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Development of Science Literacy Assessment Based on Multi Representation of Rectilinear Motion Concept to Investigate Students' Science Literacy Competencies

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ABSTRACT
There have been many assessment instruments developed to measure student science literacy. However, literacy measurement instruments that pay attention to various intelligences and are reflected in the context of multiple representations have not been developed much. On the other hand, it is important to give every student the opportunity to succeed at his intelligence level. This study aims to determine the feasibility of a multi-representation based scientific literacy assessment instrument for high school physics on rectilinear motion concept as well as to describe students' scientific literacy skills and the mastery pattern of the rectilinear motion concept measured by the instrument developed. This research is a Research & Development (R&D) research. The test subjects were 262 high school students who had studied rectilinear motion concept in public high schools with A-accreditation. Data analysis conducted were validity test of instruments by experts; empirical test to obtain validity, reliability, difficulty level, and item difference; student responses to test offerings; profile of scientific literacy skills; and the pattern of mastery of the rectilinear motion concept. From the measurement results, it is evident that the profile of the average scientific literacy ability of high school students is still in the unsatisfactory category. The pattern of mastery of the concept of straight motion based on the modes of representation ranging from the most difficult to the easier ones is graphical, pictorial, verbal, and mathematical representations. This data could indicate that learning by practicing literacy skills still can be improved.

INTRODUCTION

Education is the main pillar in the progress of a nation. Quality education will produce quality human resources as well. Education continues to develop over time. The 21st century has entered an era of

globalization which is full of challenges. Science learning carried out by teachers must be able to answer the challenges of the 21st century, namely to form humans who can survive technological developments [1]. Scientific literacy can answer local and international challenges to face the future [2]. Scientific literacy can address the challenges of the 21st century since scientific literate individuals must take advantage of scientific information they have to overcome unrest in everyday life and produce useful scientific products [3].

The problem of education in Indonesia that continues to this day is that students' scientific literacy skills are not yet optimal. The scores achieved by Indonesian students in the PISA (Program for International Student Assessment) initiated by the OECD (Organization for Economic Cooperation and Development) are still not satisfactory. This data has been recognized for its validity throughout the world, so that it can be used as a reference for analyzing the literacy achievements of students in the participating countries. Based on the results of random sampling that has been carried out and analyzed the content of the representation in the questions presented in the PISA test, it appears that discourse content is still an obstacle. The low PISA results of Indonesian students are caused by several factors, namely the neglect of the importance of students' ability in reading and writing science as a competency that must be possessed. Another factor, namely, students are less trained in solving problems with the characteristics of questions that apply scientific literacy [4].

In addition to planning and learning processes, each education unit also assesses learning outcomes as an effort to implement an effective and efficient learning process. The areas of scientific literacy assessment include, among other things, mastery of concepts, thinking skills, learning difficulties, and representation skills. The aspects of conceptual mastery, thinking skills, and learning difficulties were well exposed in the matter of scientific literacy which refers to the PISA framework. Measurements of scientific literacy that have been carried out by previous studies have not yet accommodated multi-representation content. In general, the concern of researchers, in addition to indicators of scientific literacy, also still focus on mastering the concept of energy [5] [6] [7], Newton's Law [8], Thermodynamics [9], environmental themes [10] and global warming from a physics review [11]. However, based on the analysis of PISA questions, the representation aspect is still not widely used. The form of the packaged questions also still focuses on content knowledge and has not combined multiple representations. Whereas the success of the problem solving process depends on the skills to represent the problem such as constructing and using mathematical representations in words, graphs, tables and equations, solving and manipulating symbols [12]. Therefore, efforts should be made to develop multi-representational aspects in scientific literacy problems.

Physics can be used as a means to train scientific literacy skills. However, physics is considered difficult by students because it requires students to understand mathematics which mostly considered as a difficult subject for students. The physics questions is still dominated by mathematical analysis and not many have presented various representations. Basically, representation in physics learning aims to minimize students' difficulties in learning physics. Opportunities to train literacy through physics can be done by presenting problems in mathematical representations, in the form of verbal, graphs, tables and equations, as well as solving and manipulating symbols [13]. This is because multi representation can provide three main benefits, namely as a complement to information, limiting interpretation, and building understanding. In education, teachers will find various characteristics and learning styles of different students [14]. Multi representation can help students to more easily understand a concept. Lack of multi-representation abilities of students will cause more difficult for students to understand the concepts. This means that the concept of physics can be used to train scientific literacy skills through multi-representation-based physics problem solving.

Square motion is one of the physics concepts of odd semester class X in the 2013 curriculum. The material in rectilinear motion includes the notion of distance, displacement, velocity, velocity, and acceleration. In the development of scientific literacy instruments that have been carried out by previous researchers, it still focuses on serving verbal and mathematical representations. Even though every student has a variety of intelligence. It revealed that basically every student has specific abilities

that are more prominent than other abilities. If the concept presentation is only presented with one representation, it will be beneficial for some students and detrimental for others. For example, a concept presentation is only stated in a verbal representation, so students with more prominent abilities, especially in terms of graphic representation, will find it difficult to understand the concepts presented [15]. The concept of rectilinear motions is closely related to the daily lives of students. Many representations can be used to explain the concept of rectilinear motion. In that students are trained to master the content. From the problems described and the importance of students 'multi-representation ability and the low students' scientific literacy, it is necessary to develop a multi-representation based instrument to assess the scientific literacy of high school students squarely. the topic of motion.

METHOD

The subjects of this study were high school students who had studied the concept of rectilinear motion in four A-accredited public high schools with the same quality level located in the city of Semarang. The consideration in determining the level of school quality is the average score of the 2019 National Physics Examination. This study involved research subjects on a small-scale test of 72 students and a broad-scale test of 190 students. Research on the development of a multi-representation based scientific literacy assessment instrument which aims to measure scientific literacy skills refers to Sugiyono's research design [16]. The R&D steps are as follows;

1) Potential problems. Potentials and problems are identified by conducting a preliminary study which includes literature studies and field studies. Literature studies are carried out by searching for relevant literature or data. Field studies are carried out to obtain facts in the field related to problems in assessment and the instruments used by teachers to conduct assessments.
2) Data collection. The information gathering is done as material for product planning. At this stage, a straight motion topic content analysis is carried out and a competency analysis is achieved by examining the Core Competencies (KI) and Basic Competencies (KD) of rectilinear motion topics contained in the 2013 curriculum syllabus class X semester 1.
3) Product design. At this stage, a 21st century skill-based multi-representation ability assessment instrument was compiled on the rectilinear motion material. The instruments compiled include: (a) a grid of rectilinear motion material questions, (b) a multi-representation type question text based on 21st century skills, (c) answer keys, and (d) scoring guidelines.
4) Design validation. Design validation is usually called an expert validation test. Instrument validation was carried out to assess the appropriateness of the instrument and to get criticism and suggestions as a guide for instrument improvement. Experts involved in the validation of this instrument include: (a) experts in the scientific field of physics, and (b) experts in the field of assessment instruments. The validation test by an expert (expert judgment) is important to determine the validity of the multi-representation-based scientific literacy assessment instrument prepared. Testing is carried out using a closed validation questionnaire in the form of a scale with a sign (√) in the appropriate column and open validation for experts to write opinions, criticisms, and suggestions. At this stage, an assessment of the conceptual content aspects, language, illustration presentation, and mathematical appearance of the questions is carried out.
5) Design revision. Design revisions are made to obtain products that meet the criteria for a valid assessment instrument. At this stage, the researcher corrects the instruments that have been validated by experts. Criticisms and suggestions from experts who are lacking in the instrument are used as a reference in improving the instrument. Products that have been validated by experts and revised are declared valid for the next stage.
6) Product testing. Product testing is carried out by small-scale trials in schools that have the same quality level as the sample of the school's research subjects. This is done because the purpose of this product trial is as a preliminary trial to determine the quality level of the multi-representation-based creative thinking assessment instrument which is composed of validity, reliability, difficulty level, and item difference.
7) Product revision. Data from the limited trial results were then analyzed to determine the validity, reliability, difference power, and difficulty level of the items. The results of the product trial

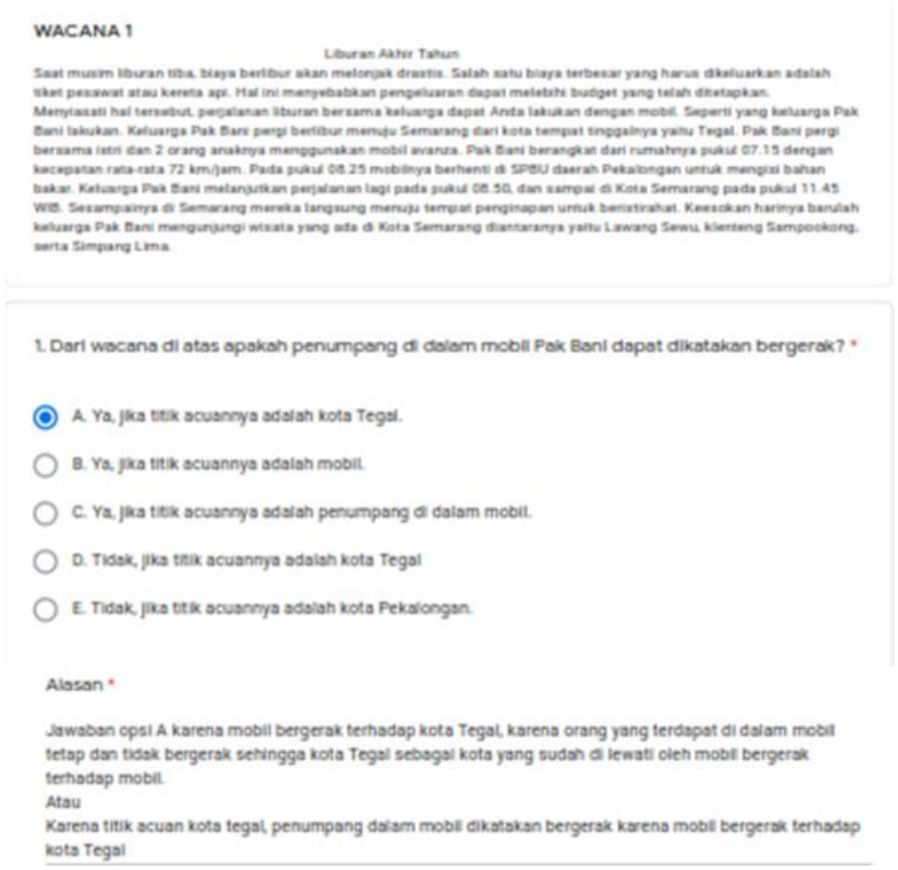
analysis are used as a guideline for instrument repair before the trial use. At the product trial stage and product revision it is possible to repeat the stage until a good level of quality assessment instrument is achieved

8) Usage trials. At this stage, a large-scale use trial was carried out in public high schools with the same level of school quality as seen from the average results of the 2019 National Physics Examination. In the test, students worked on question instruments and filled out student response questionnaires. In addition, the researcher conducted interviews with physics subject teachers to find out the teacher's opinion on the multi-representation-based scientific literacy assessment instrument that was compiled.
9) Product Revisions. Data from statistical analysis, student response questionnaires, and interviews with teachers in the trial use on a large scale were used as guidelines for instrument improvement before producing the final product.
10) Final products. The final product in this study is a question arranged using multiple representations to measure the ability of multi-representation, critical thinking, and problem-solving skills of students with rectilinear motion topic, which is equipped with test question clues, answer keys, and scoring guidelines that are ready to be used at the high school level.

The data analysis techniques were the validity of the assessment instruments by experts, the quality of the items (validity, reliability, level of difficulty and discrepancy), the level of critical thinking and problem solving, and student response questionnaires that were processed statistically.

RESULTS AND DISCUSSIONS

The output produced in the study was a multi-representation based scientific literacy assessment instrument on rectilinear motion concepts consisting of 1) design of rectilinear motion concepts questions, 2) multi-representation question sets based on scientific literacy, 3) answer keys, and 4) scoring guidelines. The results obtained include the validity test results, reliability test results, assessment instrument characteristics test results, student response questionnaire results, the results of the analysis of the scientific literacy ability profile and the results of the analysis of the pattern of rectilinear motion concepts on the multi-representation based scientific literacy assessment instrument. Figures 1, 2, 3, and 4 below are some samples of test question instruments with verbal, mathematical, pictorial, and graphic representations along with the students' answers.



WACANA 1

Liburan Akhir Tahun

Saat musim liburan tiba, biaya berlibur akan melonjak drastis. Salah satu biaya terbesar yang harus dikeluarkan adalah tiket pesawat atau kereta api. Hal ini menyebabkan pengeluaran dapat melebihi budget yang telah ditetapkan. Menyiasati hal tersebut, perjalanan liburan bersama keluarga dapat Anda lakukan dengan mobil. Seperti yang keluarga Pak Bani lakukan. Keluarga Pak Bani pergi berlibur menuju Semarang dari kota tempat tinggalnya yaitu Tegal. Pak Bani pergi bersama istri dan 2 orang anaknya menggunakan mobil avanza. Pak Bani berangkat dari rumahnya pukul 07.15 dengan kecepatan rata-rata 72 km/jam. Pada pukul 08.25 mobilnya berhenti di SPBU daerah Pekalongan untuk mengisi bahan bakar. Keluarga Pak Bani melanjutkan perjalanan lagi pada pukul 08.50, dan sampai di Kota Semarang pada pukul 11.45 WIB. Sesampainya di Semarang mereka langsung menuju tempat penginapan untuk beristirahat. Keesokan harinya barulah keluarga Pak Bani mengunjungi wisata yang ada di Kota Semarang diantaranya yaitu Lawang Sewu, klenteng Sampookong, serta Simpang Lima.

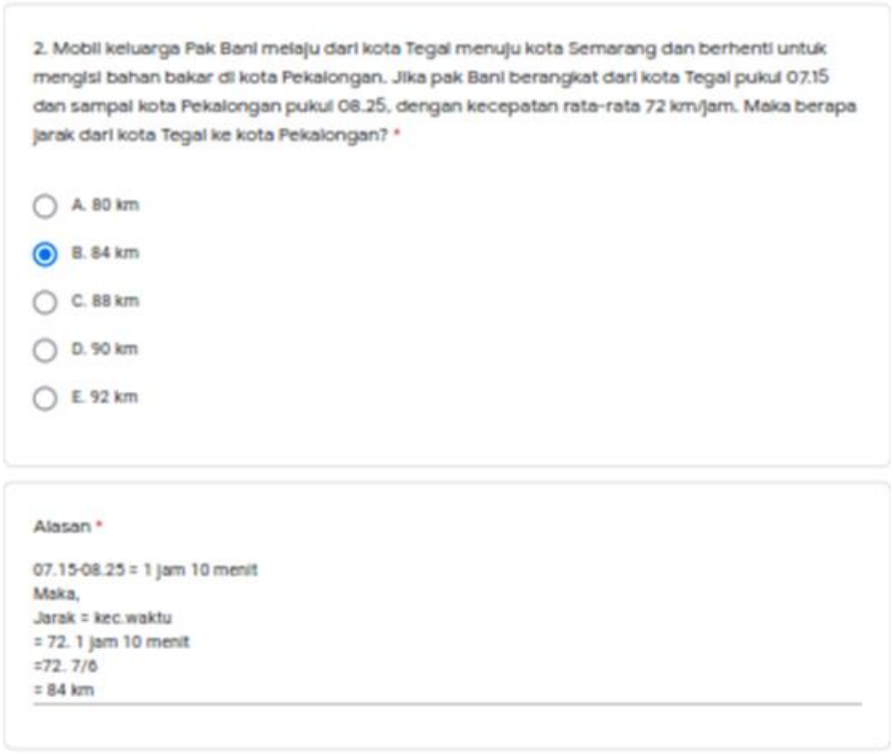
1. Dari wacana di atas apakah penumpang di dalam mobil Pak Bani dapat dikatakan bergerak? *

- (●) A. Ya, jika titik acuannya adalah kota Tegal.
- ( ) B. Ya, jika titik acuannya adalah mobil.
- ( ) C. Ya, jika titik acuannya adalah penumpang di dalam mobil.
- ( ) D. Tidak, jika titik acuannya adalah kota Tegal
- ( ) E. Tidak, jika titik acuannya adalah kota Pekalongan.

Alasan *

Jawaban opsi A karena mobil bergerak terhadap kota Tegal, karena orang yang terdapat di dalam mobil tetap dan tidak bergerak sehingga kota Tegal sebagai kota yang sudah di lewati oleh mobil bergerak terhadap mobil.
Atau
Karena titik acuan kota tegal, penumpang dalam mobil dikatakan bergerak karena mobil bergerak terhadap kota Tegal

Fig 1. *Sample of Verbal Representation Test*



2. Mobil keluarga Pak Bani melaju dari kota Tegal menuju kota Semarang dan berhenti untuk mengisi bahan bakar di kota Pekalongan. Jika pak Bani berangkat dari kota Tegal pukul 07.15 dan sampai kota Pekalongan pukul 08.25, dengan kecepatan rata-rata 72 km/jam. Maka berapa jarak dari kota Tegal ke kota Pekalongan? *

- ( ) A. 80 km
- (●) B. 84 km
- ( ) C. 88 km
- ( ) D. 90 km
- ( ) E. 92 km

Alasan *

07.15-08.25 = 1 jam 10 menit
Maka,
Jarak = kec.waktu
= 72. 1 jam 10 menit
=72. 7/6
= 84 km

Fig 2. *Sample of Mathematics Representation Test*

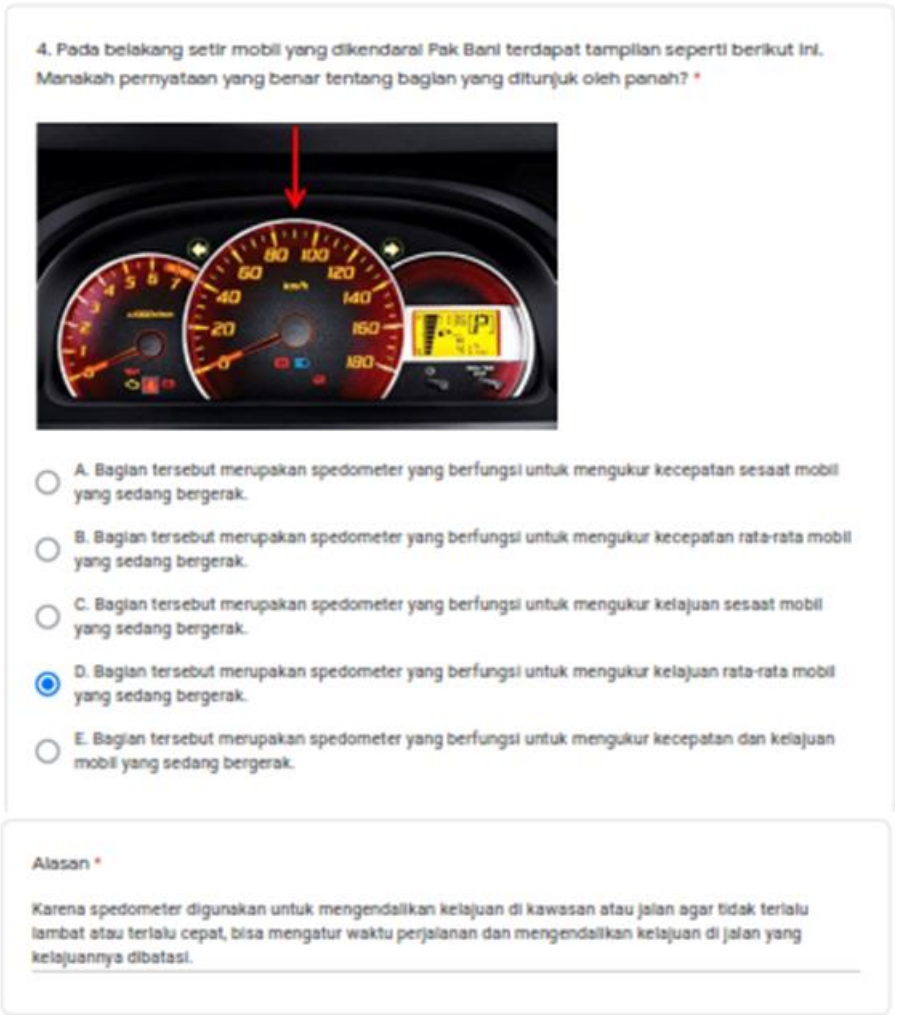


Fig 3. *Sample of Pictorial Representation Test*

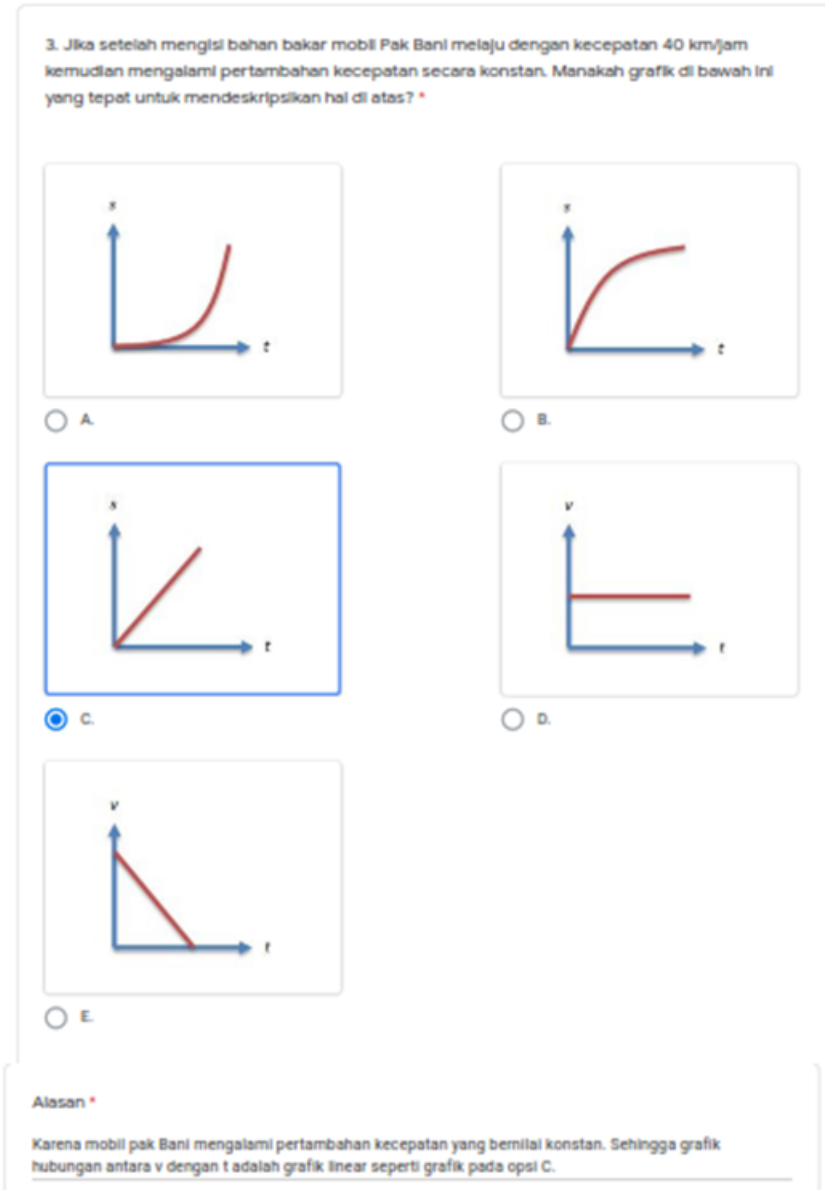


Fig 4. *Sample of Graph Representation Test*

Validity

One of the data on the validation of the assessment instrument was obtained based on the results of the instrument's assessment by experts. Experts involved in the validation of this instrument include experts in the scientific field of physics and experts in the field of assessment instruments, namely two high school physics teachers and one physics lecturer. The results of validation by experts are presented in Table 1.

Based on the data presented in Table 1, it can be concluded that the multi-representation based scientific literacy assessment instrument prepared is declared very feasible to feasible by experts and can be tested on small-scale product trials with several revisions and suggestions for improvement from experts. Product trials were carried out by small-scale trials in one school with a total of 72 students. The product trial aims to determine the validity, reliability, level of difficulty, and discrepancy of the arranged multi-representation based scientific literacy items. The results of the analysis of the validity of the items analyzed using the product moment correlation formula are shown in Table 2. Follow-up to the results of the validity analysis of the items was to reuse the items that were declared valid in the use trial and the four invalid items, namely item number 4, 13, 14, and 15 are repaired for further reuse in testing usage. In the trial use, it was carried out by large-scale trials in

two A-accredited Public High Schools in Semarang City with an average score of the 2019 National Physics Examination (UN) that was almost the same as obtained from the official website of the Ministry of Education and Culture.

Table 1. Results of Instrument Validation by Experts

Representation	Aspects	Average Scores			P (%)	Criteria
		V-I	V-II	V-III		
Verbal	Concept Content	4.00	3.80	3.80	96.75	Very feasible
	Verbal Display	3.20	3.60	3.20	83.25	Feasible
	Content of Science Literacy	4.00	3.60	3.60	93.25	Very feasible
Mathematics	Concept Content	3.80	3.80	4.00	91.75	Very feasible
	Verbal Display	3.80	3.40	3.60	90.00	Very feasible
	Content of Science Literacy	4.00	3.80	3.40	93.25	Very feasible
Pictorial	Concept Content	4.00	3.80	3.60	95.00	Very feasible
	Verbal Display	3.40	3.60	3.60	88.25	Very feasible
	Content of Science Literacy	3.60	3.60	3.80	91.75	Very feasible
Graph	Concept Content	3.80	4.00	3.80	96.75	Very feasible
	Verbal Display	3.60	3.80	3.80	93.25	Very feasible
	Content of Science Literacy	3.60	3.40	3.60	88.25	Very feasible

Based on the percentage data from the analysis of the item validity, there was an increase in the quality score in the form of the validity of the question instruments from the product trial stage by 80% to 95% in the use trial. This is due to the different number of trial samples between product trials and usage trials. In empirical trial, there were 190 students involved. The more samples that are taken, the more representative and the results are better and can be generalized [17]. The results of the validity analysis of product trials and usage trials have differences, namely there are questions that were previously invalid in product trials, namely items number 3, 13, 14, and 15 become valid when testing usage on the same number.

Table 2. Validity Test Results

Steps	Criteria	Question Item Number	Total	Percentage (%)
Product Trial	Valid	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 16, 17, 18, 19, 20	16	80
	Invalid	3, 13, 14, 15	4	20
		Total	20	100
Empirical Trial	Valid	1, 2,3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	19	95
	Invalid	6	1	5
		Total	**20**	**100**

There are also questions that were previously declared valid in product trials, namely number 6 being invalid in the use trial on the same number. Based on this evidence, interview sessions were conducted with 3 students in each trial using high, medium, and low students who obtained 1 student each to further investigate the causes of differences in the results obtained. Based on the results of the interviews conducted, it can be concluded several things, namely in the category of invalid questions to be valid, the improvements made were good enough, as evidenced by the responses of students who responded that the questions were quite easy to understand, and quite easy to do. For valid to invalid category questions, students revealed that for questions with mathematical representations, they were fixated on an existing instant formula, so they only gave answers using only one step/stage according to the formula they knew, even though the questions required them to answer not with just one step/stage but with several steps/stages. Analysis of the validity of the questions based on their mode of representation in the product trial showed that 60% of the graphical representation questions were valid and the mathematical, pictorial, and verbal representation questions were 100% valid. The use

trial resulted in 80% valid mathematical representation questions and the graphical, image, and verbal representation questions obtained 100% valid results.

A multi-representation based scientific literacy assessment instrument that is compiled, in its completion requires scientific literacy skills which are closely related to calculation and reasoning. In addition, questions that are not valid in product trials and use trials have a negative, zero, or small number, this could be due to guesswork and incorrect answers. The validity of a question is also caused by several factors, including the number of questions considered difficult by students, namely questions with the type of reasoning and calculation [18]. In addition, the students' responses to the multi-representation-based scientific literacy assessment instrument that were arranged showed that students were not used to working on questions with the concept of scientific literacy.

Reliability

Based on the calculation of the reliability of the questions, the results obtained were 0.676 on the product trial and 0.790 on the use trial. The results of the reliability analysis fall into the high category. Thus, the assessment instrument prepared is a good quality assessment instrument in terms of reliability. Factors that can affect the reliability of a test include: (1) The greater the number of items, the more reliable the test. (2) The longer the test time, the more reliable. (3) The narrower the item difficulty range, the greater the reliability of the questions. (4) Questions that are interconnected will reduce the reliability of the questions. (5) The more objective the scoring, the greater the reliability of the questions. (6) The condition of the examinees [19].

Degree of Difficulty and Discernment

Based on the results of the item analysis in product trials and usage trials, the proportion of the difficulty level of the questions in Table 3 is almost ideal. The proportion of good problem difficulty level is 25% difficult questions, 50% moderate level questions, 25% easy questions (1: 2: 1) [20]. From the data from the student response questionnaire results, several factors were obtained that influenced the results of the analysis of the difficulty level of the items, including: (1) students could not grasp the meaning contained in the questions (2) students forgot the formula (3) students were not familiar with multi-representation questions (4) students are not familiar with scientific literacy questions and (5) students are not familiar with questions in the form of reasoned multiple choice.

Table 3. Level of Difficulty Proportion

Steps	Criteria	Question Item Number	Total	Percentage (%)
Product Trial	Very Difficult	-	-	-
	Difficult	3, 4, 6, 11, 13, 14, 15, 16	8	40
	Moderate	1, 2, 5, 7, 8, 9, 10, 12, 17, 18, 19, 20	12	60
	Easy	-	-	-
	Very Easy	-	-	-
	Total		20	100
Empirical Trial	Very Difficult	-	-	-
	Difficult	4, 13, 14, 15	4	21.05
	Moderate	1, 3, 7, 11, 12, 16, 17, 18, 19	9	47.37
	Easy	2, 5, 8, 9, 10, 20	6	31.58
	Very Easy	-	-	-
	Total		19	100

The results of the analysis of the difference in the items based on Table 4 for a multi-representation based scientific literacy assessment instrument that was arranged. The questions have bad or very bad distinction because they are difficult questions so that students only guess in their answers [18]. The data analysis conducted shows that the questions that have different power in the bad or very bad

categories have a difficulty level in the difficult category. The follow-up to the results of the analysis of the level of difficulty and discrepancy is to document the good questions in the question bank and can be used again in future tests and discard the bad or revised questions [21].

Table 4. Discriminatory Analysis

Steps	Criteria	Question Item Number	Total	Percentage (%)
Product Trial	Very good	-	-	-
	Good	1, 2, 5, 7, 8, 9, 10, 11, 16, 19, 20	11	55.00
	Moderate	12, 17, 18	3	15.00
	Poor	3, 4, 6, 13, 14,15	6	30.00
	Very poor	-	-	-
	Total		20	100.00
Empirical Trial	Very good	20	1	5.26
	Good	3, 8, 9, 10, 11, 12, 14, 16, 17, 18, 19	11	57.89
	Moderate	1, 2, 4, 5, 7, 13	6	31.58
	Poor	15	1	5.26
	Very poor	-	-	-
	Total		19	100.00

Students' Science Literacy

The test developed in this study used the scientific literacy category according to Chiappetta [22]. Based on Figure 5. Based on the data shown, it can be concluded that the most dominant students' scientific literacy skills are in the very poor category, followed by the moderate category, the poor category, the good category, and the very good category. The difference in the number of students in each category shows the diversity of students' scientific literacy abilities.

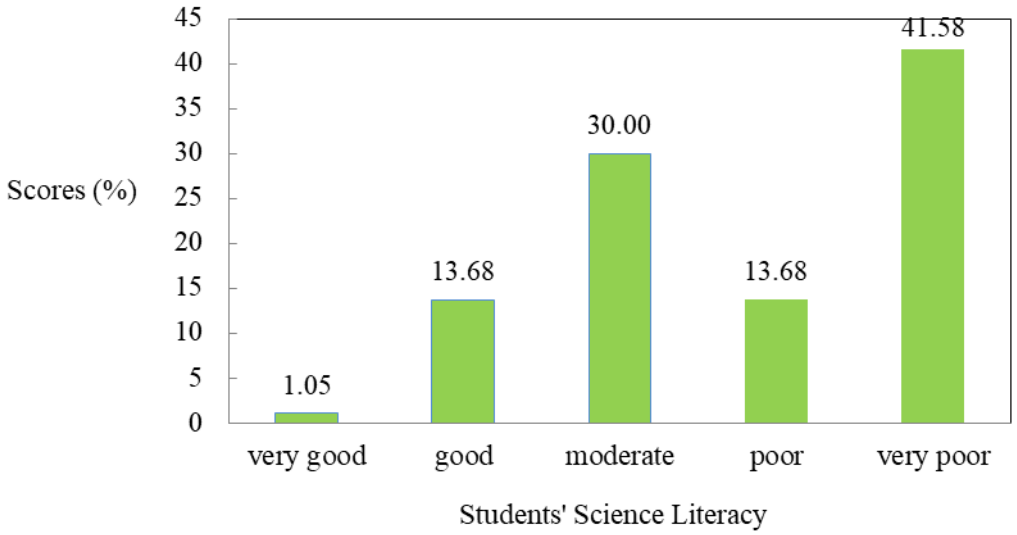


Fig 5. *Bar Chart of Students' Science Literacy Ability Based on Scores*

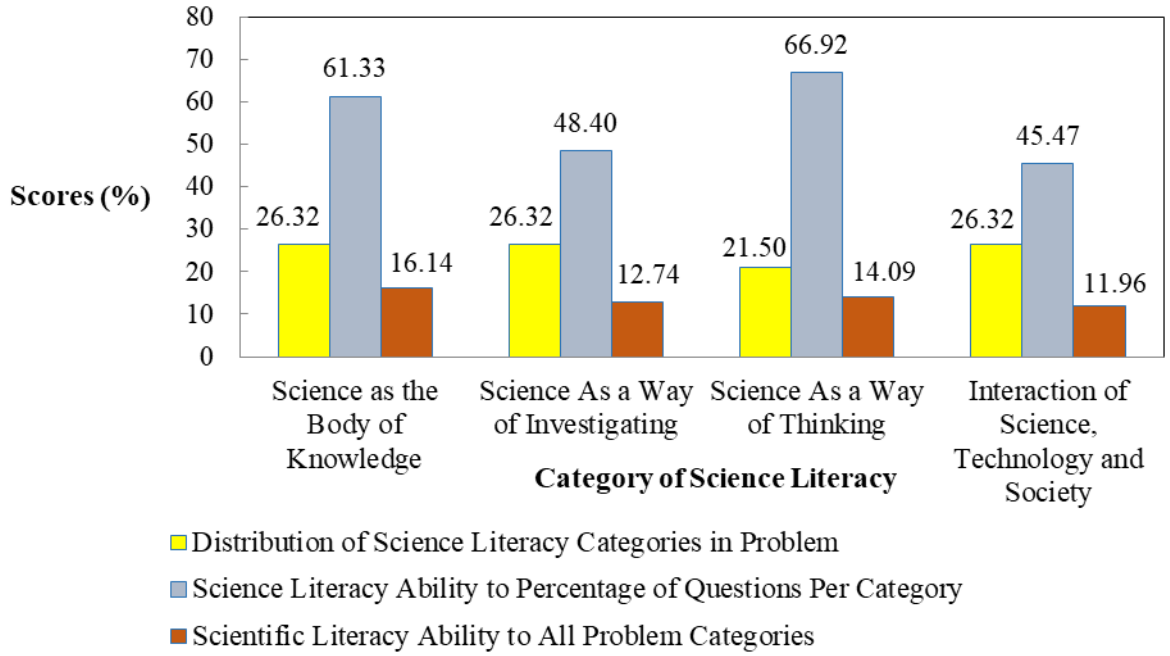


Fig 6. *Students' Science Literacy Ability by Category*

In Figure 6, the profiles of students 'scientific literacy abilities were analyzed by considering the proportion of the categories of scientific literacy abilities in the arranged instruments, it was obtained that the percentage of students' scientific literacy abilities was different. The highest percentage of the category of scientific literacy is science as a way of thinking, followed by science as the body of knowledge, science as a way of thinking, and the interaction of science, as well as technology and society. The factors that are considered to have influenced the results of the data are: (1) difficulties in using or interpreting terms, concepts, and principles; (2) students forget the concept that has been formulated in the questions; (3) students experience procedural errors in the processing of test questions due to incorrect attention to the question commands and errors in not answering questions [23]. The result of literacy skills which is still classified as low is of course caused by several factors. First, from the results of preliminary observations, it is known that learning in high school still uses the lecture method, and the learning media and assessment instruments used do not develop scientific literacy skills. The teacher ignores habits in learning physics about the importance of students' abilities in reading and writing science as competences that must be possessed [24]. Second, the results of the student response questionnaires also showed that students generally lacked training in solving problems with characteristics such as questions that applied scientific literacy. There is no continuity between science learning in schools and problems in life [25]. Therefore, the action that educators in schools need to take is to carry out learning that contains scientific literacy so that students' scientific literacy skills are honed and can get used to working on scientific literacy-based questions.

Pattern of Students' Concept Mastery of Rectilinear Motion Based on Multi-Representation Assessment

Based on the data presented in Figure 7, there are differences in students' mastery of concepts based on their mode of representation. Students' understanding of the concept of rectilinear motion based on the mode of representation starts from the most difficult to the easier one is a matter of graphical, pictorial, verbal, and mathematical representations. The results of measuring the ability of multi-representation using the developed questions prove that there are differences in students' problem-solving abilities based on the representation format of a problem presented. The difference in conceptual understanding based on the mode of representation also shows the diversity of students' intelligence.

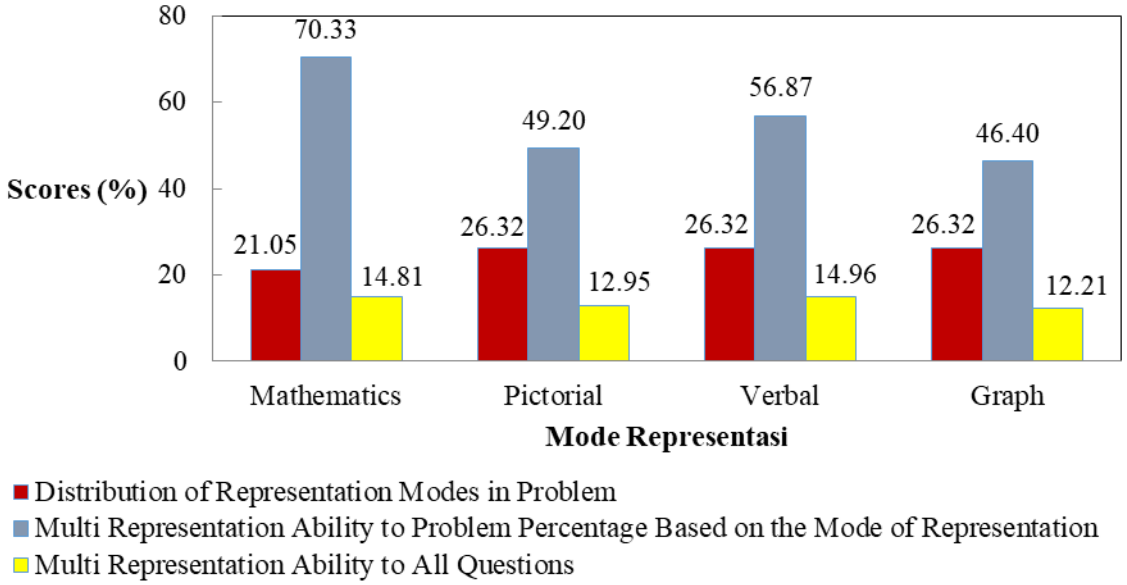


Fig 7. *Student' Representation Abilities based on Mathematical, Pictorial, Verbal, and Graphs Mode of Representation*

All intelligence possessed by humans is not the same [26]. All intelligences can be explored, grown, and developed optimally, with practice, one can build the strengths of intelligence that is owned and dilute the weaknesses. Multirepresentation can form new knowledge for students, not only as a translation of something [24]. Presentation of topics with a variety of representations will certainly make it easier for students to understand the concept according to their representational abilities because each student has different intelligence, so students will learn in different ways according to the type of intelligence [25]. The application of various modes of representation will provide optimal learning opportunities for each student's intelligence [26]. Multi-representation-based questions have an advantage over the evaluation questions that have been used by teachers in high school level [27]. This is because multi-representation questions are not dominated by mathematical representation questions so that they can describe the understanding of concepts in students' cognitive structures. The various representations analyzed make this concept clear. The practicality of the instrument and students' responses to the multi-representation-based science literacy assessment instrument were measured using a student response questionnaire. The results of the dominant student response gave a good response. This states that the scientific literacy ability instrument is suitable for use in learning to determine multi-representation-based scientific literacy skills in rectilinear motion concepts.

Interviews to find out the teacher's response to the question instruments developed were carried out on physics teachers in high schools using interview guide sheets. The conclusion of the interview results is that the concepts coverage and indicators of the scientific literacy ability assessment instrument using multiple representations in rectilinear motion are in accordance with the core competencies and basic competencies in the 2013 curriculum. The multi-representation based scientific literacy assessment instrument on rectilinear motion concepts that was arranged supported students interested due to more varied and less saturated especially with randomly arrangement between one representation and another. A multi-representation based scientific literacy assessment instrument on rectilinear motion concepts can train and measure scientific literacy skills of students in high school. The multi-representation-based scientific literacy assessment instrument on rectilinear motion concepts that is arranged is suitable for use as an assessment instrument for students, right but it requires more time in preparation due to it requirement of a deeper understanding of concepts. Students must first be accustomed to using scientific literacy learning and introduced to various representations.

CONCLUSION AND SUGGESTION

The results showed the validity of 95% of the items were declared valid and 5% of the items were declared invalid as well as had a high reliability with a value of 0.790. The proportion of the difficulty level of the questions was almost ideal, namely 21.05% of the questions in the difficult category, 47.37% of the questions in the medium/moderate category and 31.58% of the questions in the easy category. The difference power of the questions was 5.26% of the questions with very good differences, 57.89% good, and 31.58% sufficient, and 5.26% poor. The profile of the students' scientific literacy abilities was in the very poor category on average. The percentage of students' scientific literacy abilities based on their category from the highest to the lowest is science as a body of knowledge, science as a way of thinking, science as a way to investigate, and the interaction of science, as well as science for technology and society. The pattern of mastery of the students' straight motion concept based on their mode of representation, starting from the most difficult to the easier ones, were graphical, pictorial, verbal, and mathematical representations. It is necessary to develop a multi-representation-based scientific literacy assessment instrument on other concepts so that students are familiar with multi-representation-based scientific literacy questions. Learning models, learning media, and assessment instruments that can improve scientific literacy skills so that students should be trained to work on scientific literacy questions.

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