



The Effectiveness of the Creative-Scientific Decision Making Skills (CSDMS) Model to Practice Creative Thinking Skills and Decision Making Skills

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ABSTRACT

This study aims to produce an effective Creative-Scientific Decision Making Skills (CSDMS) learning model that can be used in training students' creative thinking skills and decision-making skills. This study uses the One Group Pretest - Posttest design. Data were analyzed descriptively with pre-test and post-test data analysis using paired t-test in limited trials, and independent t-test in broad trials. It was concluded that the CSDMS model was declared valid both in terms of content validity and construct validity in order to improve students' creative thinking skills and decision-making skills. The results showed that the CSDMS model met the effective criteria in terms of the average n-gain of creative thinking skills in the high category and decision-making skills in the medium category, consistent with the average n-gain not significantly different in each university. It was concluded that the CSDMS model was found to be effective in improving students' creative thinking skills and decision-making skills.

INTRODUCTION

The quality standards of education in Indonesia will continue to grow every year. The development of the quality of education in Indonesia today has led to higher-order thinking skills or often referred to as High Order Thinking. Education has a very important role in ensuring human survival, especially in the industrial world 4.0 (Malik et al., 2019). The industrial revolution 4.0 brought very fast changes in the world of education and technology (Ramankulova et al., 2016). Rapid changes require students to be able to compete in the world of education and work (Cancer & Mulej, 2015). In order to compete in the world of education and work, students must have several skills. One of the skills that students must have is creative thinking skills and decision-making skills (Handayani et al., 2020; Vrchota & Svarova, 2015).

Creative thinking is basically a way of thinking to generate new ideas or thoughts that are different from before so that they can be used to solve a problem (Ayas & Sak, 2014). Divergent thinking will produce many ideas and the truth of that thinking will be determined by logical thinking. According to Marzano & McNulty (1998) there are five aspects of creative thinking, namely: (1) Creativity is closely related to desire and effort; (2) Creativity produces something different; (3) Creativity requires more internal evaluation than external evaluation; (4) Creativity includes ideas that are not limited, and (5) Creativity often appears when doing something. There are four indicators of creative thinking, namely: (1) fluency, is the ability to generate many ideas; (2) flexibility, is the ability to generate ideas or ways that vary; (3) originality, is the ability to generate new ideas that did not exist before; (4) elaboration, is the ability to develop or add ideas so that more detailed and detailed ideas are produced (Hu & Adey, 2002). Humans who are able to express many

ideas or ideas in solving a problem are creative thinking.

Decision making is the result of a mental or cognitive process based on an act of choosing a path among several available alternatives (Celik, 2017). Decision making is the result of each individual's thinking in choosing one of the most appropriate answers from the various options available (Santrock, 2011). The most appropriate answer is a decision, so that each individual must be provided with education through coaching and training so that later they are able to make rational decisions and give birth to actions in dealing with problems in society. Boehm & Webb (2002) the steps in making a decision include writing down questions, making choices, gathering information, making lists of pros and cons, and making decisions.

The reality in the world of education, especially in Indonesia, is that creative thinking skills and decision-making skills have not been trained on students. Students are only required to memorize the subject matter, without being given the opportunity to develop their knowledge and not being given the opportunity to make decisions. Knowledge that is only based on memorization will not last long in memory, especially if the student is not trained in making decisions, so that students' creative thinking skills and decision-making skills are very low. The low creative thinking skills and decision-making skills of students result in not being able to compete globally. The low creative thinking skills and decision-making skills are caused because they have not been trained intentionally to students. This can be seen from the absence of a learning model that has a syntax to train creative thinking skills.

This study aims to produce an effective Creative-Scientific Decision Making Skills (CSDMS) learning model that can be used to train students' creative thinking skills and decision-making skills. The researcher developed the CSDMS model based on theoretical studies and empirical evidence from the PBL learning model and the DEAL-cycle model. The development of the CSDMS model uses a transdisciplinary approach to produce creative, original, and tested learning models in overcoming various educational problems, especially the problem of low creative thinking skills and decision-making skills. Based on the results of the synthesis of previous research on the application of the PBL model and the DEAL-cycle model to train creative thinking skills and decision-making skills, the researcher argues that it is necessary to carry out several syntaxes in the learning model, including: 1) problem orientation; 2) creative exploration; 3) creative elaboration; 4) develop group investigations; 5) strengthen decision making; 6) evaluation and reflection.

RESEARCH METHOD

This research method is pre-experimental with the type of one group pretest-posttest design through the application of the Creative-Scientific Decision Making Skills (CSDMS) model. The population in this study were students with a total of 56 people. Data were analyzed descriptively with pre-test and post-test data analysis using paired t-test in limited trials, and independent t-test in broad trials. The broad trial design of the CSDMS model was carried out using a one group pre-test and post-test design, as shown in Table 1.

Tabel 1. Design pre-test dan pos-test design.

University	Pre-test	Treatment	Post-test
HKBP Nommensesn Medan	O ₁	X	O ₂
UDA	O ₃	X	O ₄

Instrument and Procedures

a. Creative Thinking Skills Test

The assessment instrument for creative thinking skills test is in the form of a written test in the form of a description. This test is used to measure students' ability to think creatively. The creative thinking test validity instrument was adapted from Hu & Adey (200) and developed by the researcher. The creative thinking skills test assessment sheet before being used was validated by 3 experts.

b. Decision Making Skills Test

The assessment instrument for the decision-making skills test is in the form of a written test in the form of a description. This test is used to measure students' ability to make decisions. The instrument validity of the decision-making skills test was adapted from Suryanti (2012) and developed by the researcher. The assessment sheet of the decision-making skills test before being used was first validated by 3 experts.

Data Analysis

Technique Analysis of Creative Thinking Skills and Decision Making Skills with Quantitative Descriptive Inferential Statistics. Data on creative thinking skills and decision-making skills were obtained from tests of creative thinking skills and tests of decision-making skills before learning (pre-test) and after learning (post-test) using the CSDMS learning model which was analyzed descriptively using the following equation:

$$VCTS = \frac{\text{total score obtained}}{\text{maximum score}} \times 100$$

Note : VCTS = Value Creative Thinking Skills.

$$VDMS = \frac{\text{total scor obtained}}{\text{maximum score}} \times 100$$

Note : VDMS = Value Decesion Making Skills

VCTS and VDMS results of pre-test and post-test of students were analyzed using normalized gain (n-gain). N-gain shows an increase in creative thinking skills and a test of decision-making skills which is calculated using the formula:

$$< g > = \frac{S_{\text{posttest}} - S_{\text{pretest}}}{S_{\text{max}} - S_{\text{pretest}}}$$

The N-gain category of creative thinking skills and decision-making skills tests are as shown in Table 2.

Table 2. Normalized criteria *gain* <g>.

Score <g>	Criteria <g>
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Currently
$g < 0,3$	Low

(Hake, 1999)

Testing the impact of learning on students' creative thinking skills and decision-making skills after applying the CSDMS model, pre-test and post-test data analysis will be carried out using paired t-test in limited trials, and independent t-test in broad trials

RESULT AND DISCUSSION

a. Creative Thinking Skills

1) Limited Trial

Table 3. Improved score (n-gain) indicator of creative thinking skills on limited trial.

No	Indicator Creative Thinking Skills	Pretest Score	Posttest Score	n-Gain	Category
1	Fluency	35	83,1	0,74	High
2	Flexibility	39,4	80	0,67	Currently
3	Originality	33,6	78,8	0,68	Currently
4	Elaboration	20,6	77,5	0,72	Currently
Average		32,2	79,9	0,70	High

Table 3 shows that the average n-gain on the indicators of students' creative thinking skills is 0.70 in the high category.

Table 4. Test results paired t-test data pre-test-post-test skills creative thinking in limited trials.

Implementation	University	T	P	Conclusion
Limited Trial	Univ. Siantar	-17.138	0,000	There is a difference

*p < .05(2-tailed)

Table 4 shows that there is a difference between the average pre-test and post-test scores of creative thinking skills in the limited trial. This can be seen from the negative value of t which indicates that the average post-test value is greater than the average pre-test value. This means that the use of the developed CSDMS model has an impact on increasing students' creative thinking skills.

2) Extensive Trial

Table 5. Improved score (n-gain) indicator of creative thinking skills in the wide trial at hkbp nommensen University Medan.

No	Indicator Creative Thinking Skills	Pretest Score	Posttest Score	n-Gain	Category
1	Fluency	50	84,4	0,69	Currently
2	Flexibility	40,6	80	0,66	Currently
3	Originality	33,1	81,3	0,72	High
4	Elaboration	30,0	82,5	0,75	High
Average		38,4	82	0,71	High

Table 5 shows that the average n-gain on the indicators of students' creative thinking skills is 0.71 in the high category.

Table 6. Improved score (n-gain) indicator of creative thinking skills in the wide trial at Darma Agung University.

No	Indicator Creative Thinking Skills	Pretest Score	Posttest Score	n-Gain	Category
1	Fluency	28,8	79,4	0,71	High
2	Flexibility	41,9	78,8	0,63	Currently
3	Originality	37,5	83,8	0,74	High
4	Elaboration	18,1	81,3	0,77	High
Average		31,6	80,8	0,71	High

Table 6 shows that the average n-gain on the indicators of students' creative thinking skills is 0.71 in the high category.

Table 7. Test results independent t-test data n-gain creative thinking skills on extensive trial.

Implementation	University	P	Conclusion
Extensive Trial	Nommensen Medan Darma Agung	0,975	No difference

*p < .05(2-tailed)

Table 7 shows that there is no difference between the average n-gain of creative thinking skills at HKBP Nommensen University Medan and Darma Agung University in the wide trial. This means that there is an impact on the application of the CSDMS learning model to significantly increase students' creative thinking skills, so that the CSDMS model can be used to improve students' creative thinking skills.

b. Decision Making Skills

1) Limited Trial

Table 8. Improved score (n-gain) indicator of decision-making skills on limited trial.

No	Indicator Decision Making Skills	Pretest Score	Posttest Score	n-Gain	Category
1	Make a question	35	92	0,87	High
2	Gathering information	61	84	0,60	Currently
3	Making choices	48	70	0,42	Currently
4	Make a list of pros and cons	52	78	0,55	Currently
5	Decision making	33	81	0,72	High
Average				0,63	Currently

Table 8 shows that the average n-gain on the student decision-making skills indicator is 0.63 in the medium category.

Table 9. Test results paired t-test data pre-test-post-test decision making skills in limited trials.

Implementation	University	T	P	Conclusion
Limited Trial	HKBP Nommensen Siantar	-19.799	0,000	There is a difference

*p < .05(2-tailed)

Table 9 shows that there is a difference between the average pre-test and post-test scores of decision-making skills in the limited trial. This can be seen from the negative value of *t* which indicates that the average post-test value is greater than the average pre-test value. This means that the use of the developed CSDMS model has an impact on increasing students' decision-making skills.

2) Extensive Trial

Table 10. Improved score (n-gain) indicator of decision-making skills in the wide trial at HKBP Nommensen University Medan.

No	Indicator Decision Making Skills	Pretest Score	Posttest Score	<i>n-Gain</i>	Category
1	Make a question	45	92	0,85	High
2	Gathering information	64	81	0,48	Currently
3	Making choices	49	74	0,49	Currently
4	Make a list of pros and cons	64	79	0,41	Currently
5	Decision making	20	85	0,81	High
Average				0,65	Currently

Table 10 shows that the average n-gain on the student's decision-making skills indicator is 0.65 in the medium category.

Table 11. Improved score (n-gain) indicator of decision-making skills in the wide trial at Darma Agung University

No	Indicator Decision Making Skills	Pretest Score	Posttest Score	<i>n-Gain</i>	Category
1	Make a question	48	90	0,81	High
2	Gathering information	53	83	0,63	Currently
3	Making choices	36	73	0,57	Currently
4	Make a list of pros and cons	53	80	0,58	Currently
5	Decision making	48	82	0,65	Currently
Average				0,65	Currently

Table 11 shows that the average n-gain on the student's decision-making skills indicator is 0.65 in the medium category.

Table 12. Test results independent t-test data n-gain decision making skills in wide trials.

Implementation	University	P	Conclusion
Extensive Trial	HKBP Nommensen Medan UDA	0,633	No difference

**p* < .05(2-tailed)

Table 12 shows that there is no difference between the average n-gain of decision-making skills at HKBP Nommensen University Medan and Darma Agung University in the wide trial. This means that there is an impact of the application of the CSDMS learning model on increasing students' decision-making skills significantly, so that the CSDMS model can be used to improve students' decision-making skills.

Discussion

a. Creative Thinking Skills

The application of the CSDMS model in limited trials and broad trials has an impact on increasing students' creative thinking skills. Learning with the CSDMS model is student-centered so that creative thinking skills increase significantly. Creative thinking skills on the flexibility indicator have lower results compared to the fluency, originality, and elaboration indicators. After the analysis, the reason is that students find it difficult to distinguish between flexibility and fluency indicators, so the answers are always the same. In addition to using n-gain to determine the impact of learning on improving creative thinking skills after applying the CSDMS model, paired t-test was also carried out in a limited trial, and an independent t-test in a wide trial. The results show that there is no difference between the average n-gain of creative thinking skills in each university.

The effectiveness of the CSDMS model can be seen from the improvement of students' creative thinking skills through limited trials and extensive trials conducted at 3 universities (University of HKBP Nommensen Pematangsiantar, University of HKBP Nommensen Medan, and University of Darma Agung) in the Physics Education Study Program. Data on improving students' creative thinking skills were obtained by analyzing the n-gain of the pre-test and post-test scores on each indicator, namely: (1) fluency, (2) flexibility, (3) originality, (4) elaboration. Students' creative thinking skills have increased with high criteria. The CSDMS model provides a learning environment that allows students to be actively involved in developing creative thinking skills during the learning process. This is because the CSDMS model provides opportunities for students to improve the achievement of creative thinking skills which is reflected in the syntax.

b. Decision Making Skills

The effectiveness of the CSDMS model can be seen from the improvement of students' decision-making skills through limited trials and extensive trials conducted at 3 universities (University of HKBP Nommensen Pematangsiantar, University of HKBP Nommensen Medan, and University of Darma Agung) in the Physics Education Study Program. Data on improving students' decision-making skills were obtained by analyzing the n-gain of the pre-test and post-test scores on each indicator, namely: (1) Making questions; (2) collect information; (3) Determine options; (4) make a list of pros and cons; and (5) Making decisions. Students' decision-making skills have increased with moderate criteria. The CSDMS model provides a learning environment that allows students to be actively involved in developing decision-making skills during the learning process. This is because the CSDMS model provides opportunities for students to improve their decision-making skills, which is reflected in the syntax.

The application of the CSDMS model in limited trials and wide trials has an impact on improving students' decision-making skills. Learning with the CSDMS model is student-centered so that decision-making skills increase significantly. In addition to using n-gain to determine the impact of learning on improving decision-making skills after applying the CSDMS model, paired t-test was also carried out in a limited trial, and an independent t-test in a wide trial. The results show that there is no difference between the mean n-gain decision-making skills in each university.

CONCLUSION

The developed CSDMS model is effective, because: a) the average n-gain of creative thinking skills is at least at the high criteria; b) the average n-gain of decision-making skills is at least at the moderate criteria; c) consistent with the mean n-gain is not significantly different in each university with a significant level and d) very good student response to the learning process by applying the CSDMS learning model. The implication of the results of this study is that the application of the CSDMS model for creative thinking skills on the Flexibility indicator is still in the medium category, so further research needs to be carried out so that it is in the high category. The implications of the results of the research on the application of the CSDMS model for decision-making skills are still in the medium category, so further research is needed to be in the high category.

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