **Data Analysis of Practicality of Test Instruments**
   To determine the practicality of the module, data analysis was used through student response questionnaires. This questionnaire was taken when the evaluation activity with the test package was completed. The student

response questionnaire is a list of statements compiled by 4 aspects with 17 positive statement items with 4 alternative answers, namely "Strongly agree", "Agree", "Disagree", and "Strongly Disagree". The aspects contained in this student response questionnaire are aspects of graphics, aspects of material development, aspects of linguistics or language, and aspects of the benefits of the test instrument. The results of the analysis from filling out the student response questionnaires by 87 students after learning in online classes. The average of all aspects of the assessment items is 3,295 which is in good qualitative criteria. The details are as follows:

Table 3.1 Questionnaire Responses from Students

No.	Assessment aspects	Average	Qualitative Criteria
1	Graphics	3.03	Good
2	Material development	3.25	Good
3	Language	3.5	Good
4	Benefits	3,4	Good

From the table above, it can be concluded that the developed test instrument has a good level of practicality.

4. ACKNOWLEDGMENT (HEADING 5)

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5. REFERENCES

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[4] UNESCO. (2011). UNESCO and Education; Everyone Has the Right to Education. Columbia: UNESCO.