Validity of Teaching Materials Based on Socio-Scientific Issues Approach on The Topic of Vibration, Waves, and Sound

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Abstract. Participation in TIMSS and PISA showed that the achievements of Indonesian children are still under the average and low in the scientific literacy. Scientific literacy is the ability to make decisions about scientific issues and scientific phenomena that can be applied in daily life. This ability can be developed using innovative learning approaches such as socio-scientific issues (SSI). SSI is an approach that represents issues or problem in social life that are conceptually related to science. The material discusses on the topic of vibration, waves, and sound because it related to scientific issues and phenomena in daily life. This study aims to describe validity of teaching materials based on socio-scientific issues approach including Syllabus, Lesson Plan, Students’ Book, Students’ Worksheet, and Scientific Literacy Test. The data are then collected through validation questionnaire to assess validity of teaching materials. Data collection instruments used validation sheets. The data are analysed by using both descriptive quantitative and qualitative methods. The result of teaching materials validation showed that teaching materials is very valid and can be used for learning process.

1. Introduction
Science lessons in junior high schools is implemented 2013 Curriculum based on internal challenges and external challenges. One of the internal challenges is the readiness of education personnel in developing teaching materials as an innovation in the learning process, while external challenges are related to the development of education at the international level. Indonesia faced these external challenges by participating Trends in International Mathematics and Science Study (TIMSS) in 1999 and the International Student Assessment Program (PISA) in 2000 [1]. Indonesia’s participation in TIMSS aims to gain information on Indonesian students’ competence in Mathematics and Natural Sciences compared to other countries in the world. Participation in PISA aims to examine and compare the achievements of students around the world with a view to improve educational methods and results. The participation indicates that the achievements of Indonesian students are not encouraging in the results of TIMSS and PISA are presented [2].

The results of TIMSS data for 2011 for the field of science class VIII, Indonesia ranked at number 39th with a score of 406 points from 42 participating countries. In 2015 for class IV, the results are ranked 45th with a score of 397 points from 48 participating countries. Both of these results indicate
that Indonesia is below the average score of the TIMSS scale of 500 points. PISA results are also not encouraging in 2012 and 2015, Indonesia ranked 64th with a score of 382 points from 65 countries and ranked 62th with a score of 403 points from 70 participating countries [2]. Indonesia have under-average scores in TIMSS and PISA scores that show Indonesian students are still low in scientific literacy such as identifying scientific problems, using scientific facts, understanding living systems and understanding to use of science equipment [3]. Scientific literacy is the ability to understand the science of content, competence, processes and attitudes to make decisions regarding evolving scientific issues and scientific phenomena that can be applied in daily life [4-6].

Understanding of science learning that leads to the formation of scientific literacy of students is still not fully understood by science teachers. It results the learning process is still conventional and based on the conceptual mastery of students so that the achievement of scientific literacy of students is low. Other causes were due to lack of learning that involves the process of science related to the students’ daily life [7].

Learning process that can be taught or increase scientific literacy is using approach of socio-scientific issues [8]. Socio-Scientific Issues (SSI) approach is a learning approach that involves socio-scientific issues by orienting learning to the context of science and its relation to social life in society [9-10]. This approach aims to improve the ability of making decisions on discussed or developed issues [11-13].

The topic of vibration, wave and sound is the science topic of Junior High School grade 8th in basic competence such as analysing the concept of vibration, waves, and sound in daily life including auditory system in human and sonar system in animals and presents experimental results about vibration, waves, and sound. The sub topic are vibrations, waves, sound, applications of vibration and waves in technology [14]. In this topic, students are expected to identify, analyse, evaluate, and criticize the utilization of sound waves in daily life. This topic is chosen because it is closely related in the students’ daily life application. In addition to its knowledge of science content in PISA 2015, the physical system requires knowledge of "Interactions between energy and the topic" e.g. light and radio waves, sound waves and seismic [15]. Thus, this material has authentic issues that can be used as learning materials that are linked to the scope of context, knowledge, competence and attitudes in scientific literacy.

The mastery of scientific literacy can be enhanced by teaching materials with the scientific issues discussed. The development of teaching materials is a process of designing a logical and systematic learning of a set of media used by teachers and students in the learning process in the classroom. It becomes a reference for learning that teachers should prepare in teaching and learning activities [16]. Teaching materials usually contain syllabus, learning plan, students’ book, students’ worksheet, and scientific literacy test. The purpose of this study is to describe the validity of teaching materials based on socio-scientific issues approach on the topic of vibration, wave, and sound that can improve the students’ scientific literacy.

2. Research Method

The type of this research is a development research. It refers to a process of developing teaching materials based on socio-scientific issues approach on the topic of vibration, waves, and sound associated with scientific literacy. This research uses Dick and Carey development model [17]. This development model has 10 procedural steps, they are: identify instructional goals; conduct instructional analysis; identify entry behaviours, characteristics; write performance objectives; develop criterion referenced test items; develop instructional strategy; develop and select instructional materials; design and conduct formative evaluation; revise instruction; design and conduct summative evaluation [17].

The variables observed in this study is the feasibility of instructional devices in terms of validity. Validity in the form of validation result of instructional device. The developed teaching materials is validated by 3 validators to provide assessment in accordance with validation instrument.

Validation instrument sheet of teaching materials in this study consist of (1) Validation Sheet of Syllabus, (2) Validation Sheet of Lesson Plan, (3) Validation Sheet of Students’ Book, (4) Validation Sheet of Students’ Worksheet, and (5) Validation Sheet of Scientific Literacy Test. It contains instructions and requests to validator that provide an assessment of the teaching materials. The validation instrument of teaching material is in the following Table 1 [18].
Table 1. Rubric on Validity of Teaching Materials.

| Score | Criteria       |
|-------|----------------|
| 1     | Low            |
| 2     | Enough         |
| 3     | Good           |
| 4     | Very Good      |

Validation data were analysed quantitatively with the following steps: (1) tabulating all obtained data from validators for each item of assessment available in the validation instrument, (2) calculating the average score of every component aspects of teaching materials.

\[
\text{Average Score} = \frac{\text{Score Counts Obtained}}{\text{Observers}}
\]  

(1)

and (3) giving the average score criterion from interpretation score of validation as seen in Table 2 [19].

Table 2. Score Interpretation of Validation.

| Average Score | Criteria          | Interpretation            |
|---------------|-------------------|----------------------------|
| 0.00 – 1.49   | Invalid           | Not applicable             |
| 1.50 – 2.49   | Less Valid        | Can be used with larger revisions |
| 2.50 – 3.49   | Valid             | Can be used with smaller revisions |
| 3.50 – 4.00   | Very Valid        | Can be used without revisions |

Teaching materials are said to be valid when teaching materials reach valid or very valid criteria. Reliability is calculated using the following percentage agreement formula.

\[
R (\%) = 100 \left[ 1 - \frac{A-B}{A+B} \right]
\]  

(2)

Where R is the percentage agreement (%), A is the frequency counts of observers who gives a larger frequency, B is the frequency counts of observers who gives a smaller frequency. Teaching materials are said to be reliable if the percentage agreement is more than 75% [20].

3. Result and Discussion

The validity of teaching materials can be seen from the validation results. Teaching materials are validated by 2 expert lecturers and 1 science teacher before the research is conducted. Validity of teaching materials are then revised based on the suggestions given by the validator. Recapitulation of teaching materials validation results can be seen in Table 3.

Table 3. Recapitulation of Teaching Materials Validation Results.

| No. | Components of Teaching Materials | V-1 | V-2 | V-3 | Average Score | Criteria | Reliability (%) |
|-----|----------------------------------|-----|-----|-----|---------------|----------|-----------------|
| 1   | Syllabus                         | 3.62| 4.00| 3.12| 3.58          | Very Valid | 87.64           |
| 2   | Lesson Plan                      | 3.86| 3.95| 3.64| 3.82          | Very Valid | 95.91           |
| 3   | Students’ Book                   | 3.82| 3.69| 3.81| 3.77          | Very Valid | 98.27           |
| 4   | Students’ Worksheet              | 3.60| 3.90| 3.80| 3.77          | Very Valid | 96.00           |
| 5   | Scientific Literacy Test         | 3.69| 4.00| 3.77| 3.82          | Very Valid | 95.97           |

All of components of teaching materials get more than 3.50 with very valid criteria. Otherwise, the reliability of all components also represented more than 75%, so we can state that components of teaching materials are reliable.

As mentioned above that the aim of this research was to describe the validity of teaching materials based on socio-scientific issues approach including Syllabus, Lesson Plan, Students’ Book, Students’ Worksheet, and Scientific Literacy Test. The teaching materials were developed using Dick and Carey development model. After the materials were developed, the next step was to describe their validity.

3.1 Syllabus

Principles of syllabus development include scientific, relevant, systematic, consistent, adequate, actual and contextual, flexible, and comprehensive. The steps in developing syllabus are the study of core competence and basic competence, identify the topic subject, develop the learning activities,
formulate the indicators of achievement of competence, determine the type of assessment, determine the allocation of time, and determine the source of learning.

The validity of the syllabus had been stated to be very valid. This is supported by the average score to be more than 3.50. The validator’s suggestions are emphasizing literacy activities by reading socio-scientific issues and informal reasoning activities, adding experimental or observational activities then reasoning and discussing observations. The results of revision are giving motivation by reading introductory issues such as "BMKG: News that there will be a secondary earthquake with 7.5 SR: Hoax", and adding activities to collecting data by working on students’ worksheet 1 and reasoning/associating the results of the discussion to interpret the data and scientific evidence of the occurrence of waves and types of waves.

3.2 Lesson Plan

The learning process is implemented based on syllabus and the teacher must prepare the lesson plan. Lesson plan is a grip for teachers in implementing learning to achieve one or more basic competencies set out in the standard competencies. There are several principles that must be considered by a teacher in the development of lesson plan, such as the competencies formulated in the lesson plan must be clear or easily observed; the developed activities in the lesson plan should be supportive and in conformity with the basic competencies; lesson plan should be simple and flexible so that it can be implemented in the learning activities and the formation of competence of learners; must be complete, comprehensive, clear stages and steps of achievement.

The developed lesson plan refers to the analysis of the characteristics of learners and the format of the Curriculum 2013. It was made in 3 meetings with time allocation of 3 x 40 minutes at the first and third meetings, and 2 x 40 minutes at the second meeting. It was structured based on the stages in socio-scientific issues developed to improve the scientific literacy.

The validity of the lesson plan had been stated to be very valid. This is supported by the average score that is more than 3.50. The validator’s suggestions are clarifying the learning activities by emphasizing the SSI approach that it is the provision of reading scientific or socio-scientific issues. In each learning activity, there are issues discussed such as: "BMKG: News that there will be a secondary earthquake with 7.5 SR", "Ship is safer in the middle of the sea in the event of a tsunami", "Lightning", "Uncomfortable ear when riding an airplane", "Myth: Blind Bats", "Animals Can Predict Earthquakes, Myths or Facts?", and "Ultrasound is Harmful to Pregnancy, Myths or Facts".

3.3 Students’ Book

Students’ book is a set of teaching materials that it is designed in a systematic and interesting in achieving the learning objectives and competencies. It is good that it should be designed according to the instructional rules. It can help students to gain new knowledge.

Students’ book should be developed in accordance with the rules of which must be tailored to the students, able to change the students’ behaviour, included specific learning objectives, and contained more detail learning materials. The steps in the preparation of students’ book is setting the title of teaching materials, setting the learning objectives, establishing the outline or concept of learning materials, developing the material based on basic concepts, and re-examining the draft of teaching materials produced [21]

Students’ book-oriented science literacy with the SSI approach that is developed contain readings materials to the concept of vibration, waves, and sound. Scientific literature in students’ book can improve students’ interest and motivation to read and relate them with science concepts so that science literacy can also be improved. The students’ book is also equipped with a Mini Lab to facilitate students in initial observation.

The validity of the students’ book had been stated to be very valid. This is supported by the average score that is more than 3.50. The validator’s suggestions are replacing the term module with students’ book, source writing needs to be improved, and the picture needs to be clarified.

3.4 Students’ Worksheet
Students’ worksheet is a learner's guide that is used to conduct investigation or problem solving activities. It contains a set of basic activities that must be done by the learners to maximize the understanding in the effort of forming basic skills according to indicators of achievement of learning outcomes pursued [6].

It contains socio-scientific issues in the form of reading related to the purpose of observation, tools and materials, work steps, observations, discussions, and conclusions. Students are trained to read literature by finding concepts related to the material and analysing the results of the facilitation in the discussion and questions. Students are also trained in making decisions from the answers of discussion and questions and making conclusions from observations and discussions.

The validity of the student worksheet had been stated to be very valid. This is supported by the average score that is more than 3.50. The validator’s suggestions are the purpose of students’ worksheets such as “evaluating and designing scientific investigations about types of waves” should replaced by "collecting data and analysing types of waves"; “interpreting the data and scientific evidence of the wave” should replaced by "presenting the results of discussions about waves"; and the sentence in the discussion quest is "analyse the graph of the relationship between the direction of vibration and direction of wave travel’ should replaced by "Draw a wave pattern and complete it with an amplitude position (A), wavelength (λ), hill, and valley!".

3.5 Scientific Literacy Test
Science literacy test is an assessment done in the process of collecting and processing information to measure the achievement of scientific literacy who refers to the instrument of scientific literacy test in PISA 2015 with the assessment using the score and level. Indicators of the scientific literacy test include the suitability of the item with the purpose of learning/ specification and the item on the reading is given. Scientific literature assessment includes aspects of context, competence, knowledge, and attitude of science.

The validity of the scientific literacy test had been stated to be very valid. This is supported by the average score that is more than 3.50. The validator’s suggestions are improving some questions that have the same answer and have different alternate lengths, replacing the socio-scientific issues, and creating questions that can increase students’ scientific literacy to make informed decisions about what to do.

The novelty or research findings of this paper are validity of teaching materials based on socio-scientific issues approach on the topic of vibration, waves, and sound; this research can be implemented in the scientific learning process and be able to increase the students’ scientific literacy.

4. Conclusion
Based on the results of the research, the teaching materials were very valid. It can be concluded that teaching materials based on socio-scientific issues on vibration, waves, and sound subject can be used for learning process. The teaching materials are related with the increased of students’ scientific literacy.

There are several suggestions that can be given as follows: (1) content of scientific literacy test is more increased, (2) literature of socio-scientific issues is more increased, and (3) time allocation must be considered and regulated appropriately to achieve maximum results.

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