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Application of Physics E-Learning Material Integrated Social-Scientific Issue Context to Improve Students' Scientific Literacy Skills

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ABSTRACT (10 PT)

Conceptual understanding and scientific literacy of science are important part for students. Through a good understanding of scientific concepts and literacy, it is easier for students to learn new material and solve the problems they face. The purpose of this research is to improve students' learning Literacy through E-teaching materials with the context of Social-Scientific Issue (SSI). The research method used is Classroom Action Research with the Kemmis and Mc Taggart action research model. The research was conducted at SMA N 3 Padang in March 2023. The research subjects were students of class X E 3 in the 2022/2023 academic year with a total of 35 students. Data collection techniques in this study were observation and tests. Data analysis techniques in quantitative and qualitative descriptive research. The results of classroom action research were carried out in 2 cycles with the stages of planning, implementing, observing and reflecting. The use of the e-learning material in the context of Social-Scientific Issue (SSI) can improve students' ability to understand concepts and scientific literacy skills on Renewable Energy material. Therefore, e-teaching material can be used by physics teachers to improve the students' conceptual understanding and scientific literacy.

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INTRODUCTION

The main competencies of human resources in the 21st century are literacy, inventive thinking, effective communication, and high productivity (Bagasta, 2018). The 2016 World Economic Forum also stated that students need 16 skills to be able to survive in the 21st century, namely literacy foundations or basic literacy, competence, and character (Wiedarti et al., 2016). Other countries have invested heavily in creating incentives to work that are scientifically and technologically "literate". To survive in the global market, every country

needs to have citizens who have the same capabilities. 21st century education requires preparation to create graduates who can compete in the 21st century (Asrizal, 2018a). One of the government's efforts in facing the 21st century is to change the curriculum. The Indonesian minister of education has made changes to the curriculum to produce graduates who are relevant to the 21st century (Asrizal, 2018b).

Scientific literacy is one of the 16 skills needed in the 21st century. Scientific literacy is the ability to use scientific knowledge and principles to understand the environment and test hypotheses. Scientific literacy serves to understand the environment, health, economy, and other problems faced by modern societies that depend on technology and scientific developments (Widya & Sanjaya, 2017). The development of scientific literacy plays a role in improving decision making, at the social and personal levels. Mastery of scientific literacy by society is important for survival in an increasingly modern and dynamic world (Ilsadiati, Mislinawati, 2017). Scientific literacy has a very close relationship with student learning outcomes (Shofiyah et al., 2020). Scientific literacy, namely individual skills in studying science, expressing science verbally and in writing, and using scientific insights to solve problems so that when making decisions based on scientific considerations, they have great behavior and sensitivity regarding themselves and their surroundings (Nurhayati, 2020).

Scientific literacy skills are divided into context, knowledge, processes and attitudes of science. The context aspect includes the ability to identify problems that occur and apply science in solving them (Subaidah et al., 2019). The knowledge aspect is an understanding of facts, concepts and explanatory theories that form the basis of scientific knowledge (Firdaus & Asmali, 2021). Process aspects include the ability to find, process and present the data that has been obtained (Rusilowati et al., 2018). The attitude aspect is how interested in science and technology, respecting scientific approaches, using scientific methods and perceptions of problems that occur (OECD, 2018).

From the results of observations made by researchers in the field, the reality found in the field has not described the expected ideal conditions. This can be seen from the results of the in-class evaluation that was carried out at SMAN 3 Padang. Based on the results of tests on scientific literacy of students in class X E 3 that there were 58% of students in the low category, 16% of students in the very low category, 20.3% of students in the medium category, and only 5.7% of students who had high category of scientific literacy ability. Previously, researchers had conducted preliminary studies from previous researchers which stated that students' needs for scientific literacy-laden multimedia were 97% in the very high category and the teacher's need for interactive multimedia with scientific literacy was 100% very high category, the conclusion from previous researchers was the need to develop multimedia-laden scientific literacy in physics subjects at SMAN Kota Padang (Muh.Arlim, 2022). The existence of a gap between ideal conditions and real conditions in the field indicates a problem in students' scientific literacy skills at school. This problem is important to research and solve. The low ability of students' scientific literacy is also influenced by the selection of teaching materials used in schools. Teaching materials play an important role in the learning process, namely as a medium for delivering information. Thus, good teaching materials are needed so that learning objectives are achieved optimally.

One of the solutions to overcome the problem of students' low scientific literacy skills is to apply good teaching materials, namely teaching materials that contain components of scientific literacy in a balanced way (Fuadi, 2020). This can be overcome by applying E-Teaching Materials with Socio-scientific Issues (SSI) Context to improve students' Scientific Literacy abilities. In the IPA material for phase E class X of the Merdeka curriculum, there is Renewable Energy material. Renewable energy is very close to people's daily lives, starting from forms of energy, the law of conservation of energy and forms of alternative energy that can be used by the community. The lack of time allocation for Physics learning in schools

makes students less empathetic and less active when solving problems related to Alternative Energy. In response to this, the application of E-Teaching Materials with SSI is considered suitable for use in this material. SSI learning is expected to be able to provide learning experiences for students. According to the research results of Kartika et al (2019) students will be more active in learning activities when the teacher provides SSI-based teaching materials. The use of Renewable Energy has become a concern of the community and has emerged as SSI (Rostikawati & Permanasari, 2016).

Application of the Social-Scientific Issue Context (SSI) is a learning strategy in which the material learning process is associated with social issues in the environment and society that have the potential to support the development of intellectual abilities, communication skills, social attitudes, concern and student participation. The SSI approach is able to make students more interested, motivated, active and understand better when teaching and learning activities in class (Sari et al, 2021). SSI is an approach to delivering science material related to social issues by including elements, ethics and morals (Rohmawati et al., 2018). Through SSI students are able to hone their skills in arguing and analyzing from various perspectives. The use of SSI in schools can be used as an intermediary for concrete problems in society and as a reference for students to find science content (Nazilah et al., 2019). The research results of Rostikawati & Permanasari (2016) state that learning with SSI is able to build scientific literacy and is able to guide students to give birth to responsible individuals. This is because learning in the SSI context realizes students in analyzing and investigating social problems related to science (Kartika et al., 2019).

Learning the Social-Scientific Issue Context (SSI) guides students in understanding how science assignments work in reality by including evidence in explaining a problem. SSI applies social problems that exist locally to foster scientific literacy skills and solve problems in critical thinking. In the opinion of Alvita (2017) SSI is a way to make learning meaningful by students. According to Sadler & Zeidler (2004) applying the SSI approach in classroom learning has the following benefits: (1) Physics learning becomes more meaningful for students; (2) interpreting science principles and ensuring that learning outcomes are managed by students; (3) build students' argumentation skills; (4) improve the ability to evaluate related to scientific information; (5) increase students' scientific literacy. Thus, the Social-Scientific Issue Context (SSI) will be very suitable to be combined with efforts to improve students' Scientific Literacy skills.

The application of E-Teaching Materials with the Social-Scientific Issue (SSI) Context is expected to solve the problem of this research, namely the low scientific literacy ability of students. For this reason, researchers are interested in applying solutions to the Application of E-Teaching Materials with the SSI Context for physics learning. The purpose of this research is to describe the increase in students' scientific literacy in Renewable Energy material using a socio-scientific issues approach assisted by Teaching Materials. The researcher hopes that with this research, there will be an increase in skills in class X E 3 students at SMA N 3 Padang and the results of this study can be used as a reference for other researchers. It is hoped that the results of this study can also be a reflection to teachers of the importance of scientific literacy skills in students.

METHODS

This type of research is Classroom Action Research. Classroom action research is an examination of learning activities in the form of an action, which is deliberately raised and occurs in a class together (Arikunto, 2007). Classroom action research aims to improve the quality of learning practices in the classroom (Arikunto, 2006). The CAR research model uses the Kemmis and Mc. Taggart in 1988 which consisted of four stages, namely planning, action,

observation, and reflection. The research was conducted at SMA N 3 Padang in March 2023. The research subjects were students in class X E 3 for the 2022/2023 academic year with a total of 35 students.

CAR research uses the Kemmis and Mc. model. Taggart carried out with 2 cycles (Figure 1). The planning stage is action planning based on the results of the initial condition observations. This includes determining the learning to be applied, preparing learning tools that are used in Renewable Energy material in the sub-material changes in electrical energy and changes in heat energy, preparing teaching materials for students to study, preparing articles on Renewable Energy research results, compiling student test sheets. The second stage is the implementation of meaningful learning on school Renewable Energy material. The third stage is the observation stage. The observation stage is carried out simultaneously with the implementation of learning. Every action taken by the teacher and students is observed by fellow teachers using observation sheets. The last stage is the reflection stage. The results obtained in the previous stage were analyzed as material for evaluating learning in cycle 1 as an effort to improve the next cycle.

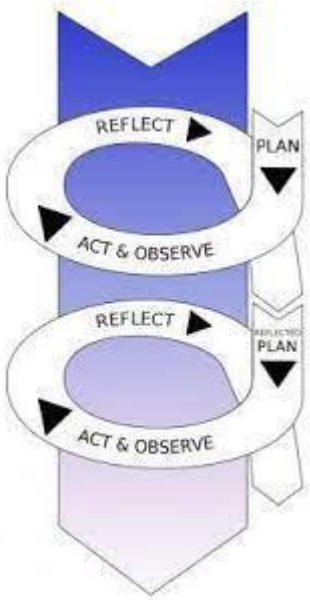

Figure 1. Kemmis and Mc's CAR Spiral Model. Taggart

Data collection techniques in research are observation and learning achievement tests. The research instrument used was an essay test sheet on Teaching Materials about understanding concepts adapted to indicators of scientific literacy ability (Table 1). Data analysis techniques in quantitative and qualitative descriptive research. Quantitative data is in the form of data on conceptual understanding test results presented in the form of numbers with the help of diagrams, while qualitative data is in the form of observational data on the implementation of CAR presented in the form of explanatory descriptions. Calculation of the percentage of achievement of indicator test results is used to collect research data on scientific literacy skills for each element. This percentage is calculated by comparing the learning outcomes of each student with the maximum score and calculating the average achievement of literacy skills for each indication of the elements of knowledge, process and context. According to Mutia Risma (2019) To measure the achievement of aspects in Scientific Literacy, namely Context Aspects, Scientific Process aspects and scientific concepts, indicators are needed that are in accordance with the teaching materials made. The average score of students' scientific literacy skills is calculated using the score of each student. The proportion of achievement of scientific literacy skills is then interpreted descriptively using the percentage interpretation described by Arikunto (2016) which has been adjusted as follows:

Table 1. Interpretation of the Average Percentage of Scientific Literacy Ability Scores

Science Literacy Ability	Category
80-100	Very high
66-79	Height
56-65	Currently
40-55	Low
0-39	Very low

RESULTS AND DISCUSSION

Results

The research was conducted in March 2023 in class X E 3 at SMA N 3 Padang with a total of 35 students. This research was carried out in 2 cycles, namely cycle 1 and cycle 2. . The stages of research conducted in cycle I are planning, implementing, observing and reflecting. While the stages in cycle 2 have the same steps as cycle 1. In cycle 2 the teacher makes the results of reflection in cycle 1 as a consideration for lesson planning in cycle 2. Learning is carried out by applying learning*Problem Based learning* (PBL) on Renewable Energy material.

The first aspect of scientific literacy is the scientific context. The scientific context in this study consists of seven indicators. Based on this explanation, the scientific context indicators in this study consist of seven indicators. These indicators are: 1) contain scientific phenomena to explain everyday phenomena; 2) contains the link between science and everyday phenomena; 3) applying science in the health sector; 4) apply science in the use of natural resources; 5) applying science in improving environmental quality; 6) apply science to minimize the danger of damage to nature; and 7) applying science in the field of technology. Based on the seven indicators on the aspect of the scientific context. Obtained student learning outcomes are outlined in graphical form in Figure 3.

The second aspect of scientific literacy is the scientific process. The scientific process consists of eight indicators. 1) identify scientific phenomena; 2) analyze and apply appropriate scientific knowledge; 3) identify how to explore the questions given scientifically; 4) evaluate how to scientifically explore the given questions; 5) interpret data and evidence scientifically; 6) distinguish between arguments based on scientific evidence and theories based on other considerations; and 8) analyze and interpret data and draw appropriate conclusions. Obtained student learning outcomes are outlined in graphical form in Figure 3.

Furthermore, the third aspect of scientific literacy is scientific concepts. This aspect consists of seven indicators. These indicators include: 1) the material presented has relevance to real life situations; 2) contains important scientific concepts and theories; 3) the material presented is in accordance with the level of development of high school students; 4) contains proper design properties for scientific questions; 5) contains constructive knowledge in defining science; 6) scientific statements are supported by data and scientific reasoning; and 7) contains the role of collaboration and criticism in building confidence in scientific statements.

Results of Students' Scientific Context

The scientific context relates to the application of scientific knowledge and the use of scientific applications. To test this aspect of the scientific context, students are asked to work on the questions given based on contextual discourse with*Sosial-Scientific Issue* (SSI). Based on student learning outcomes on scientific literacy abilities in aspects of the scientific context can be seen in Table 2.

Table 2. Descriptive Statistical Context Parameter Values

No	Descriptive Statistics Parameters	Cycle 1	Cycle 2
1	The number of students	35	35
2	Average value	73	86
3	Median	74	82
4	Modus	74	84
5	Standard deviation	6,3	7,87
6	Nilai minimum	61	75
7	Maximum value	88	90
8	Reach	27	15

Table 2 shows that there was an increase in the context aspect of students' scientific literacy abilities, in cycle 1 the average student got a score of 73. In this aspect students were given a reading context with*Sosial-Scientific Issue* (SSI), students are given problems that are currently being discussed in the community about renewable energy. Students look very interested and can connect the learning material with the context of the reading given. In cycle 2, students are used to using reading contexts using SSI so that there is an increase in the average student score, namely with a value of 86. Students look enthusiastic when discussing readings that are currently viral in the community, issues that are warm and related to learning make it easier for students to think critically.

Results of Students' Scientific Process

The scientific process deals withabilities centered on obtaining, interpreting and acting on evidence. To test this aspect of the scientific process, students are asked to do experiments related to contextual discourse*Sosial-Scientific Issue* (SSI). Based on student learning outcomes on scientific literacy skills in the scientific process aspect, it can be seen in Table 3.

Table 3. Parameter Value of Scientific Process Descriptive Statistics

No	Descriptive Statistics Parameters	Cycle 1	Cycle 2
1	The number of students	35	35
2	Average value	80	91
3	Median	74	85
4	Modus	74	86
5	Standard deviation	7,2	8,1
6	Nilai minimum	69	75
7	Maximum value	93	94
8	Reach	24	19

Table 3 shows the statistical parameters from the Process aspect of the Scientific Literacy skills. The process aspect given is by providing a simple experiment to link skills with the concepts of physics learning in renewable energy material. In cycle 1 the average student score was 80, students who usually conducted experiments without an introduction in the form of a reading context with SSI tended to be unable to connect process skills with the given physics concept, with the reading context*Sosial-Scientific Issue* (SSI) before being given an assessment of the process aspect makes student learning outcomes on the process aspect quite high. In cycle 2, there was an increase again after evaluating the implementation and deficiencies in cycle 1, the average score of students in the process aspect of the Scientific Literacy skills was 91, much increased from the previous cycle.

Results of Students' Scientific Content

Scientific content relates to scientific knowledge or concepts that help understand related phenomena. To test this aspect of scientific content, students are asked to connect experiments related to contextual discourse with Social-Scientific Issues (SSI) with the physics formulation being studied so that meaningful learning occurs. Based on the results of student learning on scientific literacy skills in the aspect of scientific content, it can be seen in Table 4.

Table 4. Parameter Value Descriptive Statistics Scientific Content

No	Descriptive Statistics Parameters	Cycle 1	Cycle 2
1	The number of students	35	35
2	Average value	75	88
3	Median	70	80
4	Modus	70	82
5	Standard deviation	6,2	7,9
6	Nilai minimum	64	75
7	Maximum value	88	91
8	Reach	24	16

Data in Table 4 shows the statistical parameter values on the scientific content aspect. It can be seen that in cycle 1 students get an average score of 75, in cycle 1 students are asked to complete questions related to physics concepts that have been linked to the two previous aspects of scientific literacy skills. In cycle 2, an evaluation of the deficiencies that occurred in cycle 1 was carried out, namely students were not used to connecting learning material with problems. They were used to learning separately between context, process and content. In cycle 2, the teacher tries to direct and accustom students to think more critically and connect learning materials and problems, resulting in an increase in the average student score is 88.

From the explanation above, it can be seen that there is an increase in every aspect of scientific literacy. Of the three aspects, namely the scientific context, scientific process and scientific content, there is a difference in the increase from cycle 1 and cycle 2. The difference in this increase can be seen in Figure 2 based on the results of student scores.

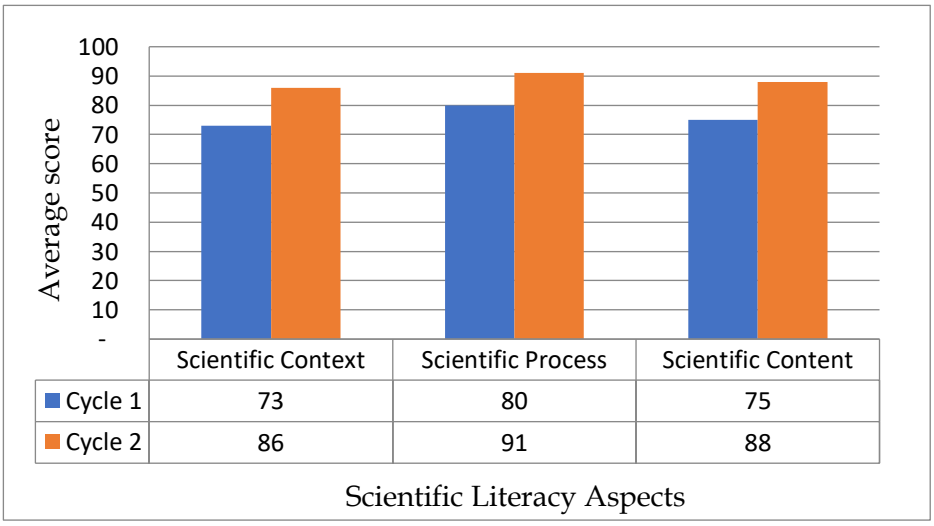

Figure 2. Results of the Average Score of Students on the Aspect of Scientific Literacy

From Figure 2 it can be explained that there was an increase in each aspect when cycle 1 and cycle 2 were carried out. It can be seen that in cycle 1 the lowest average student score was

in the aspect of scientific content, namely 73%, this was due to the students' unfamiliarity with reading content that contained current issues and then connecting it with learning in Physics, in this study Physics content was given using SSI . The highest average score in the scientific process aspect is 80%, in this E-learning material students are asked to carry out experiments according to the material on the issues discussed. In the scientific concept aspect the class average score obtained is 75%, in this scientific concept students are asked to understand the issue and then relate it to the scientific concepts and theories of physics. In cycle 2 there was an increase in all three aspects of Scientific Literacy, at 86% Scientific Context, 91% Scientific Process, and 88% Scientific Concepts. This proves that the provision of E-learning materials with context*Sosial-Scientific Issue* (SSI) can increase the level of Student Science Literacy

Discussion

Implementation of CAR Cycle 1

Planning activities in cycle 1 include action planning based on observation results. This includes determining the use of E-Teaching Materials in the context of Social-Scientific Issue (SSI) to increase students' Scientific Literacy, the use of learning models*Problem Based Learning* (PBL), Preparation of learning tools on Renewable Energy material, compiling student learning outcomes test sheets and student observation sheets.

Implementation activities are the realization of planning activities such as the implementation of planned learning activities in the teaching modules of the Learning Activities section based on the learning model used, namely*Problem Based Learning* (PBL) there are several stages, namely first the teacher orients students towards the problem, at this stage the teacher provides E-Teaching Materials with the SSI Context, in this teaching material there is a Scientific Context section where discourses/issues that are developing in the community about Renewable Energy are given. Furthermore, the teacher orients students to learn, at this stage there is a section on scientific concepts in teaching materials that directs students to Renewable Energy material. The next stage is guiding individual and group investigations, students are asked to conduct experiments in an aspect of Scientific Literacy called the Scientific Process. Finally, developing and presenting results, analyzing and evaluating the problem-solving process, here students are asked to present their learning results.

Observation and reflection activities are carried out by students and class teachers and lecturers to discuss reflection after learning in Cycle 1. In Cycle 1, learning is implemented with the help of E-Teaching Materials with context*Sosial-Scientifc Issue* (SSI) to improve students' Scientific Literacy is better than the application of learning in general. The students were enthusiastic about giving the SSI Context discourse that was given because the issue was quite warm in the community. Interesting presentation of teaching materials makes students more interested in reading, students become more enthusiastic because learning is related to everyday life with the help of Scientific Literacy. After reflection, there are weaknesses, such as students who are not used to reading in physics learning as seen from the low pretest results, some students are not used to connecting physics concepts with issues in everyday life, students are used to minimal learning and compartmentalizing physics concepts by formula. This is the record of the reflection activities in cycle 1 which will later be taken into consideration in carrying out cycle 2.

Implementation of CAR Cycle 2

The implementation of CAR in cycle 2 is the same as in cycle 1, but the planning stage in cycle 2 is the result of reflection in cycle 1 which is then corrected for cycle 2. Planning activities in cycle 2 include action planning based on observation results. This includes determining the use of E-Teaching Materials in the context of Social-Scientific Issue (SSI) to increase students'

Scientific Literacy, the use of learning models*Problem Based Learning* (PBL), Preparation of learning tools on Renewable Energy material, compiling student learning outcomes test sheets and student observation sheets.

Implementation of learning activities using models*Problem Based Learning* (PBL) there are several stages, namely first the teacher orients students towards the problem, at this stage the teacher provides E-Teaching Materials with the SSI Context, in this teaching material there is a Scientific Context section where discourses/issues that are developing in the community about Renewable Energy are given. Furthermore, the teacher orients students to learn, at this stage there is a section on scientific concepts in teaching materials that directs students to Renewable Energy material. The next stage is guiding individual and group investigations, students are asked to conduct experiments in an aspect of Scientific Literacy called the Scientific Process. Finally, developing and presenting results, analyzing and evaluating the problem-solving process, here students are asked to present their learning results.

Observation and reflection activities are carried out by students, teachers and lecturers to discuss reflection after learning in cycle 2. Learning in cycle 2 shows that students are getting used to learning to apply E-Teaching Materials with Context*Sosial-Scientific Issue* (SSI), this can be seen from the participation of students in class. In cycle 2 learning students are more mature and ready to convey the findings in the analysis of research articles on renewable energy provided by the teacher. Students are enthusiastic when discussing the issues given, students are also used to digesting the problems that exist in the issues given and relate them to the physics concepts being studied.

Based on the presentation of the implementation and the results of the research, it shows that learning using E-Teaching Materials with the SSI Context is able to improve students' conceptual understanding skills and scientific literacy skills on Renewable Energy material. This research is in line with previous studies such as the results of Siagian et al. (2017) that the ability of students' scientific literacy skills in North Labuhanbatu Regency based on the dimensions of scientific literacy (content, process, and context) is in the low category. According to Yuliati (2017) the best way to increase scientific literacy is by connecting learning material with everyday life. Based on data on scientific literacy abilities, it indicates that teachers should pay more attention to improving students' scientific literacy skills through a contextual learning process by linking science and science applications in students' daily lives.

One component of scientific literacy is argumentation and decision-making skills (Macalalag et al., 2020). the existence of issues that are carried out in SSI will help students develop socio-scientific reasoning (Socioscientific Reasoning/SSR) as a construct to train reasoning practices related to negotiation and solving SSI problems (Zeidler et al., 2019). SSI-based learning will train students in these skills. The existence of SSI issues or problems in learning can trigger polemics and the emergence of pro and con camps that require students to reason and interpret these issues. Learning presented in the SSI context will train students' skills in making decisions related to polemical and controversial social issues and make students capable of scientific literacy. SSI also has a high contextuality aspect, presenting dilemmas and even problems (Permanasari et al., 2021). Problems in SSI can be solved using mastery of science and social awareness that arise in mental conflicts. So that individuals who have scientific literacy will be able to solve problems and make decisions with responsibility (Hodson, D, 2014).

CONCLUSION

Based on the research results in cycle 1 and cycle 2 there was a significant increase in student learning outcomes. Students' Scientific Literacy ability can be improved with teaching materials that support 3 aspects, namely Scientific Context, Scientific Concepts, and Scientific

Processes. One effort that can be done is to use E-Teaching Materials with*Social-Scientific Issue Context* (SSI), by getting used to contextual learning students are able to connect between issues that develop in society with the physics concepts studied at school. This research was conducted on renewable energy materials, so it is hoped that this research can be continued on other physics materials.

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