International Journal of Research and Review
Vol. 9; Issue: 4; April 2022
Website: www.ijrrjournal.com
Research Paper *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Mobile Learning Media Based on *Science, Technology, and Society* (STS) to Improve Science Literacy for V Grade SD Students

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DOI: https://doi.org/10.52403/ijrr.20220423

ABSTRACT

This study aimed to analyze the need, feasibility, and effectiveness of mobile learning media based on Science, Technology, and Society (STS) in improving scientific literacy in fifth grade elementary school students. This study used research and development procedures that refer to the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The research design used was "Quasi Experimental Nonequivalent Control Group Design" with research subjects at SDN Jombang as the experimental class and SDN Ngombol as the control class, totaling 56 students. The research instruments used were observation sheets, interview sheets, expert validation test sheets, written tests (pretest and posttest), and questionnaire sheets (questionnaire). The results showed that the media-based mobile learning (STS) was needed by students in learning. The feasibility of the media, according to the media expert validator, was declared very valid with an average percentage of validity reaching 95.54%, material expert validator 96.68% with very valid criteria. Meanwhile, the teacher's response regarding the practicality of the media obtained a score of 97.73%, with very practical criteria. Students' responses regarding the practicality of the media obtained a score of 89.74% with very practical criteria. The effectiveness of STS-based mobile learning media according to the calculation of the increase in scientific literacy of students in the experimental class was 42.27%, from an average score of 57.15 to 81.31 in the very good category. Meanwhile, the control class increased by 37.56%, from an average score of 52.80 to 72.63.) in the good category.

Keywords: *Mobile Learning*, STS, Science Literacy

INTRODUCTION

Rapid progress in all fields and aspects of daily life today is heavily influenced by technological developments, which in turn presents a new challenge for the world of education. Implementation of the 2013 curriculum is very much needed in the era of globalization which demands quick and precise changes at any time. 2013 curriculum planning prioritizes learning that can provide experience (constructivism) and the use of media in every lesson. Through providing learning experiences, students will also be able to introduce and improve scientific literacy skills (Dragoş & Mih, 2015). Scientific literacy is very much needed in the post-industrial era. The scientific literacy ability of the community is expected to be ready and able to analyze an emerging scientific phenomenon, as well as have views and assessments of new technologies presented in the industrial era (Correia et al., 2010).

An effective way that can be used to teach students' scientific literacy skills is by utilizing digital technology. The development of digital technology (smartphones) is increasingly widespread

and its use is increasingly in demand by all groups. Mobile learning realizes effective learning in achieving the learning objectives set. The practicality of the existing material content allows students to understand the concept of learning easily, and the results that have been achieved shows the progress of learning taken individually or independent learning (Huang et al., 2020).

The developed mobile learning media will be integrated with the Science, Technology, Society (STS) approach. The aim is to strengthen the content of learning materials that are oriented towards scientific literacy skills. The STS approach is a way that teachers can use to integrate elements of science, technology, and society into a single unit in presenting topics and discussions about problems that exist in society (Nadia, 2020).

The results of the 2011 Trends International Mathematics and Science Study (TIMSS) survey showed that Indonesia was ranked 40th out of 42 countries for scientific achievement (Martin et al., 2011). Further the results of international research show that the scientific literacy level of students in Indonesia is in the low category. Indonesia is ranked 66th out of 67 countries based on the 2012 PISA Program for International Student Assessment (OECD, 2013). This fact is the reason for researchers to improve scientific literacy skills from an early age, namely in elementary schools (SD) through mobile learning media. The application of STS-based mobile learning media is expected to be able to grow the ability of students in Indonesia in scientific literacy. The low scientific literacy of Indonesian students is caused by several factors, such as lack of practicum activities, not understanding terms in investigation activities, and still comfortable learning the old way, namely memorizing (Sukowati & Rusilowati, 2016).

Based on observations and interviews that have been conducted in one of the elementary schools in the Purworejo sub-district in the 2019/2020 school year. Some problems began to be found in teaching and learning activities carried out in class V, such as learning media which were very rarely used in the learning process. Meanwhile, the media is a very important and useful learning tool to simplify the material so that it is more easily understood by students. The media used in learning are only teaching materials for teacher books and student books which only lead to passive learning. The most important finding in the observations that have been made is that when the presentation of science material took place, students seemed only to memorize the material without understanding, analyzing, and evaluating what the teacher said during learning. In addition, it was also found that teachers rarely conduct scientific investigation activities such as practicum and experimental activities in learning. This is the basis for conducting a research and development of an STS-based learning media. The main purpose of this study was to determine the level of scientific literacy skills in fifth grade elementary school students through the developed mobile learning media.

STS-based Mobile Learning media encourages students to connect science concepts with technology that is developing in society. After the implementation of this learning media, students are expected to be able to analyze the impact of environmental problems, solve problems related to the environment, and cultivate an attitude of concern for the surrounding environment.

LITERATURE REVIEW

Based on a review of research related to STS-based Mobile Learning, the design of Android-based "mobile learning" learning media is a tool that presents interesting features on it, of course, it will make students more enthusiastic in learning. The spirit of learning that arises in students will make it easier for teachers to carry out the process of transferring knowledge and forming various skills for students. In addition, mobile learning media also

supports students in gaining learning experiences both independently and in group collaboration (Wibowo & Arifudin, 2016).

Ibrahim's research (2017) showed the results of this study include the results of the alpha and beta feasibility tests. The negligent feasibility test by each of the two experts, namely the material expert showed the category of material results was very good, the media expert based on the assessment of the two media experts was in the good category. Research by Rinasih et al. (2010) stated that the product results from STS-based mobile learning media were very valid and feasible to be used as devices that can assist in the learning implementation process.

Ramdani et al. (2020) conducted a study with the title "Development of Android-Based Learning Media in the Covid-19 Pandemic Period to Improve Students' Scientific Literacy". The purpose of this research was to develop an appropriate mobile learning product to improve students' scientific literacy. The research method used is Research and Development (R&D) with the Four D model. The results show the feasibility of the product with a validity level of 84% with a very valid predicate. The media feasibility got an average score of 88%, syllabus 83%, lesson plans 82%, and scientific literacy instruments with an average score of 83%. This Mobile Learning product is feasible to be applied in learning in the era of the Covid-19 pandemic.

MATERIALS & METHODS

The development model applied in R&D research is ADDIE. Tegeh et al. (2015) stated that the ADDIE model has five stages, there are: (1) analysis; (2) design (design); (3) development (development); (4) implementation (implementation); and (5) evaluation. The ADDIE development model was chosen because this model is structured systematically and sequentially in the design of learning media products.

The research was conducted on students at the elementary school in Ngombol District, Purworejo Regency. Data collection was carried out with several instruments including interviews, documentation, written tests, and questionnaires (questionnaires) given to students related to scientific literacy skills. Determination of research subjects used in this study was through purposive sampling technique. Purposive sampling technique is a sampling technique based on certain reasons. The application of this technique is because not all samples have criteria that are in accordance with the problems and phenomena studied. The sampling criteria in the research to be carried out are: 1) Elementary schools that have implemented the 2013 curriculum as a whole, 2) Elementary school fifth grade teachers and students in one cluster, 3) Equality of achievement and academic ability of students, and 4) Problem finding. which tends to be the same in the aspect of scientific literacy ability.

RESULT AND DISCUSSION

Analysis of STS-based mobile learning media to improve science literacy for V (fifth) grade elementary school students

Initial discussion on the results of interviews with teachers regarding learning needs, it is known that the use of mobile-based media has never been done. The learning process is still focused on the teacher as a learning center or teacher center. Nevertheless, the learning center should be focused on students so that their activeness is formed in exploring any knowledge information. The lack of teacher knowledge regarding mastery of scientific literacy skills is also a separate obstacle, in an effort to increase scientific literacy. Given this skill is very much needed in forming students who are critical in responding to current environmental problems.

The implementation of application-based learning media on smartphones has never been done by teachers. Considering that at this time we need a learning media that has a high level of flexibility, meaning that it takes a learning media that can be used anywhere and anytime by students without limitations of time and place. The choice of a smartphone as a place for learning media is that it has almost the same function as a computer in terms of practicality and makes it easier to operate and is more flexible to use (Hafidz & Masriyah, 2020).

As for the questions asked by researchers regarding the implementation of experimental and practicum activities, the teacher said that activities that lead to investigation and problem solving are still rarely carried out. Scientific investigation activities and mastery of understanding scientific concepts are very necessary in mastering scientific literacy skills. The low scientific literacy of Indonesian students is caused by several factors. Such as lack of practicum activities, not understanding terms in investigation activities, and still comfortable learning the old way, that is memorizing (Sukowati & Rusilowati, 2016). The main obstacle in implementing experimental activities is the difficulty of teachers in developing basic competencies (KD) into broader material while the availability of material in the textbook is very minimal.

Meanwhile, the initial description of the student needs questionnaire from the results of the material aspect analysis showed that the teaching given by the teacher to students rarely included material related to the theme of environmental problems. Based on the responses given by students, it is indicated that the curiosity of students about environmental problems is very high. The majority of students strongly agree to hold an experimental activity that can support research activities related to environmental problems.

Based on the results of the questionnaire on the needs of students, it concluded that the use of mobile learning media based on Science, Technology, and Society (STS) is needed by students in understanding the concept of science. Not only interesting and interactive learning media are needed. However, they also need media that present learning materials related to environmental issues and topics that are often encountered in everyday life.

Feasibility analysis of STS-based Mobile Learning media to improve scientific literacy of V (fifth) grade elementary school students

The results of media analysis were determined from the results of media and material validation by experts. In addition, it is also determined on the responses of students and teachers regarding the practicality of the developed media. Researchers conducted a limited-scale product trial first to 15 students in class VI, taking into account that the class had surpassed and mastered the learning materials contained in the mobile learning media. After that, it was continued to the large-scale product trial stage in class V with a total of 26 students to determine the suitability of media products. The presentation of the results of media validation and STS-based mobile learning materials is as follows:

Table 1 Results of Learning Media Validation by Media Experts

No	Scoring Aspect	Score	Criteria
1.	Validator 1	95%	Very Valid
2.	Validator 2	98,75%	Very Valid
Average		96,68%	Very Valid

The validity of the media expert covered four aspects of the assessment, there are learning design, software engineering, audio-visual communication, and other aspects. All of these aspects consist of 14 statement items getting an assessment of 98.21% from expert lecturers as validator 1 and practitioners as validator 2, there is with the achievement of a score of 92.86%, overall the average score is 95.54% with very valid criteria. . The achievement of this score was obtained because the mobile learning media

developed was very easy to access by its users, presented images and interesting features in it, and was interactive. Students are not only silent by observing the learning media, but also can interact directly by operating the learning media directly and independently.

The concept of science which is designed in such a way based on the steps of the STS approach, must be conveyed well. Therefore we need a learning tool to build interest in learning in students. Learning media is very much needed in fostering interest in learning for students, one of the learning media that is very appropriate to be applied to package science concept material is mobile learning media. In accordance with what was stated by Wibowo & Arifudin (2016), mobile learning media can focus students on allocating a long time to study and being able to foster self-confidence. Laziness in learning can also be eliminated by the application of mobile learning media which is presented with a display and other interesting features.

Table 2 Results of Validation of Learning Content by Material Experts

No	Scoring Aspect	Score	Criteria
1.	Validator 1	98,21%	Very Valid
2.	Validator 2	92,86%	Very Valid
Average		95,54%	Very Valid

The validity of the material expert cover edthree aspects of the assessment, namely language, presentation, and content. All of these aspects consist of 20 statement items getting an assessment with very valid criteria from expert lecturers reaching a score of 95% and practitioners with achieving a score of 98.75%, overall the average score is 96.68%. The assessment of the material expert is also an important requirement in assessing the feasibility of the media. All aspects of the material assessment reached the very good criteria. The material expert is of the opinion that there is a need for improvement in the reading text section, one of which is related to the effectiveness of the sentence.

Based on the assessment of experts, STS-based mobile learning media has a number of advantages. The advantage is that increase the activity of students to carry out analytical activities such as experiments and practicum. The material designed is oriented towards a science, technology and society (STS) approach that is able to provide an understanding of scientific concepts and relate them to the phenomena of daily life. One of the features in the mobile learning media is the material feature, in this feature there is a learning video containing practicum and experimental content. In addition to motivating learning, learning videos also provide explanations that make easier for students to understand because the discussions are packaged in real concepts. So that the process of experimental activities will be easier to carry out (Darma Wisada et al., 2019).

The small-scale product trial stage was carried out in class VI with a total of 15 students. This trial aimed to determine the feasibility level of STS-based mobile learning media. After conducting a small-scale trial, it will be possible to identify product deficiencies that need to be corrected before being implemented on a large scale.

Table 3 Small-Scale Teacher Responses

No	Response	Final Score	Criteria
1	Teacher	97,73	Very Practical

Table 4 Responses of Small-Scale Participants

No	Scoring Aspect	Percentage	Criteria
1	Ease of use	89,58 %	Very Practical
2	Usefulness	89,44 %	
3	Presentation	90,83%	
	Average Percentage	89,95%	

The results of the feasibility test by teachers and students lead to responses regarding the practicality of learning media that were developed after the implementation of small-scale trials. The feasibility test by the teacher consists of three aspects of assessment, namely aspects of ease of use, usefulness, and presentation. The results gained by the score percentage 97.73% with very valid assessment criteria. The teacher revealed that students were very enthusiastic in participating in learning activities using STS-based mobile learning media. The impact is able to improve higher-order thinking skills and support

students in understanding the material being taught. This is very relevant to what was conveyed by Roswita et al. (2021) that the application of the Science, Technology, and Society (STS) approach in learning encourages students to express ideas or thoughts in identifying, analyzing, and finding appropriate solutions to existing problems.

Meanwhile, scores have been gained with a percentage score of 89.58% from the aspect of ease of use of media, 89.44% from the aspect of media usefulness, and 90.83% from the aspect of presenting learning media. Based on observations made directly by researchers, students seem more free to explore and explore any information presented in mobile learning media. Students also do not feel confused in operating the media. In line with what Kamasi & Saruan (2020) stated that the more flexible and portable characteristics of mobile learning provide opportunities for students to explore subject matter, video tutorials, virtual experiments.

The large-scale product trial stage was carried out in class V with a total of 26 students. This trial aims to determine the feasibility level of STS-based mobile learning media. After conducting large-scale trials, the mobile learning media will still be revised or improved to produce an ideal learning media product in the world of education.

Table 5 Large-Scale Teacher Responses

No	Response	Final Score	Criteria
1	Teacher	97,73	Very Practical

Table 6 Large-Scale Student Responses

No	Scoring Aspect	Percentage	Criteria
1	Ease of use	89,66%	Very Practical
2	Usefulness	89,42%	
3	Presentation	90,14%	
	Average Percentage	89,74%	

The feasibility test by students in a large-scale trial was determined through filling out a practicality questionnaire totaling 11 statements. The score has been obtained with a percentage score of 89.66% from the aspect of ease of use of the media, 89.42% from the aspect of the usefulness of the media, and 90.14% from the aspect of presenting the learning media with the achievement of very practical criteria. The score is actually gained from the responses of students as outlined through a questionnaire.

Researchers observed directly how the response of students when studying the material, seemed so enthusiastic, enthusiastic, and serious in learning. This indicates that learning is really interesting for students. Learning media is very influential on the learning climate that is created, thus the teacher will more easily convey information about the material and assist teachers in improving the competence of students (Husna, 2021).

Analysis of the effectiveness of STS-based mobile learning media to improve scientific literacy of fifth grade elementary school students

The effectiveness of the media can be seen by observing the increase in cognitive test results (scientific literacy) before and after learning is carried out. In addition, the effectiveness of STS-based mobile learning media can be seen from the students' classical mastery achievement. The increase in cognitive test results was then calculated using the N-Gain formula, to see the effectiveness of increasing pretest and posttest scores. Previously, a paired sample t-test was conducted which aims to see the difference between the average pretest and posttest scores. Meanwhile, to see the difference in the average of two different classes, namely the control and experimental classes, an independent sample t-test will be conducted.

The results of the paired T-test above stated that in the sig. (2-tailed) in the experimental and control classes, it is known that the value of sig pair 1 and pair 2 pretest-posttest = 0.000 <0.05. So Ho is rejected, H1 is accepted, meaning that there is a difference in the average value of the pretest-posttest in the experimental and control classes. The results of the Independent Sample T-test above state that, in the column sig. (2-tailed) in the post-test experimental and control classes are known

= 0.000 < 0.05. So Ho is rejected, H1 is accepted, meaning that there is a difference in the average posttest value in the experimental and control classes.

Scientific literacy can be defined as a student's ability to apply scientific concepts, examine questions, and conclude answers based on evidence. The analysis of increasing scientific literacy aims to determine the comparison of treatment in the control class and experimental class based on the pretest and posttest scores. The presentation of the results of the students' scientific literacy skills is as follows.

Table 7 Results of Pretest and Posttest Data on Scientific Literacy Ability

No	Class	Pretest Score	Category	Posttest Score	Category	Improvement
1	Experiment	57,15	Fair	81,31	Very Good	42,27%
2	Control	52,80	Less	72,63	Good	37,56%

The increase in scientific literacy of students in the experimental class was 42.27%, from an average score of 57.15 to 81.31. Meanwhile, the control class increased by 37.56%, from an average score of 52.80 to 72.63. This means that the increase in scientific literacy in the experimental class is higher than the control class.

The increase in scientific literacy skills can be seen after the N-gain test is carried out to see the effectiveness of increasing each indicator. The calculation process began by calculating the results of the average pre-test and post-test scores for each scientific literacy indicator in the experimental class and the control class. Next is the N-gain test.

Table 8 Results of the Analysis of Scientific Literacy Improvement

Class	No	Indicator	Pre-test	Post-test	N-Gain	Criteria
Experiment	1	Explaining Scientific Phenomena	58,12	83,76	0,61	Average
	2	Identifying Scientific Problems	58,97	85,04	0,64	Average
	3	Interpreting Data	54,81	76,60	0,49	Average
Control	1	Explaining Scientific Phenomena	55,56	76,92	0,48	Average
	2	Identifying Scientific Problems	57,69	80,70	0,55	Average
	3	Interpreting Data	45,51	62,50	0,30	Average

The N-gain test is carried out on each scientific literacy indicator, experimental class: The indicator explained scientific phenomena the N-gain score reaches 0.61 (Medium), the Indicator identified scientific problems 0.64 (Medium), and the Indicator interpreted the data 0.49 (Medium). While in the control class: Indicators explain scientific phenomena the N-gain score reaches 0.48 (Medium), Indicators identifies scientific problems 0.55 (Medium), and Indicators interprets data 0.30 (Medium). It can be concluded that the increase in scientific literacy per indicator in the experimental class has a higher average value than the control class.

The increase in literacy skills occurred after the implementation of mobile learning media with content based on Science, Technology, and Society (STS) in learning. The explanation of scientific literacy in self-learning is the potential of students in understanding knowledge, applying, and informing scientific concepts. Then it is connected with science, technology, society, and the environment (Situmorang, 2016). The application of mobile-based media makes learning meaningful. Students can dig deeper into the interesting information contained in the learning media up to the analysis and evaluation stage. In addition, students are directed to carry out experimental and practical activities to investigate a problem related to environmental issues (Shalehha et al., 2017).

Learning in class is declared successful if 75% of the number of students in the class have achieved classical completeness. The results of classical completeness are presented in table 9 below:

Table 9 Classical Completenes

Class	Number of Completed Students	Number of Students	Completed Percentage	Criteria
Experiment	26	26	100%	Completed
Control	26	30	83,33%	

Based on table 9, it concluded that there were differences in the increase in students' scientific literacy skills in the group using mobile learning based on Science, Technology, and Society (STS). The results of classical completeness after the posttest in the experimental class reached 100% and 83.33% in the control class.

CONCLUSION

The development of Science, Technology, and Society (STS)-based mobile learning media is needed for learning in fifth grade elementary school. Mobile learning media is oriented towards 21st century learning, it is very appropriate to be applied as a supporting element for the implementation of learning activities. Because mobile learning media is interactive, contextual media and is equipped with interesting features in it, so that it will make it easier for students to understand the learning material.

Science, Technology, and Society (STS)-based mobile learning media was declared very feasible by material experts and media experts. Based on the aspects of the feasibility of content, language, presentation and getting very feasible criteria so that mobile learning based on Science, Technology, and Society (STS) can be used in learning in schools to improve students' scientific literacy skills.

Science, Technology, and Society (STS)-based mobile learning media with sub-theme 2 “The Importance of Clean Air for Health” is used to improve scientific literacy skills. The scientific literacy ability of the students increased in the very good category. The increase in scientific literacy of students in the experimental class was 42.27%, from an average score of 57.15 to 81.31. Meanwhile, the control class increased by 37.56%, from an average score of 52.80 to 72.63. This means that the increase in scientific literacy in the experimental class is higher than the control class. It can be said that STS-based mobile learning media is very effective in improving scientific literacy skills.

Acknowledgement: None

Conflict of Interest: None

Source of Funding: None

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How to cite this article: Heru Siddik Nugroho, Supriyadi, Sri Haryani. Mobile learning media based on science, technology, and society (STS) to improve science literacy for V grade SD students. *International Journal of Research and Review*. 2022; 9(4): 180-188. DOI: *https://doi.org/10.52403/ijrr.20220423*

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