Developing of natural science teaching materials character-based in science technology and society (STS) approach

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Abstract. Teaching materials that link aspects of science, environment, technology, and society, as well as teaching materials that contain character values, are not yet in school. For this reason, this study is conducted to describe the feasibility of teaching materials developed in terms of the aspects of validity, practicality, effectiveness, and character achievement. This research includes research and development (R&D) that refers to the ADDIE model. The subjects of the trial from this study were 33 VIIIH class students of SMP 1 Banjarmasin. The research instruments used included the validation sheet, lesson plan implementation sheet, learning outcome test, and self-assessment sheet. The results of data analysis show that the natural science teaching material developed has a very good validation category; practical, which can be done very well; effectiveness with effective categories; and the achievement of students' character is a very good category. It was concluded that natural science teaching materials character-based appropriate were used on the subject matter of vibrations, waves, and sounds for middle school in science technology and society (STS) approach.

1. Introduction

The era of the industrial revolution 4.0 requires education to adapt to technology and various other developments. The development of knowledge and technology is one of the characteristics of the 21st century, by mastering both humans can gain success and effectiveness of time [1]. However, with these developments, educators must not forget that students must have strong character and quality.

The 2013 curriculum is implemented in the hope that it can produce people of good character and quality (intelligent, productive, creative, and innovative and virtuous and noble character). Character and competency-based curriculum enables the achievement of these expectations, and can be the basis for developing abilities [2] such as the ability to solve problems in daily life and the development of various aspects of personality that can be done to the maximum according to certain competencies, with the hope that students will be able to achieve high learning meaningfulness.
The implementation of character education can be done by integrating into learning Natural Sciences. To develop the character of students in learning science can be done with learning that relates the material to the real situation, so students can know the relationship between knowledge possessed by the application of that knowledge in their lives. Such learning can have a herding effect on students’ character development, such as curiosity, critical, logical thinking, and environmental care [3].

Given the multi-pluralist Indonesian society, there will certainly be a lot of customs and culture that can be used as a basis for values-based education. The term baiman (a believer) is certainly familiar to the Banjar community, in terms of local values owned by the people of southern Kalimantan, namely the term *Baiman, Bauntung, Batuah* which is the utterance of parents to their children, which parents hope that their children become human the faithful, useful, and noble [4]. *Baiman, Bauntung, and Batuah* are expected human characters. Humans can achieve *bauntung* and *batuah* by being based on faith- and armed with knowledge. Faith is the most important aspect of human life. An ingredient in learning with values closely related to local values is needed in an effort to improve the character of students through science learning.

Science learning in junior high schools has the goal that students will have the ability to be able to develop positive attitudes, develop curiosity and be able to develop awareness about the relationships that can influence each other between aspects of science with environmental aspects, technological aspects, and aspects of society [5]. So at the junior high school level, it is expected that there will be learning that emphasizes the relationship of the four aspects in order to achieve the science learning goals.

In the realm of education, learning begins to be carried out by emphasizing aspects that link science, technology, and society, such as Science, Technology Society (STS). Problems found in the community are brought into the classroom to be solved using learning with STS in an integrated way in the interrelationship between the elements of science, environment, technology, society. In the framework of implementing the 2013 curriculum, learning science by using the STS learning model can apply the knowledge gained by students to improve the quality and way of life of humans without endangering their environment, the effect of encouraging STS learning is the achievement of Core Competencies and Basic Competencies in accordance with the 2013 curriculum. by using the STS, a model is to link science and technology, and its benefits for the community [6].

Based on the results of an interview with a resource person at a junior high school in Banjarmasin on September 26, 2016, information was obtained that: (1) science learning has not been carried out by linking science aspects and technological aspects and their benefits to the community; (2) learning science has not been done by linking the material discussed to the values of faith; (3) There is also no science teaching material in schools that connects science with technology or community life and also teaching material that contains values. Based on the acquisition of this interview, it is deemed necessary to develop a teaching material that links aspects of science, technology, society, and charged with the value of faith in order to help students gain learning experiences that are directly related to their daily lives.

Science learning for the subject of vibration, waves, and sound can be carried out by linking aspects of science, aspects of technology, and society. The implementation of character education and education with values in schools is the integration in the learning process. In fact, in the field, there are no teaching materials that link all these aspects, even though these teaching materials are needed in the learning process.

Teachers, as facilitators, need to provide innovative teaching materials to improve the quality of education [7]. The development of physics learning tools containing the integration of Islam and science to instil spiritual values can be used as an effort to achieve
the educational function as in the National Education System Law, inculcating religious values through the process of integrating Al-Qur'an content in science is an option that can be given [8]. By instilling religious values, students are expected to not only think about what exists and about what is happening but also be able to contemplate and understand that there is a great behind the natural or physical events that are objects in science.

Previous research has yet to develop STS teaching materials about vibrations, waves, and special sounds to improve student character. Considering that it is very important to improve student character, the researcher develops a teaching material that is able to achieve this. Therefore, researchers develop teaching materials that aim to make students able to achieve learning objectives optimally, help students in understanding science, provide understanding to students to be more concerned about social issues and the impact of the development of science and technology which is also directed so that participants students are encouraged to get to know the Creator and all His creations in understanding scientific phenomena.

Based on this background, a research study was conducted on the development of natural science teaching materials in STS learning settings. The purpose of this study, in general, is to describe the feasibility of science teaching materials in the STS Learning settings on the subject of vibration, waves, and sound.

2. Method
This type of research is research and development with ADDIE design. The subject of the research is the science teaching materials on the subject of vibration, waves, and sound for junior high school in the setting of science learning technology with character-loaded society. The subjects of this research trial were students of class VIII-H of SMP Negeri 1 Banjarmasin consisting of 33 people. The research instruments used included a validation sheet of teaching materials, a validation sheet of self-assessment, a test of learning outcomes, an observation sheet of the implementation of the lesson plan, and a self-assessment sheet.

The validation of teaching materials is carried out to measure the validity of teaching materials (lesson plans, student worksheets, learning achievement tests, teaching materials). Validation data from the validators were analysed so that the scores were then interpreted with validity criteria [9]. Observations were made to measure the practicality of teaching materials, which were carried out by observing the implementation of the lesson plans made by two observers. Student learning outcomes data are measured using tests of learning outcomes to determine the effectiveness of the product being developed. Test results obtained using equations and normalized gain (N-gain) criteria[10]. The achievement of students' baiman character is measured by using a self-assessment sheet. The scores obtained are matched with the student achievement criteria for character [11].

3. Result and Discussion
Science teaching materials in the setting of science learning technology in society are charged with character (baiman value) on the subject of vibration, waves, and sound.

3.1. Validation of teaching materials
The product of science teaching materials developed consists of lesson plans, student worksheets, learning outcomes tests, and teaching materials. The following are the validation results that have been validated by the validator. The results of the validation of the material can be seen in Table 1.
The results of lesson plan validation are reviewed in terms of format, language, and content. Overall, an average validity score of 3.58 was categorized as very good, as shown in Table 1. The validity of the lesson plans is seen from the syntax of the STS Model. The use of this model trains students to deal with various issues that develop in society related to science and technology to be solved individually or together, students do problem solving presented by digging up as much information as possible, then analysing and finding solutions to problems that are there, in this case students are required to use critical thinking skills so that students will learn more meaningfully and can develop their thinking if students are given the opportunity to work, discover, and construct their own knowledge [12].

The results of the validation of the worksheets are evaluated in terms of format, language, and content — overall validity of 3.62 with a very good category. For a worksheet to have good quality, it must be arranged based on didactic, construction, and technical requirements that must be met [13]. These aspects have been included in the aspect of evaluating worksheets validation. From the overall description above, it can be concluded that the worksheets developed were considered to be very good based on the validation results from practitioners and academics.

The results of the learning outcomes test validation consist of general construction aspects and item validity aspects. Overall validity is 3.82, with a very good category. So it can be concluded that the learning outcomes test developed is considered very good based on the results of validation from practitioners and academics. Learning outcomes become a measure of the achievement of the objectives of the learning process. Therefore, the learning process needs to be assessed or evaluated to determine the achievement of the objectives of the learning process [14]. Therefore we need a measuring instrument in the form of a valid martial arts test to measure precisely about student learning outcomes.

The results of the validation of the teaching material developed were reviewed from the aspects of format, content, language, presentation, and benefits / uses. The overall validity is 3.57, with a very good category. This acquisition shows that teaching material can be used as a guide for teachers in learning and can be used as a guide for students in independent learning. To be able to produce good teaching materials need to pay attention to accuracy, compatibility between the competencies that must be mastered with the scope of content and reader competencies, and relevance [15,16]. These aspects have been included in the evaluation aspects of teaching material validation, which includes the format of teaching materials, language, content of teaching materials, presentation, and benefits / uses. It can be concluded that the development teaching material is considered very good based on the results of validation from practitioners and academicians.

### 3.2. The practicality of teaching materials

The practicality of teaching materials from the lesson plan implementation sheet [17,18]. The results of the lesson plan implementation can be seen in Table 2.

| Meet | Percentage | Category   | Reliability | Category |
|------|------------|------------|-------------|----------|
| I    | 95.09      | Very Good  | 0.99        | High     |
| II   | 95.54      | Very Good  | 0.99        | High     |
| III  | 95.98      | Very Good  | 0.99        | High     |
| IV   | 96.43      | Very Good  | 0.99        | High     |
Based on Table 2, the results of the implementation of lesson plans can be said overall have a very good category. The implementation of lesson plans with very good categories shows that the developed teaching materials can be applied to learning in the classroom; in other words, the developed teaching materials are considered practical in learning. The results of the development are categorized as practical if they can be implemented in classroom learning [19,20].

3.3. Effectiveness of teaching materials
The effectiveness of teaching materials is measured using a test of learning outcomes. Then analysed using N Gain. The N Gain results can be seen in Table 3.

|                      | Pretest Average | Posttest Average | N-gain |
|----------------------|-----------------|------------------|--------|
|                      | 6.04            | 52.67            | 0.496  |

Based on Table 3, N-gain of 0.496 is classified as medium (effective) so that learning can be said to be effective in improving student learning outcomes. The acquisition of student learning outcomes shows that this is in line with several functions and objectives of making teaching materials[21] where the specific purpose of this learning is to improve student learning outcomes and character.

The results of this acquisition are in accordance with previous research, which shows that learning with the STS learning model can improve student learning outcomes [2,6,14,22,23]. Teaching materials with the STS model are suitable for use in learning [24]. The development of teaching materials like this is very important because it will greatly help the learning process itself, especially the teacher to help students learn to be interested and feel fun [25].

There are several factors that support this; among them are the various processes that occur during learning. One of them is an experiment/practicum activity. Experimental activities can improve students' cognitive abilities [2]. The STS model is a model of constructivism based on thinking (philosophy) building knowledge through exploration and discussion activities and applying to new situations and integrating new knowledge gained by building intellects that previously existed [14]. Students who implement STS, they carry out more processes and creativity skills and are better able to apply various scientific concepts in various situations [26].

Achievement of physics learning objectives can be assessed from students' success in understanding physics and utilizing this understanding to solve physics problems in daily life [22]. Students who implement STS are able to increase their understanding significantly [27]. Through STS, students will be actively involved in identifying social and technological issues in society [2]. STS is learning that invites students to know about technical issues that occur in the community that will be discussed in class learning [28].

The main advantages of STS are motivation and involvement in content related to science, technology, and society [29]. STS is able to provide a means to achieve scientific and technological matters in which students make decisions about the real world in which science and technology play an important role [30]. Knowledge built through the STS learning model will exist in students as a copy of real-life situations [12].

The application of the STS learning model has a positive impact on learning activities because students appear to be more active and enthusiastic and understand more about the material that has been conveyed in conducting discussions and exchanging ideas [28]. This causes the process of student acceptance to the lesson will be more enjoyable so as to form a good and perfect understanding.

3.4. Achievement of the character of students
The inculcation of student character values is needed in the current era of globalization [31]. In implementing learning, the teacher must also teach students about the character [32]. The character measured in this study is religious; that is, it refers to the baiman that is contained in the teaching material developed. This character is measured through a self-assessment sheet (self-assessment) at the end of the series of learning carried out. The term Baiman is often heard and spoken by the Banjar people,
baiman means that people are believers, people who believe are often referred to as religious people. This term is usually pronounced 'one package' with Bauntung and Batuah. Moto Baiman, Bauntung, Batuah are characters that need to be developed for education [33]. Bauntung and Batuah are human characteristics expected by the parents of the Banjar community [4]. Baiman, Bauntung, and Batuah illustrate the ethos, conceptions, and educational practices that have been carried out for a long time by the Banjar people who crave human figures based on faith and scholarship based on religious values and Banjar cultural customs as manifestations of local wisdom in educating children.

The concept of faith is very broad because it covers all aspects of personality and human life. However, the meaning and purpose and influence of faith sometimes feel shallow and even experience inflation so that the impact on human behaviour and actions is not so visible. The concept of faith desired by Islamic teachings is true faith, namely faith in God and supernatural that produces charity based on the knowledge and belief of the heart so that it is active and dynamic. Between faith and charity, words and deeds, theory and practice, and life and inner life cannot be separated [34]. The achievement of students' baiman character can be seen in Table 4.

| Score | Number of students | %  | Category |
|-------|--------------------|----|----------|
| 13≤x≤16 | 33                 | 100 | Very good |
| 10≤x<13 | 0                  | 0  | Good     |
| 7≤x<10  | 0                  | 0  | Enough   |
| 4≤x<7   | 0                  | 0  | Poor     |

In Table 4, the results are obtained that all participants can achieve a baiman character in the excellent category. This shows that the teaching materials resulting from the development are effective for use in learning and can be used to support the implementation of character education.

Education is a process of shaping human character, so it can be assumed that the root of the problem of the low quality of education is also related to the deterioration of national identity [12]. Character education is not a process of memorizing the material; character education requires habituation. Character is not formed instantly but must be trained to become a habit. Character education can be integrated into learning in each subject [35].

STS contributes to the reappearance of values in science education, fostering the values and character of students [36]. STS trains about the character to students related to various values and norms in daily life [37]. Integrating character values into physical material can be done by exploring character values contained in the physical material. By exploring the character values of physics material, it is expected that the learning carried out is more meaningful to students' lives so that they are able to develop all the potential contained in students optimally, both cognitive, affective, and psychomotor potentials [35].

4. Conclusion
Natural science teaching materials in the STS Learning setting are suitable for use in the Vibration, Wave, and Sound Subjects for the junior high school level. Thus, this teaching material can be used in learning specifically to improve student learning outcomes and character. Further research is needed on implementing this teaching material on another subject. In addition, further research is needed to achieve the abilities and other skills of students who are more specific, such as critical thinking skills, problem-solving, and creative thinking skills.

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