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Improving Students' Numeracy Literacy Ability in Physics Subjects

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Abstract: Numeracy literacy is one of the six basic skills that are prerequisites and life skills in the 21st century, for numeracy literacy in Indonesia is still relatively low and far behind other countries for that, numeracy literacy skills are important in physics subjects because physics is inseparable from mathematics. The purpose of this study was to determine the increase in numeracy literacy of SMA A Class XI IPA students in Physics. The approach in this study used a qualitative and quantitative approach with a descriptive analysis method. The sample in this study amounted to 26 students in class XI IPA-2 at SMA A, West Seram Regency. The instrument used was a test instrument consisting of 15 test questions that included numeracy literacy indicators on the material of material elasticity. The data analysis technique in this study was quantitative and qualitative data which were the main data of the study in the form of numeracy literacy skills before (pretest) and after (posttest). The results of the study showed that the average N-gain value was 0.45 and it was found that 2 students (8%) had numeracy literacy skills at the Skillful level, at the Provicient competency level there were 8 students (31%), at the basic competency level there were 13 students (50%), and at the competency level requiring special intervention there were 3 students (11%), so it can be concluded that there was an increase in the numeracy literacy skills of SMA A Class XI IPA-2 students in Physics with a low category and classified as a basic level.

Keywords: Capacity Building; Numeracy Literacy; Physics Lessons.

Introduction

The Ministry of Education and Culture has replaced the national exam (UN) with a minimum competency assessment (known as AKM). The assessment in AKM is reading literacy and numeracy literacy. One of the basic skills that plays a very important role in daily decision-making is numeracy literacy (Supriyati, et al., 2020; Widiastuti & Kurniasih, 2021). In addition, numeracy literacy is one of the six basic skills that are prerequisites and life skills in the 21st century (Arbain and Sirad, 2023). Numeracy literacy is a reflection of the quality of learning in all phases of school and all curriculum areas (Puspaningtyas & Ulfa, 2020; Wyatt-Smith et al., 2011). However, numeracy literacy in Indonesia is still low and far behind other countries (A. Sa'adah, et al., 2021). 2022 data from The OECD Programme for International Student Assessment (PISA) states that Indonesia's performance in reading, mathematics and science is ranked 69th out of 80 countries with a numeracy score of 366.

Numeracy skills include the ability to read data, graphs, tables based on numbers (Mahmud & Pratiwi, 2019; Winata, et al., 2021). Numeracy skills are a person's intellectual abilities that involve systematic and logical thinking processes in carrying out arithmetic operations (Gunur, et al., 2018). Meanwhile, according to (Teresia, 2021), numeracy skills are basic abilities that equip students to apply the concept of numbers, arithmetic operation skills (which include aspects of knowledge, skills, and attitudes) in everyday life and the abilities used to interpret quantitative information around students. The implementation of numeracy contains skills to apply physics concepts and rules in everyday situations (Ratnasari & Setiawan, 2022). Numeracy literacy can also develop logical and systematic thinking in understanding, analyzing and solving problems using mathematical knowledge if integrated into the learning process properly (Patriana, et al., 2021). Numeracy literacy assessment aims to measure a person's ability to think using mathematical concepts, procedures, facts, and tools in various contexts that are relevant to

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individuals as Indonesian citizens and world citizens at the global level (Hidayah, et al., 2021).

Based on previous research conducted by (Dekriati, et al., 2022) revealed that students' ability to solve numeracy literacy problems is still relatively low, especially when using numbers and symbols in an effort to solve everyday problems. In addition, lack of conceptual understanding, lack of spatial abilities possessed by students, students' misunderstanding of terms and errors in interpreting the meaning of questions are indicated as some of the difficulties students face in solving problems (Sri Aprilia, et al., 2021; Linda, et al., 2020; Ai Sumiati, et al., 2020).

Numeracy literacy skills are one of the skills measured in the Minimum Competency Assessment (AKM). Along with the elimination of the National Examination (UN), AKM began to be used and implemented in schools (Miftah & Setyaningsih, 2022). The three assessment parts in the National Assessment are AKM, Character Survey, and Environmental Survey. The Minimum Competency Assessment is used as an assessment to measure students' literacy and numeracy skills. AKM is designed to create more concrete education, not just memorization but requires students to apply high-level skills and the problems given refer to the benchmarks contained in the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS). The application of AKM is something new in physics subjects so that the analysis of numeracy literacy in physics material is very rare.

The relation to reading and numeracy literacy skills, especially in physics subjects, is important to apply, because learning physics is not enough to just memorize but must be understood and practiced (Ramdani, et al., 2019). Basically, physics material is interesting to learn. The many formulas and calculations without being related to real life make physics a difficult and boring subject. Therefore, it is necessary to understand the concept of physics concretely, not just formulas and calculations so that students' understanding of physics phenomena in everyday events increases.

Concrete problems in physics are related to AKM questions that are developed with different question forms. This is so that students are accustomed to answering AKM questions in various question variations (Sari, et al., 2021). Physics is closely related to the scientific context that integrates science problems with science and technology so that numeracy literacy skills can be optimized. Students are trained to use analytical power through AKM questions on information to make the right conclusions. In addition, AKM result reports are categorized according to competency from the highest, namely proficient, competent, basic, and requiring special intervention (Asrijanty, 2020).

The results of interviews with physics teachers at SMA A in West Seram Regency showed that the physics learning process in schools has implemented AKM questions with various forms of questions, but the student handbook still uses the 2013 curriculum so that AKM practice questions are still limited. The differences in the abilities of each student in answering questions and each teacher making different types of AKM questions affect the final results so that it is necessary to practice working on AKM questions on other physics materials. The material in this study is material elasticity because there are many phenomena that can be associated with physics concepts. AKM questions on the material elasticity of materials that focus on numeracy literacy have never been worked on by students. Interestingly, in the AKM questions tested, several phenomena related to material elasticity have been presented in one question stimulus so that students do not only calculate using formulas but can analyze the concept of material in complex events. The questions on the material elasticity of materials developed in the study have never been applied in schools because the researcher developed a new product in the form of a Minimum Competency Assessment (AKM) instrument. Based on the background above, this research aims to determine the increase in numeracy literacy of SMA A Class XI Science students in Physics Subjects.

Method

This study uses a qualitative and quantitative approach with a descriptive analysis method. According to Adiputra et al., (2021) Descriptive research is research that aims to describe existing phenomena, namely natural phenomena or man-made phenomena, or which is used to analyze or describe the results of the subject, but is not intended to provide broader implications. The research flow is presented in Figure 1 below.

Figure 1. Research Flow

Participant

The population of SMA A in West Seram Regency is 55 students. The sample of this study was class XI IPA 2 which consisted of 26 students. The sampling

technique used simple random sampling where there were 2 homogeneous classes.

Instrument

The question instrument is a test question that includes numeracy literacy indicators consisting of 25 multiple-choice test questions based on 5 numeracy literacy indicators, including; 1) estimating and calculating, 2) using decimal fractions, percentages, and comparisons, 3) using reasoning, 4) using measurements, and 5) interpreting information. The questions have been validated and tested on 58 students. The validity data of the questions obtained were 15 valid questions and the reliability value was 0.8, which means that the questions are reliable.

Data Analysis Techniques

The data collection technique is through pretest and posttest. The data analysis technique in this research is quantitative and qualitative data which is the main research data in the form of numeracy literacy skills before (pretest) and after (posttest). The pretest results serve to determine initial numeracy literacy skills regarding material elasticity. Meanwhile, the posttest results serve to determine the final ability in numeracy literacy regarding material elasticity. To calculate and analyze the magnitude of the increase in numeracy literacy skills, the normalized-gain formula is used as follows (Hake, 2002):

$$g = \frac{s\ post\ test - s\ pretest}{s\ \max - s\ pretest} \quad (1)$$

The gain points obtained are then analyzed using high, medium, and low criteria (Hake, 2002) and are associated with the numeracy competency level which consists of 4 levels, namely 1) requires special intervention, 2) basic, 3) Provicient, and 4) Skillful (Ministry of Education and Culture, 2020).

Table 1. Qualification Percentage Score of Students

Percentage (%)	Criteria	Numeracy Literacy Competency Level
86 – 100	has reached completion, needs enrichment or more challenges	Skillful
66 – 85	has reached completion, no need for remedial	Proven
41 - 65	not yet achieved completion, remedial in the required sections	Basic
0 - 40	not yet achieved, remedial in all parts	Need Special Intervention

Results and Discussion

Based on the results of research conducted on 26 students in class XI IPA 2, an increase in literacy skills was found through N-Gain as seen from the pretest and posttest scores which can be presented in Figures 2 and 3.

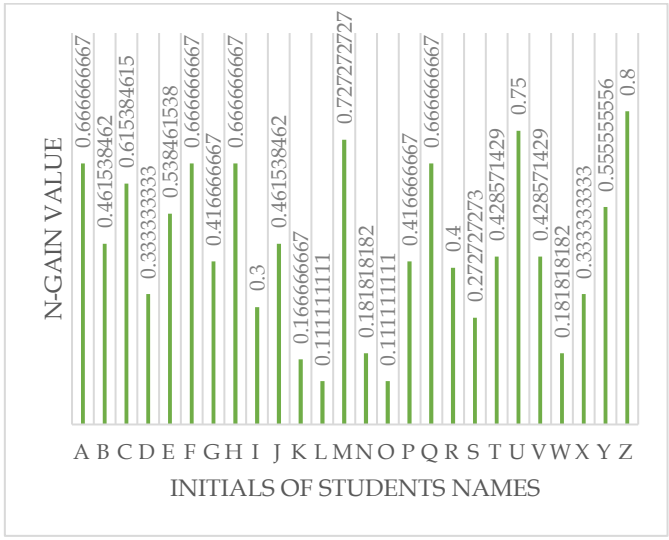

Figure 2. Achievement of N-Gain of Students

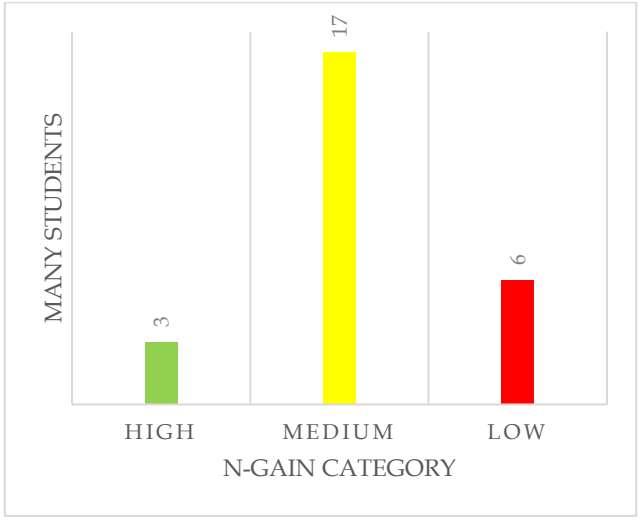

Figure 3. Student Achievement Per Category

Based on Figure 2 and Figure 3, it was found that there were 3 students with the initials M, U, and Z with N-Gain values of 0.73, 0.75, and 0.8 respectively with a high category because these three students during the learning process were very enthusiastic and very active in working on practice questions both independently and in groups besides that, they really understand basic mathematics because physics is inseparable from mathematics so that this has an impact on the final test. High-ability students will have various mathematical ideas to solve problems and be able to solve problems

through various forms of mathematical representation (Sulastri, et al., 2017). Numeracy literacy is the knowledge and ability to use various numbers and symbols related to numbers and basic mathematical operations (add, subtract, multiply, divide) and the ability to use the meaning of numbers and symbols to analyze information and solve problems in everyday life (Yulinggar, 2019). while for the low category there are 6 students with the initials K, L, N, O, S, and W because the six students are not focused during the learning process they are just silent and if there are questions they are passive in answering besides that, these students are basically the ability to calculate, fractions, comparisons, reasoning, making graphs is still very low. Obstacles in self-adjustment also result in individuals being less able to participate actively in groups, and feeling high pressure from the environment and making them tend to be quiet (Maimunah, 2020). The moderate category has 17 students because during the learning process most students show numeracy literacy skills both in calculation, reasoning, fractions, comparisons, percentages, and data interpretation still depend on peers who are more Skillful and Provicient, only they have the desire to try to do all the questions independently or in groups with the help of peers. Students who have social support from peers tend to have the ability to manage problems faced every day (Pradana & Susilawati, 2019). It can be concluded that there is an increase in numeracy literacy skills in the elasticity of materials material with an average N-gain of 0.45 in the medium category. This is in line with the data on numeracy literacy achievement based on competency levels presented in Figure 3.

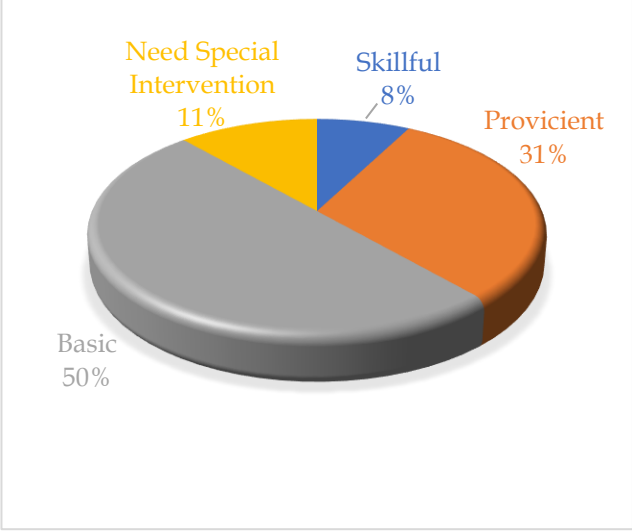

Figure 3. Achievement of Numeracy Literacy Based on Competency Level

Based on Figure 3, it was found that 2 students (8%) had numeracy literacy skills at the Skillful level so that they had achieved completion and needed more challenges. At the Provicient competency level, there were 8 students (31%) so that they had achieved completion and did not need remedial. At the Basic competency level, there were 13 students (50%) so that they had not achieved completion and remedial in the required sections. At the competency level requiring special intervention, there were 3 students (11%) so that it can be said that they had not achieved and remedial in all sections. The low ability of students to solve physics problems related to mathematics causes them to have a fear of physics lessons which has an impact on the results of numeracy literacy in physics material which is still low (Surya, et al., 2021). The fears that can be found include feelings of nervousness, stress, or anxiety in solving physics problems related to mathematics. In addition, numeracy is the ability to use mathematics to solve problems and meet the demands of everyday life (Surya, et al., 2021). Students in the low mathematical ability category, most of them tend to write all the information in the question without first looking at the meaning or information needed to solve the problem. This indicates that they only write all the information in the question but do not understand it so that the strategies and solutions provided are not appropriate (Ahmad & Nasution, 2018; Kamid, et al., 2020). In line with this opinion, subjects who have low problem-solving abilities are less able to choose and implement solution strategies and do not re-check the answers obtained so that the general conclusions given are not appropriate. resulting in the provision of wrong conclusions (Sari I, et al., 2021). This problem indicates that the numeracy literacy skills possessed are still low and need to be improved. Numeracy literacy is the knowledge and skills to use various numbers and symbols related to basic mathematics to solve practical problems in various contexts of everyday life and analyze information presented in various forms, then use the results of the analysis to predict and make decisions (Patriana, et al., 2021).

Conclusion

Based on the research results from the discussion above, it was found that there was an increase in numeracy literacy skills in the elasticity of materials material with an average N-gain of 0.45 in the medium category. The most numeracy literacy skills were found in students who had a numeracy literacy level at the Basic level (50%), so this study needs to be trained more deeply because numeracy literacy skills are important in solving everyday problems, especially physics which is closely related to mathematics.

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The authors declare no conflict of interest

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