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The Improvement of Student's Critical Thinking Skills Through the Development of Science Learning Material Based Socioscientific Issues with Interactive Multimedia-Assisted on Gadget

Ayu Ilfiana[1*], Wahono Widodo[2], Pirim Setiarso[3]

[1] Science Education Study Program Postgraduate, State University of Surabaya, Indonesia.
[2] Science Education Study Program, State University of Surabaya, Indonesia
[3] Chemical Study Program, State University of Surabaya, Indonesia

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Abstract: This research aims at understanding the effect of Socioscientific Issues (SSI)-based interactive multimedia (MMI) on the gadget (MMI-SSI-GADGET) toward the junior high school student's critical thinking skills. The research was conducted in two stages. The first stage was the preparation, which was done to design the learning tools. The next stage was the teaching and learning process in the classroom using pre-test post-test design. The subjects of the research were 28 students of class VII A3 at MTsN 3 Trenggalek. The results of this research showed that the validity score for the learning tools was 3.84 with a percentage of 98.04%, which was categorized as very valid. The practicality percentage was 88.5% which was categorized as very practical, and the N-gain effectiveness was 0,77, which was categorized as very good. Based on the data analysis, it can be concluded that SSI-based MMI on gadgets was categorized as 'very suitable' to improve the junior high school students' critical thinking.

Keywords: Socioscientific issues; critical thinking skill; interactive multimedia on gadget

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Introduction

The aim of national education is nationwide intellectual with a vision towards the realization of the educational system as a strong and authoritative social institution to help Indonesians become citizens with good qualifications and improving students' potential in answering the changing demands of the world (Kemendikbud, 2016a). One of the educations that can affect national education, in general, is natural science education (Usman et al., 2021).

According to National Science Education Standards (NSES, 1996), "Learning science is something that students do, not something that is done to them." This means that the learning of natural science is meant to be done by the students themselves, not one done towards the students. Students are expected to be active during the learning processes, showing both hands-on activity and minds-on activity. Therefore, the Government has been continuously improving the curriculum to optimize students' abilities.

The current curriculum being applied is the 2013 curriculum. This curriculum was designed based on the 21st Century Skill framework. It was not enough to base the curriculum on the 21st Century Skill, but it also needed thinking skills (Partnership 21st century skill, 2002). One of the thinking skills based on the 21st Century Skill (or known as 4-C) is Critical thinking skills.

Critical thinking skill is the ability to think reflectively and reasonably (Ennis, 1985) and relate to the Higher Order Thinking Skill/HOTS (Rahayu, 2019),

Email: ayuilfiana.18021@mhs.unesa.ac.id

which focuses on decision making towards what to believe and what not. Students are expected to have critical thinking skills to analyze problems and solve them based on the available evidence (Pieterse et al., 2016). Students with critical thinking skills are expected to have the ability to understand and take part in solving various problems in life and technology according to the demand of the world (Pradana et al., 2020).

Based on the preliminary research, it could be known that the thinking skill of students at MTsN 3 Trenggalek is low, with 78% of the students scored below 50. This resulted from the learning at the school that solely focused on core knowledge, without taking account into students' thinking skills especially their critical thinking skills. Based on the results of questionnaires which were distributed to 28 students of MTsN 3 Trenggalek, 71% of natural science lesson was interesting for the students due to the experiment activity. This indicated that the learning processes only used hands-on activity and were lack of minds on activity. This could result in students' difficulty in understanding the concepts during classroom discussion. Therefore, students are not able to identify real-life problems and apply the essence of materials taught to them in everyday life (Rahmawati, 2018). In addition, the teacher did not make use of the available learning media, such as gadgets, and merely used PowerPoint. This could lead to students' boredom during the teaching and learning processes, resulting in unoptimal learning (Jami, 2020). This was supported by the result of an interview with one of the natural science teachers at the school. It showed that the less frequent use of the learning media was due to the limited animation media at the school and the time available in the teaching and learning processes. Whereas, one of the creative ways to make students interested in reading and learning is through the use of learning media (Suryanti et al., 2021).

One solution to the problems is using teaching strategies to promote students' critical thinking skills, that is, Sosioscientific issues (SSI). According to Zeidler (2019), SSI uses controversial and unstructured scientific topics to enable students to engage in dialogs, discussions, and debates. Based on Pratiwi et al., (2021), the use of SSI in learning can improve the critical thinking skill of junior high school students. Rahayu (2019) emphasized that using SSI effectively in learning processes can support Higher Order Thinking Skill (HOTS) achievement in students, such as critical thinking and problem-solving. Another way to make students interested in reading and learning is by including SSI in media, such as interactive multimedia. According to Widodo et al., (2018), computer-based multimedia involve computer presentation of various media formats (such as texts, pictures, audios, and videos) to deliver information in linear or nonlinear formats. This particular research used gadget-based multimedia. According to previous research done by Widodo et al., (2018), the use of SSI-based interactive multimedia on gadgets improved the science literacy of generation Z. However, the use of interactive media on gadgets by promoting socio-scientific issues to improve students' critical thinking skills has not much conducted.

Based on the above description, it is considered needed to conduct further research on the critical thinking skill of junior high school students through SSI-based learning on gadgets. This research was conducted to give the students meaningful learning, especially on the aspect of critical thinking skills.

Method

At the preparation stage, this research aimed at designing learning tools with interactive multimedia on gadgets based on SSI. The learning tools adopted the developmental model of Thiagarajan et al. (1974) that was the 4-D model. This model has 4 stages: define, design, develop, and disseminate. In this research, the stage disseminate was not done. The the 4-D model was chosen because it is designed with a systematic order of activities and suitable for designing learning tools. The stages were modified and adjusted to the needs for the design of the learning tools.

The product eligibility tests in this research were done through three stages: validity test, practicality test, and effectiveness test—the validity test aimed at assessing the validity of the learning tools. The subjects of this test were 2 validators: 1 media expert and 1 material expert. The media expert validator was lecturer of The Surabaya State University Science Education Study Program who is competent in the respective fields. The media expert lecturer is a lecturer in the Science Education Study Program of The State University of Surabaya. The data were collected through questionnaires and summarized to be analyzed using a descriptive quantitative method by finding the average score of each component based on the assessment instrument for the designed learning tools. The validity scores of the learning tools were referred to the criteria as seen in Table 1 as follows.

Table 1. Criteria of Likert Scale

No	Score	Criteria
1	$3.25 < \text{Score} \leq 4.00$	Very Valid
2	$2.50 < \text{Score} \leq 3.25$	Good
3	$1.75 < \text{Score} \leq 2.50$	Quite Valid
4	$1.00 < \text{Score} \leq 1.75$	Invalid

The practicality test was done by a natural science teacher, with some others observing the application of the learning tools in the teaching and learning process. The subjects of the controlled experiment for the effectiveness test were 28 students of class VII A3 at MTsN 3 Trenggalek. The test was done by conducting a pre-test before the SSI-based media was used in the teaching and learning processes, then a post-test was conducted at the end of the class to know the students' scores after using the SSI-based media. The effectiveness of the learning tools can also be examined based on students' responses after conducting the teaching and learning process using SSI-based gadget-assisted learning tools.

Testing to the improvement on students' critical thinking skills after the teaching and learning processes using SSI-based interactive multimedia was done by using the *gain score*. The formula for the standardized *gain score* as contained in Triyana (2016) is as follow.

$$\langle g \rangle = \frac{T1' - T1}{Tmaks - T1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Information:
g (gain) = gain score
T_1' = mean pretest score
T_2 = mean posttest score

This standardized formula for *gain score* has three categories which explained in Table 2 below.

Table 2. Criteria for Standardized Gain Score

No	Result of gain score	Criteria
1	Gain > 0.7	High
2	0.7 > Gain > 0.3	Medium
3	Gain < 0.3	Low

(Source: Triyana, 2016)

Result and Discussion

A. Validity Aspect

This research and development produced SSI-based gadget-assisted learning tools for environmental pollution topic. The materials included a syllabus, lesson plan, SSI-based teaching and learning media (MMI-SSI on gadgets), a worksheet contained in the media (gadgets), and a test instrument. The learning tools were validated by 2 media experts. The validity score from the experts on the gadget-assisted learning tools based on SSI was 3.84, with a percentage of 96.04%. The summary of the validity results can be seen in Table 3 as follow.

Table 3. Summary of the validity results of the learning tools.

No	Material	Score	Criteria (%)	Criteria
1	Syllabus	3.85	96.1%	Very Valid
2	Lesson plan	3.90	97.6%	Very Valid
3	MMI-SSI on gadgets	3.96	99%	Very Valid
4	Worksheet on gadgets	3.86	96.4%	Very Valid
5	Test instrument	3.64	91.1%	Very Valid

Based on Table 3, it was known that the syllabus, lesson plans, mobile media, students, worksheet, and question instruments were categorized as Very Valid. This showed that the learning tools were very well developed and can be used in the learning process. According to Yaumi et al. (2019), good learning tools should be well designed and authentic to help students gain new knowledge. In line with the tools that have been developed, each context in the lesson plan, media, and students' worksheet is authentic and closely related to students' daily life. This learning tools also included SSI-based interactive media on gadgets. According to Aufa et al., (2021), good instructional media can integrate the ability to read and have an attractive appearance. Accordingly, the developed media is good according to the media validation results on the attractive gadgets and contains text, images, audio, and video.

B. Practical Aspects

The learning material implementation can be seen from the use of learning tools based SSI on gadget during the learning process. The implementation of the lesson plan during the data collection process was observed by two observers. They were the science teacher and the observer. The observations were made for 3 meetings and presented in Table 4.

Table 4. Implementation of Lesson Plan

No	Meeting	Score	C (%)	Category
1	I	3.57	89.3	Very Good
2	II	3.47	86.9	Very Good
3	III	3.57	89.2	Very Good

Note: C (%) = Percentage of Compliance

Based on the data analysis results of science learning tools implementation, which was developed showed that the overall ability of teachers in processing SSI-based learning activities with a scientific approach was Very Good. It shows that every step contained in the lesson plan was carried out well. The learning process integrates the scientific approach with SSI. SSI is a learning strategy that emphasizes decision-making or opinion based on scientific and social issues. At the

observing stage, students observed images of several kinds of pollution. Then at the questioning stage, students made some questions based on what they have observed. At the data collection stage, the orientation of socio-scientific issues, questions, and data collection emerged. In the information processing stage, students carried out the discussion and make decisions on the issue being debated. After that, the stage of communicating, in this stage, students presented the discussion results and then concluded. SSI with scientific approach can improve students' thinking skill. This is because the use of issues can invite pros and cons to require the students to think and analyze the issue (Rohmawati et al., 2018). This SSI requires the students to be actively involved in discussions or debates to lead to more meaningful learning for students because the issues raised are directly related to the students' social lives (Rahayu, 2019). This is following the observer's assessment that the learning process is student-centered.

C. Aspect of Effectiveness

1. Results of Students' Critical Thinking Skills

First, students' critical thinking skills were measured by giving a pre-test before the learning process to determine the student's initial abilities. The post-test was carried out after the learning process that used SSI-based learning tools on gadgets to determine the final abilities of the students. Based on the results of the critical thinking skills test of the students, it shows that after learning activities using SSI-based science learning tools assisted by gadget media, there is an increase in the score of the critical thinking skills. The results of the pretest and posttest can be seen in Table 5 and Figure 1.

Table 5. The Results of Students' Pretest and Posttest

Class	Score		
	Pretest Mean	Posttest Mean	Maximum Score
VII A3	37,5	85,4	100
Gain = 0,77			

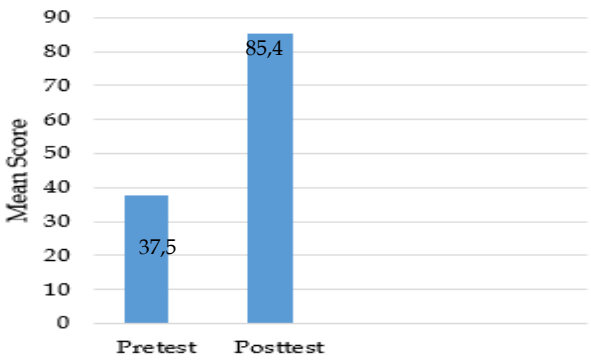

Figure 1. The Results of Pretest and Posttest

Based on the results, it shows that SSI-based learning tools assisted by gadget media were very effective to be used in science learning tools on environmental pollution. Several factors caused the increasing score of posttest:

a. MMI-SSI-gadget used was in the feasible category. The media loaded on this gadget also made the students interested in reading, eased the students to access the materials needed under the teacher's supervision. This is in line with Suryanti et al., (2021) who assert that using learning media in the form of gadget is a creative way to make students interested in reading the learning tools. In addition, every content and context contained in MMI-SSI on the gadget is authentic and controversial to develop the students' analytical and critical thinking abilities. Following the research conducted by Widodo et al., (2018), the tasks contained in MMI-SSI on the gadget can increase students' curiosity and problem-solving abilities.
b. The use of socio-scientific issues during the learning, the issues raised were very close to students' daily life to motivate the students to make meaningful learning. This is in line with Rohmawati et al., (2018) that the learning can be more meaningful if the students earned direct experience or experience related to real life. The issues raised were also open-minded and controversial; allowing the students involved in discussions and debates can trigger the students' critical thinking skills in solving these issues. In addition, students can also improve social relations with their peers to exchange information and discuss about their task (Nurdiana, 2021). In line with research conducted by Wilsa et al., (2017), the use of open-minded issues, either conceptually or procedurally, can develop students' thinking skills, especially critical thinking skills.

2. Students' Response

Students' responses were the opinion of the students regarding the SSI- based learning tools on the gadget during the learning process. The results of students' analytical responses through the learning activities using learning material based SSI with interactive multimedia on gadget showed the average of 3.7 with a percentage of 92.6%. This indicates that the criteria was excellent and can be interpreted that the learning tool gained a positive response from the students. This gadget was effectively used in the learning process. The large percentage of the students who responded positively to this learning indicates that the students felt happy, easy, and interested in learning with socio-scientific issues assisted by gadget media.

Conclusion

Based on the results of analysis and discussion, it can be concluded that the learning tools-based SSI with assisted interactive multimedia on gadget that have been developed are declared as valid, practical, and effective to be implemented in science learning on environmental pollution material. The value of the validity was 3.84 and was categorized as Very Valid, the practicality was 88.5% and was categorized as very practical, and the effectiveness was 0.77 with a highly informative category and very effective to be used in learning. The implementation results of learnig tools-based SSI with assisted interactive multimedia on gadget shows that the learning tools were effective to increase critical thinking skills of Junior High School Students.

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