Virtual Test Instruments to Measure Scientific Literacy of High School Students on Work and Energy

Y Oktalia, A B Susila and B H Iswanto
Physics Education Master Program, Universitas Negeri Jakarta
Jl. Rawamangun Muka, Jakarta 13220, Indonesia
Email: yesyoktalia6@gmail.com, anggarabs@unj.ac.id, and bhi@unj.ac.id

Abstract. Science literacy is one aspect of assessment that is required in the K-13 curriculum. This study aims to describe the science literacy skills of high school students in the matter of effort and energy in learning physics and to determine the characteristics and quality of scientific literacy instruments using virtual test. The research method used is the 4D development method: Define, Design, Development, Disseminate. The scientific literacy test was validated by expert lecturers and physics teachers with CVI results in the very good category and CVR analysis in the valid category. The results of the analysis of the Rasch model show that the test instrument is accepted and can measure what it should measure. Research participants are tenth grade who has studied the concepts of work and energy. The virtual test contains scientific literacy skills which contain physics questions on the concepts of work and energy. The results showed that the scientific literacy skills of high school students were 65.2% for the contextual aspect, 65.1% for the knowledge aspect, and 69.5% for the competence aspect. Based on the research results, students' scientific literacy skills are in the good category.

1. Introduction
Scientific literacy is an important and needed skill in today's digital era. The importance of scientific literacy because the problems are related to knowledge and technology. Science education aims to improve students' knowledge, competence in an effort to meet the needs of life in various situations such as to understand the environment, health, economy, modern social, and technology [1] [2]. Systematic and scientific education really supports sustainable education [3]. Deep and broad scientific abilities allow students to understand the world [4]. Scientific literacy plays an important role in solving real problems [5] involving scientific thinking skills and acting in addressing existing social issues such as the development of life skills, where the need for reasoning skills in a social context and emphasizes that scientific literacy is for everyone [6].

The effectiveness and efficiency of educational teaching cannot be separated from the learning assessment instruments used [7]. Teachers must be provided with assessment instruments to support their duties, namely evaluating student learning outcomes. Assessment documents the educational process carried out on how students achieve learning objectives in the form of scores, degrees, or grades [8]. The use of computer technology to conduct student assessments has succeeded in encouraging a high level of validity, being more interactive and in accordance with the objectives to be achieved [9]. One form of assessment using technology is a virtual test. Virtual tests can measure competence more effectively than paper and pencil tests [10]. Basyari found that learning using multimedia makes learning more meaningful [11] and virtual exam assessment (ASVITE) based on interactive lecture demonstrations (ILD) supports 21st century employment skills competency Marwanti et al [12].
Work and energy are basic physics materials that examine physics concepts about motion which are often seen as complex if the assessment is in the form of text so that students need a stimulus in the form of videos or pictures. Therefore, it is very important to develop more effective virtual evaluation [10]. Instruments developed literacy test contains three aspects: context, knowledge and competence [13]. Each developed question is equipped with a stimulus in the form of videos or pictures to avoid misconceptions. Currently, the development of evaluation instruments is mostly done with classical models.

So it takes the development of virtual test instrument to measure the scientific literacy of high school students on the work and energy.

2. Method
The method used in this research is the Research & Development method. The development of the test instrument was carried out with reference to the 4D model developed by Thiagarajan. The 4D model consists of four stages:

![Diagram](image)

**Figure 1.** 4D Model Test Development Procedure

2.1. Define
The purpose at this stage is to define the terms of the virtual test instrument in the format of a scientific literacy test, which begins with an objective analysis of the material constraints to be developed by the instrument. This stage includes four main steps: needs analysis, student analysis, curriculum analysis and learning objectives.

2.2. Design
The purpose of this stage is to prepare a literacy test instrument that will be virtual. This stage includes three steps: compiling a test grid, determining the form and length of the test, and developing a validation instrument.

2.3. Development
The purpose of this stage is to produce an instrument that is suitable for use based on expert opinion and statistical analysis. This stage includes four steps: writing tests, reviewing tests, expert validation and revising based on expert suggestions. Data from the results of expert validation instruments will be analyzed for validity and reliability using CVR and CVI analysis.
2.4. Disseminate

The purpose of this stage is to produce scientific literacy instruments that are tested. This stage includes implementation to students, data analysis and conclusion. Analysis of the data obtained will be analyzed using the Rasch Model.

3. Results and Discussion

3.1. Scientific Literacy virtual test

The virtual instrument-based literacy test contains one aspect of scientific literacy. The following are some examples of literacy questions presented in the video and the picture shown in Figure 2.
(b) Knowledge indicators

(c) Competence indicators
The stimulus questions used video or animation tested to determine the student's scientific literacy consisted of the three indicators. It can be seen that an example of a problem in Figure 2 (a) shows a problem with context aspect indicators, students are asked to understand the application of work and energy with approach scientific literacy test (b) Knowledge indicators where at that stage students designing and evaluating investigations, (c) Competence indicators which means being able to interpretation data and use scientific evidence.

Based on the results of the validation, scientific literacy test on work and energy learning based on the indicators. The results of the analysis of the Rasch Model show that The average percentage of material validation by the student was 31.5%, with very good interpretation and 0.97 for reliability. The results of expert validation tests consisted of three aspects, namely substantance, a construction and language which were analyzed using the Content Validity Ratio (CVR). The average percentage of the CVR was 0.905 with a very good interpretation.

| Table 1. CVR and CVI Values |
|-----------------------------|
| Ne | CVR | Criteria | CVI | Criteria |
|-----|-----|----------|-----|----------|
| question 1 | 375 | 0.88 | Valid | 0.94 | very good |
| question 2 | 371 | 0.86 | Valid | 0.93 | very good |
| question 3 | 362 | 0.81 | Valid | 0.91 | very good |
| question 4 | 371 | 0.86 | Valid | 0.93 | very good |
| question 5 | 372 | 0.86 | Valid | 0.93 | very good |
| question 6 | 376 | 0.88 | Valid | 0.94 | very good |
| question 7 | 379 | 0.90 | Valid | 0.95 | very good |
| question 8 | 380 | 0.90 | Valid | 0.95 | very good |
| question 9 | 373 | 0.87 | Valid | 0.93 | very good |
| question 10 | 377 | 0.89 | Valid | 0.94 | very good |
| question 11 | 373 | 0.87 | Valid | 0.93 | very good |
| question 12 | 378 | 0.89 | Valid | 0.95 | very good |
| question 13 | 377 | 0.89 | Valid | 0.94 | very good |
| question 14 | 378 | 0.89 | Valid | 0.95 | very good |
| question 15 | 380 | 0.90 | Valid | 0.95 | very good |
| question 16 | 378 | 0.89 | Valid | 0.95 | very good |
| question 17 | 379 | 0.90 | Valid | 0.95 | very good |
| question 18 | 371 | 0.86 | Valid | 0.93 | very good |
| question 19 | 366 | 0.83 | Valid | 0.92 | very good |
| question 20 | 379 | 0.90 | Valid | 0.95 | very good |

3.2 Analysis of scientific literacy results

Based on table the results of the implementation science literacy test show that 65.2% of students are able to understand the matter of scientific literacy in the matter of work and energy in the context aspect Contain that students are able to answer questions related to application on work and energy. 65.1% the knowledge indicator, students are able to answer questions in designing and evaluating investigations and 69.5% of students are able to answer questions on the aspect of competence which means being able to interpret data use scientific evidence.
The average of all aspects of the feasibility test instrument is possible to be used as an assessment to measure scientific literacy of work and energy in physics learning. The instrument is stated to be able to measure what it is supposed to measure. Virtual instruments also make it easier for teachers to check or evaluate and determine appropriate feedback for each student [14].

4 Conclusion

Based on the research results that have been obtained, it can be concluded that the virtual test instrument for scientific literacy of work and energy learning is valid as an assessment instrument that show 31.5%, with very good interpretation and 0.97 for reliability. And based on the test results of students, it was found that the scientific literacy skills of high school students' scientific literacy skills 66.6% were in the good category. Virtual test instrument of scientific literacy makes it easier for students and teachers to use it and can create students' abilities in scientific literacy.

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