The application of fast feedback in discovery learning on the achievement of critical thinking ability reviewed from adversity quotient

Safira Aprillia Narumi*, Kartono

Department of Mathematics, Universitas Negeri Semarang, Sekaran, Gunung Pati, Semarang 50229, Indonesia

* E-mail address: narumisafira@gmail.com

Abstract

The objectives of this research were (1) to discover the effectiveness of discovery learning model with fast feedback towards the students' achievement of critical thinking abilities; and (2) to describe students' critical thinking abilities reviewed from adversity quotient. The research method and design used in this research was mix methods with sequential explanatory. The population of this research were 7th grade students of Junior High School 1 Semarang. Sampling for the experiment class and control class by means of cluster random sampling, and the selection of subjects using purposive sampling technique. The results showed that discovery learning with fast feedback was effective in achieving students' critical thinking abilities. The description of the subject's critical thinking abilities based on the adversity quotient showed that: (1) the climbers' subjects could master four indicators of critical thinking, namely interpretation, analysis, inference, and evaluation; (2) the campers-climbers' subjects could master two indicators of critical thinking, namely analysis and inference, and sufficiently master the indicators of interpretation and evaluation; and (3) the campers' subjects has sufficiently master two indicators of critical thinking, namely inference and evaluation, and has not mastered the indicators of interpretation and analysis.

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1. Introduction

In the 21st century, advances in science and technology are developing rapidly. This development requires humans to have knowledge and skills in order to compete globally. One of the factors that can increase knowledge and skills is education. One of the educational efforts that can improve students' knowledge and skills is through mathematics education. Mathematics is a basic science that used as a means to improve students' thinking abilities. In Decree of The Indonesian Minister of Education Number 22 in 2006, mathematics subjects need to give to all students starting from elementary schools to train students in thinking logically, analytically, systematically, critically, creatively and collaboratively.

This is in line with the skills that students must have in the 21st century, namely 4C skills (Collaboration, Communication, Creativity, and Critical thinking). Critical thinking is one of the 4 competencies that students need to have. So that critical thinking skills need to be developed by students at every level of education (NCTM, 2000: 202).

Ennis (2011: 1) said that critical thinking is the ability to make reasonable decisions about something what to believe or do. Seventika et al. (2018: 2) argued that critical thinking is the skill to review and analyze certain information, identify supporting evidence, identify and evaluate assumptions, apply various strategies to conclude based on assessment standards. In addition, Sulistiani & Masrukan (2015: 608) suggested that critical thinking is the ability to think rationally by gathering information to make a decision. Brookfield (2012: 14) explained that critical thinking is a habit to ensure that assumptions and

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actions carried out as desired. So that, critical thinking is not limited to understanding and mastering knowledge but habituation in overcoming a problem in real life. Perkins & Murphy (2006) suggested that critical thinking skills are often the goal or result of learning. Thus, learning in schools has planned to help students improve their critical thinking abilities.

Based on the results of the preliminary research test conducted at Junior High School 1 Semarang on critical thinking abilities, the average result of the preliminary research test consisting of 4 questions and followed by 64 students was 69.5. From the results of the preliminary research test, only about 50% achieved the minimum criteria of mastery learning, namely 68. One of the questions that requires critical thinking abilities given to students shown in Figure 1.

Figure 1. The Example of Critical Thinking Test Questions.

Next, the answers to questions displayed in Figure 1 from one of the students presented in Figure 2.
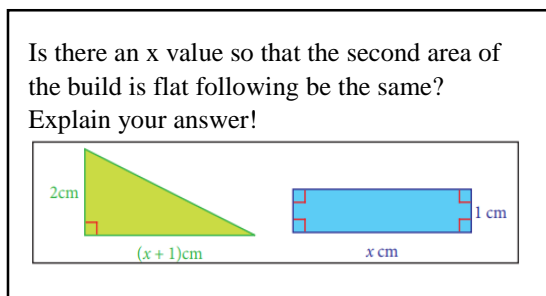
Figure 2. The Result of Student Work.

Figure 2 Shows that students cannot solve the question correctly and have not been able to provide an appropriate reason. Based on this explanation, students' critical thinking abilities in solving problems are still lacking so it needs to be improved again.

Improving the quality of learning is very necessary to improve students' critical thinking abilities, especially in mathematics subject. One of the efforts that can be made to improve students' critical thinking abilities is to create an effective learning process. The chosen learning model is discovery. Discovery learning is one of the learning models applied in the 2013 curriculum. Discovery learning model requires students to learn actively, so that learning is not only assessed by the learning outcomes, but also from the learning process.

Ismah & Sundi (2018: 163) said that discovery is a learning model in which students discover their own unknown knowledge with the teacher acting as a facilitator. The same opinion was expressed by Haeruman et al. (2017: 163) that teachers only act as mentors on the discovery learning model, while students actively conduct the learning process. In the learning process students are required to be able to find and then solve a problem so as to encourage students to build new knowledge of the problem. This is in line with the research of Nurrohmi et al. (2017: 1312) that discovery learning model had a significant effect on students' critical thinking abilities. Pratiwi (2014) argued that the discovery learning model can improve students' thinking abilities because students are trained to observe, ask, try, reason and communicate at each stage of discovery learning. The stage of discovery learning model according to Syah (2004: 244) were (1) stimulation (2) problem statement, (3) data collection, (4) data processing, (5) verification (proof), and (6) generalization (draw conclusions).

In addition to the right learning model, feedback is also needed that can help students understand the mistakes that have been made. Chen et al. (2010: 159) argued that providing feedback to students at the level of understanding the concept is important for effective learning. Feedback in the context of learning is defined as the interaction between teachers and students or students to other students with the aim of providing justification and explanation as one of verification for students. One of the efforts to provide feedback that can be done directly to students is fast feedback. According to Swari et al. (2019: 662) fast

feedback is a quick feedback given by the teacher at the end of each learning with the aim of students being able to complete the learning on the learning material immediately.

Alcantara et al. (2016) argued that fast feedback is done by providing several open-ended, conceptual, or problem-solving questions at the end of each lesson to estimate student understanding without spending a lot of time correcting students' work. So it is very appropriate to combine discovery learning model with fast feedback. In discovery learning model with fast feedback is done with learning according to the stage of discovery learning model and combined with fast feedback. Fast feedback is given to students individually or in groups after giving assignments by directly correcting common mistakes made by students.

In addition to the learning and feedback models, there are internal factors that determine the success of students' critical thinking abilities. This factor is adversity quotient. Adversity quotient is the intelligence possessed by students in turning obstacles into opportunities (Leonard, 2014: 55). Stoltz (2007: 18) divided the adversity quotient into 5 categories as follows (1) climbers, namely someone who has the ability to face tough challenges and continues to move forward, (2) campers-climbers, namely someone who may have survived enough challenges. challenges and take advantage of most of the potential that develops every day, (3) campers, namely someone who already has the ability to accept challenges but then stops because they feel they are no longer able, (4) quitters-campers, namely someone who does not take advantage of their potential in facing challenges, (5) quitters, namely someone who does not want to face challenges. The results of the research from Hidayat & Sari (2019: 247) showed that adversity quotient can have an influence on students' critical thinking abilities.

Based on the explanation, the formulation of the problem in this research are (1) what is the discovery learning model with fast feedback effective in achieving students' critical thinking abilities? (2) how is the description of students' critical thinking abilities in terms of adversity quotient on discovery learning model with fast feedback?

The objectives of this research were (1) to test the effectiveness of the discovery learning modelwith fast feedback effectiveon the achievement of students 'critical thinking abilities, and (2) to describe students' critical thinking abilities in reviewed from adversity quotient on discovery learning model with fast feedback.

In this research, indicators of critical thinking abilities refer to indicators of critical thinking according to Facione (2015: 5) with modifications. The indicators used to determine critical thinking abilities are shown in Table 1.

Table 1. The Indicators of Critical Thinking Abilities

Indicators	Information
Interpretation	Understand and express the meaning of the statement
Analysis	Identify the relationship between statements to solve the problem
Inference	Identify the statements needed to make logical conclusions
Evaluation	Assess the credibility of the statement

The proposed hypotheses were (1) the average score of students' critical thinking abilities through the application of the discovery learning model with fast feedback achieved the minimum criteria of mastery learning, namely 68; (2) students' critical thinking abilities through the application of discovery learning model with fast feedback achieved 75% classical completeness; (3) the average score of the students' critical thinking abilities test through the application of the discovery learning model with fast feedback is higher than the average score of the students' critical thinking abilities test through the application of the discovery learning model; and (4) the proportion of students who achieved the minimum criteria of mastery learning on critical thinking abilities test through the application of discovery learning models with fast feedback is higher than the proportion of students who achieved the minimum criteria of mastery learning on critical thinking abilities test through the application of discovery learning models.

2. Method

The research methods and design used in this research is a mix method with sequential explanatory, which was a quantitative research carried out first and then continued with qualitative research.

The population in this research was 7th grade students of Junior High School 1 Semarang with 288 students. Sampling for experiment class and control class conducted by cluster random sampling consisting of two class, each of which consist of 32 students. The determination of subjects in this research used purposive sampling techniques, namely selecting two research subjects from each category of adversity quotient.

The independent variables in this research was the discovery learning model with fast feedback in the experiment class, the discovery learning model in the control class, and the adversity quotient. While the dependent variable in this research was critical thinking abilities. The data collection methods used in this research were documentation, test, questionnaire, and interview.

The documentation method in this research carried out by collecting supporting data obtained from schools and researchers such as student lists, learning schedules, daily learning notes, and student work results. Then, the test method used in this research was written test method. The questions of critical thinking test validated by the validators and tested in the testing class. Testing the questions of critical thinking abilities aim to determine whether the question is valid or not. After testing, then carried out the calculation of validity, reliability, level of difficulty, and discrimination power of the items. The results of the critical thinking abilities test used to compare students' critical thinking abilities between control class and experiment class. The results of critical thinking abilities test used to compare students' critical thinking abilities between the experiment class and the control class.

The questionnaire method used to categorize the adversity quotient of students in the experiment class. In this research, the questionnaire adopted from the questionnaire from Wulandari (2019). The questionnaire used in this research consisted of 20 cases where each case consisted of 2 statements. Each item statement on the scale developed according to the grid that made and guided by the adversity quotient dimension, namely $CO_2 RE$.

According to Stoltz (2007: 131), the level of adversity quotient determined by the Adversity Response Profile (ARP) and the grouping adversity quotient based on the results of the CO_2RE.

$$ARP = (C + O_2 + R + E)$$

Information:
C   : total score of control
O_2 : total score of origin and ownership
R   : total score of reach
E   : total score of endurance

Categorization of adversity quotient student according to Stoltz (2007: 139) is presented in Table 3.

Table 2. The Category of Adversity Quotient

Category	Score
Climbers	166-200
Campers-Climbers	135-165
Campers	95-134
Quitters-Campers	60-94
Quitters	0-59

The interview method used in this study was an unstructured interview to deepen into the critical thinking abilities of research subjects. The interview conducted after obtaining the results of students' critical thinking abilities test and the guidelines used in this study was only an outline of the questionable problem.

Quantitative data analysis technique in this research was analysis on the test results of critical thinking abilities using the average tests and the proportion tests. The analysis conducted to test the effectiveness of discovery learning in achieving students' critical thinking abilities. Meanwhile, the qualitative data analysis technique in this research was an analysis of the results of the adversity quotient questionnaire by

selecting 2 subjects for each category of adversity quotient contained in the experiment class. Interviews conducted to strengthen quantitative data related to critical thinking abilities. The results of tests and interviews from research subjects used to obtain descriptions of subjects' critical thinking abilities reviewed from adversity quotient in discovery learning with fast feedback.

3. Results & Discussions

3.1. Effectiveness of the Discovery Learning Model with Fast Feedback on the Achievement of Critical Thinking Ability

The results of this critical thinking abilities test used for final data analysis. The data on the value of students' critical thinking abilities from the two research classes are shown in Table 3.

Table 3. The Results of Critical Thinking Abilities Test

Class	N	Average	Standard Deviation
Experiment	32	79,69	16,13938
Control	32	70,66	18,06299

Before testing the hypothesis, with the help of software SPSS 22.0, one sample normality test was performed, two sample normality test, and a homogeneity test were performed first. For the normality test of one sample that is in the experiment class obtained $\text{sig.} = 0.108 > 0.05$, then H_0 accepted. This means that the results of critical thinking abilities test in the experiment class was normally distributed. Then, the two-sample normality test obtained $\text{sig.} = 0.178 > 0.05$, then H_0 accepted. This means that the results of critical thinking abilities test in the experiment class and control class was normally distributed. Meanwhile, for the homogeneity test, the value obtained $\text{sig.} = 0.147 > 0.05$, then H_0 accepted. This means that the variance of the experiment class and control class was homogeneous. Based on this, for analysis and further calculations in this research was using parametric statistics.

The hypotheses tests conducted include (1) one-sample average test, (2) one-sample proportion test, (3) two-sample average difference test, and (4) two-sample proportion difference test. Hypothesis 1 test used to determine whether the average critical thinking abilities of students in the experiment class more than or equal to the minimum criteria of mastery learning, namely 68. Based on calculations with $\alpha = 5\%$ and $dk = 32 - 1 = 31$, it is obtained $t_{count} = 3,03 \geq t_{table} = 1.69$, then H_0 rejected. So, the average score of students' critical thinking abilities test in the experiment class more than 68. Then, hypothesis 2 test used to find out that the proportion of students' critical thinking abilities test results in the experiment class more than or equal to 75%. Based on the calculation, with $\alpha = 5\%$ and odds of $0.5 - 0.05 = 0.45$, it was obtained that $z_{count} = 2.09 \geq z_{table} = 1.645$, then H_0 rejected. So, the proportion of students whose critical thinking abilities test scores have reached the minimum criteria of mastery learning in the experiment class more than 75%. Based on the results of hypothesis 1 and hypothesis 2, it can be concluded that the application of the discovery learning model with fast feedback achieves learning completeness. This is in accordance with the opinion of Masrukan (2014: 17) that the criteria for learning completeness include completing individually and completing classically.

Hypothesis 3 test used to determine the average difference between the students' critical thinking abilities test scores between the experiment class and the control class. Based on calculations with $\alpha = 5\%$, $dk = 32 + 32 - 2 = 62$ and odds of $1 - 0.05 = 0.975$ on the t distribution list, it is obtained that $t_{count} = 2.049 \geq t_{table} = 1.669$, then H_0 rejected. So, the average score of students' critical thinking abilities test in the experiment class more than the average test results of students' critical thinking abilities in the control class. Furthermore, hypothesis 4 test used to determine the difference in proportions between the experiment class and the control class. Based on calculations with $\alpha = 5\%$, $dk = 32 - 1 = 31$ and odds of $0.5 - 0.05 = 0.45$ in the standard normal distribution list, it is obtained that $z_{count} = 2.54 > z_{table} = 1.645$, then H_0 rejected. So, the proportion of students who passed the critical thinking abilities test in the experiment class more than the proportion of students who passed the critical thinking ability test in the control class.

Based on the description before, it can be said that the discovery learning model with fast feedback is effective in achieving students' critical thinking abilities. This is supported by the research of Haris et al.

(2015), Haeruman et al. (2017), and Mukarromah & Sartono (2018) which showed that the discovery learning model can improved students' critical thinking abilities. According to Naimnule (2020) the feedback is one of the important things that must be given in learning. Dann (2019) also argued that the feedback is a useful activity to improve the quality of learning. Feedback can help students find out the mistakes made, and preventing the same mistakes in the next material. In addition, Arifin et al. (2020) argued that feedback is not only beneficial for students, but also useful for teachers as a correction in transferring knowledge. Thus, the addition of fast feedback to the discovery learning model also affects the achievement of students' critical thinking abilities.

3.2. *Description of Crtical Thinking Abilities Reviewed from Adversity Quotient*

Based on a adversity quotient questionnaire that distributed to 32 students of experiment class, it was known that there are only three categories of adversity quotient, namely climbers, campers-climbers, and campers with the distribution of critical thinking abilities test results as shown in Table 4.

Table 4. The Category of Adversity Quotient Students and The Spread of Critical thinking Abilities Test Result

Climbers		Campers - Climbers		Campers	
Code	Value	Code	Value	Code	Value
E – 06	100			E – 05	100
E – 15	100				
		E – 10	97	E – 30	97
		E – 21	95	E – 26	95
				E – 27	95
E – 01	92				
		E – 07	87	E – 11	87
				E – 19	87
				E – 02	84
				E – 31	84
E – 03	82	E – 23	82	E – 18	82
				E – 24	82
				E – 04	76
		E – 25	74	E – 16	76
		E – 29	71	E – 12	74
				E – 13	71
				E – 17	71
		E – 09	68	E – 32	71
		E – 20	68		
				E – 22	42
				E – 28	42
		E – 25	74	E – 08	39

Based on the table 4, the climbers' students did not necessarily have a higher critical thinking abilities test result than the campers-climbers' student and campers' students. Likewise, campers-climbers' students did not necessarily have higher results than campers' students.

The description of students' critical thinking abilities based on the category of adversity quotient carried out by analyzing the results of the critical thinking abilities test and the results of interviews conducted on research subjects. The research subjects selected as shown in Table 5.

Table 5. Selection of Research Subjects based on Adversity Quotient

Category	Subject
Climbers	E – 06
	E – 15
Campers-Climbers	E – 10
	E – 21
Campers	E – 08
	E – 22

3.2.1 Critical Thinking Abilities of Students with Adversity Quotient Climbers
Research subjects selected based on the adversity quotient climbers' category were subjects E - 06 and E - 15.

Based on the research results, it was obtained information that on interpretation indicators, both subjects were able to understand and express the questions correctly. besides that both subjects can also do calculations accurately, and can provide logical reasons about what soap should be purchased based on the calculations on the answers given. Both subjects also had no difficulty in working on the questions.

In the analysis indicator, both subjects were able to identify the relationship between the information known in the questions. Both subjects were able to explain each step of the completion correctly, precisely, and smoothly. Even though subject E - 06 admitted to having difficulties, finally the subject was able to solve it correctly.

In the inference indicator, both subjects were able to identify information that is known in the questions to draw true or false conclusions based on the questions given, and are able to explain the reasons why the conclusions are right or wrong.

In the evaluation indicators, both subjects were able to identify all the information in the questions to provide an assessment and be able to explain the steps for completion and give conclusions and reasons correctly and smoothly. Both subjects worked on the problem in a coherent and clear solution.

Based on this, the subject with the adversity quotient for the climbers' category could master four indicators of critical thinking, namely interpretation, analysis, inference, and evaluation. Subjects can complete answers properly and correctly and according to the concepts that have been taught. Fauziah et al. (2013) argued that students with the adversity quotient for the category climbers always tried to get maximum results by facing various difficulties. In addition, according to Darojat & Kartono (2016) the persistence and abilities of climbers' students to persist in facing problems are the basic things that cause climbers' students to be able to solve problems properly and correctly and can provide the right reasons. In addition, according to Yanti & Syazali (2016) that students with adversity quotient the category climbers tend to work on math problems conceptually. This is evident from how students climbers solve the questions given according to the concepts taught.

3.2.2 Critical Thinking Abilities of Students with Adversity Quotient Campers-Climbers
Research subject selected based on the adversity quotient campers-climbers' category were E - 10 and E - 21.

Based on the research results, it was obtained information that on interpretation indicators, both subjects are quite capable of understanding and expressing matter correctly, besides that both subjects can also do the calculations correctly, but both subjects still cannot give reasons on the answer sheet but can explain the reasons in the interview session. Both subjects did not find it difficult to work on the problem because they thought the problem was easy.

In the analysis indicator, both subjects were able to identify the relationship between the information known in the questions to solve the problem and were able to explain the completion process correctly and smoothly. Both subjects were able to solve the problem and use the correct steps to solve it even

though the E - 10 subject was still not coherent. Both subjects were also able to smoothly explain the completion process.

In the inference indicator, both subjects were able to identify known information in the questions to draw true or false conclusions based on the questions given. Both subjects were also able to smoothly explain the reasons why their conclusions were right or wrong.

In the evaluation indicators, both subjects were quite able to identify all the information in the questions to provide an assessment and were able to explain the steps for completion and give conclusions and provide reasons correctly and smoothly, but in the process of working on the E - 10 subject questions, the answers were still not clearly detailed.

Based on this, the subject with the adversity quotient in the campers-climbers' category could master two indicators of critical thinking, namely analysis and inference, and sufficiently mastered the indicators of interpretation and evaluation. Subjects were able to solve problems properly and correctly. Subjects include students who are willing to try to get maximum results even though sometimes they feel less enthusiastic in facing difficulties. This is also in line with the opinion of Sabiila et al. (2019) where the campers-climbers' students were not very satisfied with the results achieved and had the confidence that they could achieve maximum results. Campers-climbers may be sufficiently able to withstand adversity by exploiting their potential to continue to thrive.

3.2.3 Critical Thinking Abilities of Students with Adversity Quotient Campers
Research subject selected based on the adversity quotient campers' category were E-08 and E-22.

Based on the research results, it was obtained information that on interpretation indicators, both subjects have not been able to understand and express the problem correctly, in addition both subjects were also perform calculations incorrectly. Both subjects were also unable to explain how the completion process was correct. Both subjects also considered the questions given as difficult so they were not sure the answer was correct.

In the analysis indicator, both subjects have not been able to identify the relationship between the information known in the problem solving problems, subject E - 08 is still wrong in doing calculations, while subject E - 22 is still wrong in the concept. Both subjects were also unable to explain how the completion process was correct. Both subjects also considered the questions given as difficult.

In the inference indicator, both subjects were sufficiently able to identify the information that was known in the questions to draw right or wrong conclusions based on the questions that given, both subjects were quite capable of performing calculations and using settlement steps. Both subjects considered the questions given to be quite difficult and could be proven from how to answer both subjects.

In the evaluation indicators, both subjects were quite able to identify all the information in the questions, subject E - 22 worked on the questions quite correctly but still lacked a number of completion steps and was sufficiently able to explain the completion process smoothly, while subject E - 08 did the questions incorrectly and could not explain the completion process properly.

Based on this, the subjects with adversity quotient for the campers' category have enough to master two indicators of critical thinking, namely inference and evaluation, and have not mastered indicators of interpretation and analysis. The subject has not been able to understand the concept in working on the problem. This is in line with the opinion of Yanti & Syazali (2016) where campers tend to think semi-conceptually. According to Nafi'an (2016) semi-conceptual thinking is a way of thinking of students in solving problems by using concepts that have been learned but not fully complete. Some of the campers' students also did not try to overcome difficulties in solving problems. Sudarman (2012) said that campers' students did not try their best to take advantage of their abilities, they feel quite happy with what they were doing.

4. Conclusion

Based on the results conducted by the researcher, it was obtained concluded that the discovery learning model with fast feedback is effective in achieving students' critical thinking abilities in mathematics based on four indicators of critical thinking, namely (1) interpretation, (2) analysis, (3) inference, and (4) evaluation. The description of the subjects' critical thinking abilities based on the adversity quotient showed that (1) the climbers' subjects could master four indicators of critical thinking, namely interpretation, analysis, inference, and evaluation; (2) the campers-climbers' subjects could master two indicators of critical thinking, namely analysis and inference, and sufficiently master the indicators of interpretation and evaluation; and (3) the campers' subjects has sufficiently master two indicators of critical thinking, namely inference and evaluation, and has not master the indicators of interpretation and analysis. Overall, the critical thinking abilities of students based on adversity quotient and test results of students' critical thinking abilities, climbers' student did not necessarily have better critical thinking abilities than the campers-climbers' student and campers' students. Likewise, campers-climbers' student did not necessarily have better critical thinking abilities than campers' students.

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