

DECISION-MAKING ABILITIES OF ELEMENTARY SCHOOL STUDENTS ON SOCIO-SCIENTIFIC ISSUES BASED ENERGY MATERIALS ASSISTED BY SCRATCH APPLICATION MEDIA

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Abstract

The background of this research is the students' low involvement in decision-making, especially on energy materials which have an impact on their low decision-making ability. The purpose of this study was to determine the extent to which the scratch application-based learning media influenced the students' decision-making abilities on energy materials. The research method used was an experiment with one group pretest-posttest design. The subjects of this study were the fifth graders of an elementary school in one of the cities in West Java, Indonesia, totalling 144 students which consisted of 51 male students and 93 female students. The instrument used in this study was a test following the indicators of students' decision-making abilities. The results of this study showed that there is a significant mean difference in the students' decision-making ability between the pretest and posttest in energy materials learning using scratch application-based media and based on the analysis results, the mean score of each indicator with the lowest improvement is the indicator of identifying alternative decisions to solve problems. Meanwhile, the indicator of decision-making ability with the highest improvement is analysing the causes of problems from various factors.

Keywords: Decision-making, Energy, Scratch, Socio-scientific issues.

1. Introduction

Challenges on a local, national and global scale regarding social and environmental issues faced by society today are increasingly complex, so they need to be understood and resolved [1, 2]. Several challenges related to social, scientific, and environmental aspects are environmental pollution, scarcity of energy sources, global warming, the increase of greenhouse gases that increase every year [3, 4]. Then, other events need the touch of technological and scientific developments [5-7]. These challenges include socio-scientific issues because they have social, scientific, and technological aspects [8].

These challenges, if allowed to continue, will fatally threaten humans for they are always dependent on the environment. Therefore, it is important to build a society that can overcome these problems [9]. It is regarding what is meant by a society with such capacity, and who have 21st-century skills related to these challenges with the ability to make decisions [10].

Decision-making is the ability to choose one of the various available alternatives based on the results of the analysis of facts or information in solving a problem [11-14]. In the context of socio-scientific issues, individuals with good decision-making skills can solve problems related to socio-scientific issues based on the results of analysing facts and information, compiling alternative solutions, and evaluating alternative solutions. Thus, the best solution can be chosen. Indeed, decision-making is very important to be trained students starting from the elementary school age level.

However, based on the results of interviews with 103 elementary school teachers in one of the cities in West Java, Indonesia, 32% of them had involved the students in making decisions during learning about socio-scientific issues and 68% of them had never involved the students in making decisions during learning about socio-scientific issues. If this is allowed to continue, it is feared that the students' decision-making abilities will not develop properly and challenges on a local, national and global scale regarding socio-scientific issues will be difficult to understand and resolve.

The previous research on decision-making based on socio-scientific issues was once conducted by Sakamoto et al. [15] with the result that pre-test and post-test comparisons revealed a general shift towards higher-level responses after the intervention. The students' arguments on socio-scientific issues changed from justification arguments to proposed solutions. Another research on socio-scientific issues was carried out by Dolan et al. [16]. The results showed that socio-scientific issues could be used to improve scientific literacy in fifth-grade elementary schools. The students benefitted from argumentation, and socio-scientific issues provided a successful framework for increasing their knowledge of science content. The next research on socio-scientific issues was carried out by Yerdelen et al. [17]. The result showed that the socio-scientific problem course provided the same benefits for pre-service science teachers and pre-service social science teachers in terms of interest and use of socio-scientific issues, liking socio-scientific issues, and anxiety about socio-scientific issues.

Based on the findings of various experts, it is very necessary to have learned about energy based on socio-scientific issues by utilizing information and communication technology. Thus, students' decision-making abilities increase.

Indeed, in this study, the focus will be on examining energy learning based on socio-scientific issues with the help of scratch applications on the decision-making abilities of elementary school students.

2. Method

The method used in this study is an experimental research method with the design of one group pretest-posttest.

2.1. Research design

The design of this study is one group pretest-posttest. The basic reason for choosing this research design is because it is following the research objective to determine the effect of a treatment in the absence of a comparison group [18]. The subjects in this study were the fifth graders of elementary school students in one of West Java cities, totalling 144 students that consisted of 51 male students and 93 female students.

2.2. Research procedure

The research procedure with this design consists of several stages, namely (i) the planning stage consists of analysing relevant research result, analysing students' decision-making abilities, analysing socio-scientific issues, preparing scratch-based media, and preparing research instruments; (ii) the implementation stage consisting of carrying out the pretest, carrying out learning by using the media scratch on socio-scientific issues, and carrying out the posttest; and (iii) evaluation and preparation of reports consisting of data processing and analysis, compiling research results, and making research conclusions.

2.3. Research instrument

The research instrument used is a written test because it was considered appropriate for measuring students' decision-making abilities in accordance with the indicators of decision-making which are: (a) analysing causes of the problem from various factors; (b) identifying the impacts of the problem; (c) identifying decision alternatives for solving problems; (d) making decision to solve problems; (e) reasoning behind decision-making; (f) predicting the impacts of decision-making act in the real contexts; and (g) assessing the advantages and disadvantages of the resulting decisions.

3. Results and Discussion

The results of the study on the effect of learning on socio-scientific issues-based energy materials using scratch application-based media on the decision-making abilities of the fifth graders of elementary school after the paired sample t-test with the significance of 0.005 are as follows. Detailed analysis on how to analyse t-test is presented in previous studies [19]. Based on Table 1, it was obtained the data of sig. (2-tailed) of $0.001 < 0.005$, meaning that there is a significant mean difference in the students' decision-making abilities between the pretest and posttest in learning energy materials based on socio-scientific issues using scratch application-based media.

Table 1. Paired sample t-test.

Paired t-test	Sig. (2-tailed)	Assumption
Pretest Posttest	0.001	There is a significant mean difference

In detail, the comparison of the mean of the students' decision-making abilities in learning socio-scientific issues using scratch applications-based media is as follows. Based on Table 2, it can be seen the mean score difference of the students' decision-making abilities in learning energy materials based on socio-scientific issues. In addition, the improvement category based on the results of the N-gain analysis is included as the moderate category.

Table 2. Mean of score and n-gain.

Mean score	Pretest	Posttest
	68	82
Mean of N-gain	0.52	
N-gain Category	Moderate	

Based on the results of per indicator analysis of the students' decision-making abilities, it was obtained data that there are differences in the mean score of each decision-making indicator as follows. Based on Table 3 regarding the results analysis of each indicator's mean score, the indicator with the lowest increase is indicator C, identifying alternative decisions to solve problems. Meanwhile, the indicator of decision-making ability with the highest improvement is indicator A, analysing the causes of problems from various factors. Thus, it can be concluded that the students find it difficult to identify alternative decisions and they have convenience in analysing the causes of problems from various factors in learning socio-scientific issues using scratch applications-based media.

Table 3. The mean score of each decision-making indicator.

Procedure of Test	Indicators of Decision-making Abilities						
	A	B	C	D	E	F	G
Pretest	0.67	1.60	1.92	0.59	1.39	1.53	1.53
Posttest	0.87	1.82	2.08	0.81	1.60	1.74	1.74
Difference	0.27	0.22	0.17	0.22	0.21	0.21	0.21

The following is the learning on socio-scientific issues-based energy materials by using scratch applications-based media on students' decision-making abilities in the implementation of learning and the findings during their learning (Table 4).

Based on the learning activities according to the results (Table 4), the detailed findings are as follows. The findings at the stage of delivering apperceptions about socio-scientific issues through scratch-based videos are that most students felt enthusiastic when observing socio-scientific issues through scratch application-based videos. However, some of them still felt confused about understanding socio-scientific issues displayed through conversations in the scratch application. This shows that socio-scientific issues are indeed very appropriate to be taught from elementary school age because these issues are present in their daily lives [20]. However, socio-scientific issues based on these findings should not only be

presented through conversation but need to be presented through pictures to make it easier for students to understand the intent and examples of socio-scientific issues, especially in energy material. This consideration is based on the cognitive development of elementary school students who are still at the concrete operational stage. Thus, if the information presented through teaching materials or learning media is concrete, it will create more meaningful learning [21].

Table 4. Learning energy materials based on socio-scientific issues using scratch application-assisted media.

Learning Activities	Findings
Delivery of apperceptions about socio-scientific issues through scratch-based videos	Students were enthusiastic when observing socio-scientific issues through scratch-based videos
Delivery of materials and questions and answers on socio-scientific issues integrated with decision-making indicators	Most students felt awkward when allowed to ask questions or give opinions
Dividing the students into several groups	Some students were reluctant to group with students who are not considered close friends
Students in groups worked on students worksheets on socio-scientific issues that are integrated with decision-making indicators	<ol style="list-style-type: none"> 1. Some students working on students' worksheets on socio-scientific issues still found it difficult to identify alternative decisions to solve problems. 2. There were some students still awkward using the scratch application
Provide opportunities for each group to take turns in presenting the results of discussions on socio-scientific issues while other groups analyse and provide responses to the results of the work of the groups that are presenting.	Some students in each group were still reluctant to comment on the results of the analysis of the work of other groups

At the stage of group division, it was seen that some students were reluctant to group with those who were considered not their close friends. This happened because they are accustomed to grouping with friends of their choice when studying in groups [22]. In addition, while students work on their worksheets, it was seen that some students still found it difficult to identify alternative decisions to solve problems on socio-scientific issues. In addition, there were some of them still felt awkward using the scratch application. These findings are relevant to the results of previous research which stated that when students first used ICT-based media or teaching materials, most of them would feel confused and awkward [23].

4. Conclusion

Based on the results of the research, this study concludes that scratch-based learning media in energy materials can improve the decision-making abilities of fifth-grade elementary school students. However, in its implementation, several considerations are needed such as in the process of developing scratch-based learning media. The scratch media is required to have a good design to suit the material and characteristics of students hence it can make students more motivated to learn. In preparing students' worksheets, it is necessary to ensure that the stages of decision-making are in students worksheets, and the sentences must be easily understood by students. In the learning process the teacher's role as a facilitator should be optimized as in the analysis and question and answer stages regarding socio-scientific issues, guiding students in working on students' worksheets, responding when students convey results of students worksheets, and at the stage of concluding. Thus, students' understanding is more meaningful.

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