



## Student's Creative Thinking Skill and Belief in Mathematics in Setting Challenge Based Learning Viewed by Adversity Quotient

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### Abstract

Creativity, belief in math, and adversity quotient play a significant role in mathematics. This study aims (1) to know the quality of mathematics learning settings Challenge Based Learning on student's creative thinking skill and belief in math; (2) to examine the influence of belief in math to creative thinking skill; (3) to describe student's creative thinking skill in settings Challenge Based Learning viewed by Adversity Quotient; and (4) to describe student's belief in math in settings Challenge Based Learning viewed by Adversity Quotient. The design of this study was mixed methods of concurrent embedded type. The study subjects were students of SMP Negeri 1 Semarang grade VIII who selected by Adversity Quotient. The result showed that (1) mathematics learning setting Challenge Based Learning is qualified to student's creative thinking skill and belief in math; (2) there was the influence of belief in math to student's creative thinking skill amount 12,8%; (3) camper's students were only able to satisfy flexibility and climber's students were able to satisfy fluency, flexibility, and novelty; and (4) there was a camper's students was able to satisfy belief about self and climber's students were able to satisfy belief about mathematics education, belief about the self, and belief about the social context.

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## INTRODUCTION

The main focus of the development of mathematics learning in the present era is the development of thinking and working mathematically (Zevenbergen, Dole, & Wright, 2004). Mathematics has significance for thinking, seeing, and organizing the world because mathematics is a science that can develop an attitude of creative thinking that is the goal in learning mathematics (Hudojo, 2003; Suherman et al., 2003; Zevenbergen, Dole, & Wright, 2004). Junaedi & Asikin (2012) explains that learning mathematics needs to be designed in such a way as to encourage students to have mathematical skills, such as understanding, communication, connection, reasoning, and mathematical problem solving.

Creativity is a complex concept considered by various scholars from different points of view (Leikin & Lev, 2013). Creativity is one of the mathematical perspectives of the constructivist as one of the important mechanical activities in constructing new knowledge of students (Akgul & Kahveci, 2016; Zevenbergen, Dole, & Wright, 2004). Creativity in mathematics may be characterized in several ways such as employing non algorithmic decision making, divergent and flexible thinking which allows one to pursue many different avenues and perspectives in solving a problem (Levenson, 2015). The main components to assess mathematical creativity considered by flexibility, fluency and novelty which is the main components in The Torrance Test of Creative Thinking (Yazgan-Sag & Emre-Akdogan, 2016; Silver, 1997). Levenson (2016) mentioned that fluency may be measured as the total number of unduplicated ideas generated by students, flexibility may be evaluated by establishing if different solutions employ strategies based on different representations, properties, or branches of mathematics, while the novelty of a solution based on its level of insight and conventionality according to the learning history of the participants. Creativity is an invaluable and essential skills on this 21st, and plays a significant role in mathematics (Akgul & Kahveci, 2016; Fatah, Suryadi, Sabandar & Turmudi, 2016; Yazgan-Sag & Emre-Akdogan, 2016). Creativity put the highest cognitive level in Bloom's Taxonomy that is Create and in its development, creative thinking, critical thinking, problem solving, and mathematical

reasoning can develop into higher-order thinking skills (Rajendra, 2008; Thompson, 2008).

Both of affective and cognitive factors play a role in learning and they both must be explored to improve knowledge of mathematics (McDonough & Sullivan, 2014). One of the affective aspects that can be applied in mathematics learning is belief in mathematics because it influences their perspective in mathematics and mathematics learning, as well as student participation in mathematics learning and their way of solving problems (Markovits & Forgasz, 2017; Pongsakdi et al., 2017). Op 't Eynde, De Corte, & Verschaffel (2002) defined beliefs as subjective conceptions that students regard as true, and they classified student beliefs into three categories: (1) beliefs about mathematics, mathematical learning and problem solving, and mathematics teaching; (2) beliefs about the self in relation to mathematics; and (3) beliefs about social norms in class. Mutodi & Ngirande (2014) added that beliefs in mathematics is one of the factors that have a strong influence on student performance in mathematics in selected high schools in Polokwane, South Africa.

Mathematics learning should use methods and strategies that involve students actively learning in order to develop creative learning goals (Suherman et al., 2003). Rochmad & Masrukan (2016) added the main support in the success of classroom teaching because teacher uses appropriate and varied teaching models, and also do good teaching and give good questioning. Therefore it is necessary to do the mathematics learning that its qualified. According to Uno (2007) the quality of learning is defined as all things that to do in mathematics learning should lead to something better. Nieveen states to assess the quality of the learning model there are three aspects, namely validity, practicality, and effectiveness (Hobri, 2010).

Challenge Based Learning can be described as a special form of problem-based learning where the problem is realistic and natural (Johnson & Adams, 2011). Nichols, Cator & Torres (2016) mentioned this framework is collaborative and direct, asking all participants (students and teachers) to identify Big Idea, ask Good Question, find and resolve challenges, gain deep knowledge, develop 21st century skills, and share their thoughts with the world. This lesson aims to help students find ways to present and or solve

problems with the steps 1) The Big Idea; (2) Essential Question; (3) The Challenge: Guiding Questions, Guiding Activities, and Guiding Resources; (4) Solution - Action; and (5) Assessment: Publishing Student Samples and Reflection (Yoosomboon & Wannapiroon, 2015).

Waluya (2012) states that the success of a person is not only determined by knowledge and technical ability, but more determined by ability to manage oneself and others. Adversity Quotient (AQ) is one of the things that need to be considered to determine the success of a person, especially the success of students in learning mathematics. AQ is an overcoming intelligence that plays an important role in student life to face challenges (Nikam & Uplane, 2013; Parvathy & Praseeda, 2014; Stoltz, 2000). According to Nikam & Uplane (2013), AQ has four components: control (C), origin and ownership (O<sub>2</sub>), reach (R), dan endurance (E). The four components are the determinants of AQ levels that are divided into three types namely, quitter's students or children who try to stay away from problems, camper's students or children who do not want to take risks that are too big and feel satisfied with the conditions or circumstances that have been achieved at this time, and climber's students or children having a purpose or target (Sari, Sutopo, & Aryuna, 2016; Stolz, 2000).

**Table 1.** Preliminary Study Results on the Creative Thinking Skill and Belief in Mathematics Students

Class	Average of		in
	Creative Thinking Skill	Belief in Mathematics	
VIII E	62.94	70.53	
VIII F	41.06	70.43	
VIII G	62.83	68.19	
VIII H	52.86	74.64	
VIII I	54.42	72.22	
Total	54.90	71.21	

Preliminary studies was done by providing an early test of creative thinking skill and questionnaires of belief in mathematics in 5 class in SMP Negeri 1 Semarang grade VIII. The results of preliminary study mentioned that the average value of creative thinking skill and belief in mathematics of students is still considered not good. The result of interview with

teacher of mathematics subjects in SMP Negeri 1 Semarang revealed that the teacher has never done learning mathematics setting Challenge Based Learning and attend the creative thinking skill and affective aspects of students such as belief in mathematics and Adversity Quotient.

Based on the description before, the purpose of this study are (1) to know the quality of mathematics learning settings Challenge Based Learning on student's creative thinking skill and belief in mathematics; (2) to examine the influence of belief in mathematics to student's creative thinking skill; (3) to describe student's creative thinking skill in settings Challenge Based Learning viewed by Adversity Quotient; and (4) to describe student's belief in mathematics in settings Challenge Based Learning viewed by Adversity Quotient. The research focused on mathematics learning setting Challenge Based Learning with material is the volume of flat side space.

## METODE

The design of this study was mix methods of concurrent embedded type. Quasi experiment was used in quantitative research. Study was started with preliminary study, quantitative and qualitative data collection, and data analysis and interpretation. The study was conducted at SMP Negeri 1 Semarang in April – Mei 2018 with the study population were students grade VIII on 2017/2018 academic year. From 5 classes, 1 class was chosen as an experimental class with math learning setting Challenge Based Learning and 1 class was chosen as a control class with cooperative model.

The research's subjects were chosen based on Adversity Quotient. Adversity Quotient Questionnaire adopted by Adversity Response Profile (ARP) that has been developed by Stolz (2000). Grouping Adversity Quotient also adopted by Stolz (2000). The result of the grouping Adversity Quotient and the selected subjects in this research as follows.

**Table 2.** Grouping Student by Adversity Quotient

Category	AQ Score	The Number of Students	Percentage
<i>Camper</i>	59 – 134	21	58.33%
<i>Climber</i>	134 – 200	15	41.67%

**Table 3.** Data of Selected Subjects

Student Code	Category	Gender
E002	Climber	Man
E004	Camper	Woman
E019	Climber	Woman
E032	Camper	Woman

Data collection techniques in this research were tests, questionnaires, observations, interviews, and validation. Data analysis in this research included qualitative data analysis by using qualitative criteria, data reduction, data presentation, and conclusion drawing; and quantitative data analysis by using hypothesis testing. The quality of mathematics learning setting Challenge Based Learning was analyzed based on the preparation stage by looking at the results of the validation of learning instrument; the implementation stage by looking at the results of the implementation of mathematics learning setting Challenge Based Learning (teacher and students activity); and the evaluation stage by looking at the results of the hypothesis testing using t test and z test. The influence of belief in math to creative thinking skill was analyzed by using linear regression test. The description of student’s creative thinking skill and belief in math viewed by Adversity Quotient were analyzed by triangulation technique by comparing the result of creative thinking skill test (CTST) and the result of interview.

The creative thinking skill test (CTST) was developed by adopted Multiple Solution Task which is developed by Levav-Waynberg & Leikin (2012). The questionnaire of belief in math was developed by adopted Mathematics-Related Belief Questionnaire (MRBQ) which is developed by Physick (2010). The guidelines achievement of creative thinking skill indicators and belief in math indicators as follows.

**Table 4.** The Guidelines Achievement of Creative Thinking Skill Indicators

	Average Score	Information
Fluency (Fa)	$Fa < 4$	Not Satisfy
	$Fa \geq 4$	Satisfy
Flexibility (Fl)	$Fl < 20$	Not Satisfy
	$Fl \geq 20$	Satisfy
Novelty (No)	$Ba < 10$	Not Satisfy
	$Ba \geq 10$	Satisfy

**Table 5.** The Guidelines Achievement of Belief in Mathematics Indicators

Indicator	Average Score	Information
1	$p_1 < 75\%$	Not Satisfy
	$p_1 \geq 75\%$	Satisfy
2	$p_2 < 75\%$	Not Satisfy
	$p_2 \geq 75\%$	Satisfy
3	$p_3 < 75\%$	Not Satisfy
	$p_3 \geq 75\%$	Satisfy

**RESULTS AND DISCUSSION**

**The Quality of Mathematics Learning Setting Challenge Based Learning**

In the preparation stage, has done assessment of learning instruments validation. The learning instruments were said to be valid if the final result of learning instruments get score range 4.20 – 5.00 with very good criteria. The final result of preparation stage showed that the learning instruments validation score is 4,38 with very good criteria. The validation results for each learning instrument also showed with very good criteria with score range 4.25 – 4.60. The results mentioned that learning mathematics setting Challenge Based Learning instruments were validated with very good criteria. Thus the learning mathematics setting Challenge Based Learning instruments is feasible to be used in this study to obtain the description of student’s creative thinking skill and belief in math viewed by Adversity Quotient.

**Table 6.** Recapitulation of the Learning Instruments Validation Result

Learning Instruments	Validation Results	Final Result
Syllabus	4.56	
Lesson Plan	4.36	
Creative Thinking Skill Initial Test	4.31	
Creative Thinking Skill Test	4.39	
Adversity Quotient	4.33	
Questionnaire Belief in Mathematics	4.42	4.38
Interview Guidelines of Creative Thinking Skill	4.29	
Interview Guidelines of Belief in Mathematics	4.38	

**Table 7.** Final Results of Implementation Mathematics Learning Setting Challenge Based Learning

	Final Result	Criteria
Teacher Activity	81.25	Very Good
Student Activity	78.75	Very Good
Average	80.00	Very Good

In the implementation stage, has done assessment of learning implementation which is seen by teacher and student activity on mathematics learning setting Challenge Based Learning. Mathematics learning was said to be done very well if the result in range of score 76 – 100. The final result of implementation stage get score 80 with very good criteria. The observation result of teacher and student activity also get score 78 and 82 with very good criteria. The result showed that mathematics learning setting Challenge Based Learning has done with very good criteria. Thus the mathematics learning setting Challenge Based Learning can seek the activities to obtain the description of student’s creative thinking

skill and belief in math viewed by Adversity Quotient.

In the evaluation stage, has done assessment of learning effectiveness test. The learning effectiveness in this study referred by the completeness of classical learning, the average completeness, and the mean difference between the average of students score on the experimental class is more than the average of students score on the control class. The results obtained that (1) mathematics learning setting Challenge Based Learning was completely classical to creative thinking skill and belief in math, (2) mathematics learning setting Challenge Based Learning was completely average to creative thinking skill and belief in math, and (3) average of creative thinking skill and belief in math on mathematics learning setting Challenge Based Learning was more than average of creative thinking skill and belief in math on mathematics learning by using cooperative learning model. Thus mathematics learning setting Challenge Based Learning is effective on creative thinking skill and belief in math.

Other research on the implementation Challenge Based Learning (CBL) were revealed by some of the following researchers. Junita (2016) mentioned the achievement and improvement of student’s creative problem solving skill who learn with CBL approach was more than student’s creative problem solving skill who learn with scientific approach. Supatmo (2011) also revealed that CBL approach can significantly improve student’s creative thinking skill. Challenge Based Learning is effective to produce students with vocational competence, soft skills, problem solving, and motivation in vocational school, cybersecurity learning, and engineering academic (Cheung, Cohen, Lo, & Elia, 2011; Cirenza, Diller, & Williams, 2015; Jou, Hung, & Lai, 2010; Kukreti, et al, 2015; Lovell & Brophy, 2014; Malmqvist, Rådberg. & Lundqvist, 2015; Tajuddin & Jailani, 2013). Challenge Based Learning is also improve student’s professionalism, entrepreneurship skill and ability for design, management, and computer engineering students (Hassi, et al, 2016). The teacher’s challenge can encourage students to thinking creatively with trying to generate a new ideas, experience, failure, and feedback on spatial learning (Johnson, Smith, Smythe, & Varon, 2009; Nichols, Cator & Torres, 2016). In order to

developing solution, students also can be encouraged creative thinking in designing solution (Johnson & Adams, 2011; Nichols, Cator & Torres, 2016). Students self-confidence and belief increase as an outcome for Challenge Based Learning (Johnson & Adams, 2011; Nichols, Cator & Torres, 2016). Developing some of the student’s ability and skills in Challenge Based Learning are also the outcome from this learning such as creative thinking skill, self-productivity, self-responsibility, and self-direction (Johnson, Smith, Smythe, & Varon, 2009; Johnson & Adams, 2011).

Based on the results, where in the preparation stage was obtained a valid instruments of mathematics learning setting Challenge Based Learning with very good category on student’s creative thinking skills and belief in math, in the implementation stage was obtained the implementation of mathematics learning setting Challenge Based Learning with very good category on student’s creative thinking skills and belief in math, and in the evaluation stage was obtained the effectiveness of mathematics learning setting Challenge Based Learning with very good category on student’s creative thinking skills and belief in math. Thus the mathematics learning setting Challenge Based Learning was qualified on student’s creative thinking skills and belief in math.

**The Influence Belief in Mathematics on Creative Thinking Skill**

**Table 8.** Result of Regression Output Table Coefficients

		Coefficients <sup>a</sup>			T	Sig.
Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta		
1	(Constant)	49.189	15.486		3.176	.003
	Data BMath Pengaruh	.458	.210	.350	2.182	.036

Dependent Variable: Data Kreatif Pengaruh

**Tabel 9.** Result of Regression Output Table ANOVA

		ANOVA <sup>b</sup>				
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	357.105	1	357.105	4.672	.036 <sup>a</sup>
	Residual	2549.895	34	74.997		
	Total	2907.000	35			

a. Predictors: (Constant), Data BMath Pengaruh

b. Dependent Variable: Data Kreatif Pengaruh

**Tabel 10.** Result of Regression Output Table Model Summary

Model Summary <sup>b</sup>				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.350 <sup>a</sup>	.123	.097	8.660

a. Predictors: (Constant), Data BMath Pengaruh

b. Dependent Variable: Data Kreatif Pengaruh

Based on result of regression output in table 8, we get the result that the regression equation is  $Y = 0,458X + 49,189$  where independent variable that is belief in mathematics and dependent variable that is creative thinking skill. The result of regression output in table 9 showed linearity result of obtained regression equation. These result revealed that there was an influence belief in mathematics on creative thinking skill. The result of regression output in table 10 showed the value of  $R = 0,35 = 35\%$  and  $R^2 = 0,123 = 12,3\%$ . These result revealed that there was an influence belief in mathematics on creative thinking skill amount 12,3%.

The test of influence of belief in math variable has done by Mutodi & Ngirande (2014) at selecter Junior High School in Polokwani, South Africa. In this research, there were seven variables to determine the influence of these variables on students performance in mathematics. Belief in math placed itself at the high position among these variables to get the contribution on students performance in mathematics. McLeod said many students argue that a good belief in math is the important thing to develop skills and good self-control of mathematics (Mutodi & Ngirande, 2014). Belief in math give influence about the student’s alternative to give their perceptions about mathematics, mathematics learning, and their alternative to solve mathematics problem (Markovits & Forgasz, 2017; Pongsakdi, et al., 2017). This result strengthened researcher about the influence belief in mathematics on creative thinking skill.

Other finding in this study showed that the influence belief in mathematics on creative thinking skill only 12,3%. These result allow other variables to give stongly influence on student’s creative thinking skill. The possibility variables that can give influence on student’s creative thinking skill are the other variables that have a stong positive influence on

student's performance in mathematics which are (1) strengheness and weakness in mathematics, (2) family support and background, (3), interest in mathematics, and (4) self-confidence in mathematics (Mutodi & Ngirande, 2014).

### **The Description Student's Creative Thinking Skills viewed by Adversity Quotient**

To get the result of the description student's creative thinking skills viewed by Adversity Quotient, reseacher has done the activity of creative thinking skills test (CTST) and interview based on fluency, flexibility, and novelty. Based on the result of CTST analysis and interview, also data triangulation for each subjek, the result of the description student's creative thinking skills viewed by Adversity Quotient as follows.

The analysis result of description student's creative thinking skills for camper's student showed that the subject of E004 was identified can satisfy flexibility and the subject of E019 was identified can satisfy flexibility too. Thus it can be concluded that camper's student were only able to satisfy flexibility. These result were in line with Suhandoyo & Wijayanto (2016) that showed the profil of creative thinking skills for camper's student were only able to show flexibility component in solving higher order thinking test. These result has enricherd the characteristics of camper's student which are have characteristics as a children who are interest whith problem and challenge, but don't want to take too much risk and satisfy with the conditions that have been achieved (Sari, Sutopo, & Aryuna, 2016; Sudarman, 2012, Stolz, 2000). Floresta, et al. (2015) added the characteristics of leveling Adversity Quotient for students that have avarage math capability in solving mathematics problem based on Wallas stage were camper's student.

The analysis result of description student's creative thinking skills for climber's student showed that the subject of E002 was identified can satisfy fluency, flexibility, and novelty and the subject of E032 was identified can satisfy fluency, flexibility, and novelty too. Thus it can be concluded that climber's student were able to satisfy fluency, flexibility, and novelty. These result were in line with Suhandoyo & Wijayanto (2016) that showed the profil of creative thinking skills for climber's student

were only able to show fluency and flexibility component in solving higher order thinking test. However, it was found the difference where in this study climber's student have statisfied novelty, while the research result of Suhandoyo & Wijayanto (2016) showed that climber's student have not statisfied novelty component in solving higher order thinking test. These result has enricherd the characteristics of climber's student which are have characteristics as a children who have goal, target, and also preseverance and persistence (Sari, Sutopo, & Aryuna, 2016; Sudarman, 2012, Stolz, 2000). Floresta, et al. (2015) added the characteristics of leveling Adversity Quotient for students that have high math capability in solving mathematics problem based on Wallas stage were climber's student.

Other findings showed that climber's student had more preseverance and persistence in solving problem until the end. Both subject had a desire to improve the answer by recalculating nad re-checking the formula that was used in solving problem. These findings were in line with other result which revealed climber's student are more preseverance and persistence than camper's student in solving problem (Darojat & Kartono, 2016; Floresta, et al., 2015).

### **The Description Belief in Mathematics viewed by Adversity Quotient**

To get the result of the description student's belief in mathematics viewed by Adversity Quotient, reseacher has done the activity of belief in mathematics questionnaire and interview based on belief about mathematics, belief about self, and belief about the social context. Based on the result of belief in mathematics questionnaire analysis and interview, also data triangulation for each subjek, the result of the description student's belief in mathematics viewed by Adversity Quotient as follows.

The analysis result of description student's belief in mathematics for camper's student showed that the subject of E004 was identified can satisfy belief about self, while the subject of E019 was not identified can satisfy one of the indicators of belief in mathematics. Both subject showed the differences the achievement of indicators of belief in mathematics. Thus it can be concluded that there was camper's student who only able to satisfy belief about self. These difference result was due the subject of E019

was not satisfy belief about self both on the result of belief in mathematics questionnaire and the result of interview. The subject of E004 previously was not satisfy belief about self on the result of belief in mathematics questionnaire, but the result of interview revealed that the subject of E004 could showed her belief about self-efficacy, task value, and goal-orientation. These result revealed the achievement of belief about self for the subject of E004.

The analysis result of description student's belief in mathematics for climber's student showed that the subject of E002 was identified can satisfy belief about mathematics, belief about self, and belief about the social context and the subject of E032 was identified can satisfy belief about mathematics, belief about self, and belief about the social context too. Both subject showed the simmilarity of the achievement for all indicators of belief in mathematics. Thus it can be concluded that climber's student were able to satisfy belief about mathematics, belief about self, and belief about the social context. These results had simmilarity of the achievement of belief in mathematics with other research. These results revealed that climber's student satisfy all indicators of belief in mathematics. These results were in line with Darojat & Kartono (2016) who revealed that climber's student reach all indicators of NCTM-problem solving.

## CONCLUSION

Based on results and discussion, it can be concluded that matematics learning setting Challenge Based Learning was qualified on student's creative thinking skill and belief in mathematics; (2) there was the influence of belief in mathemtics to student's creative thinking skill amount 12,8%; (3) camper's students were only able to satisfy flexibility and climber's students were able to satisfy fluency, flexibility, and novelty; and (4) there was camper's students was able to satisfy belief about self and climber's students were able to satisfy belief about mathematics education, belief about the self, and belief about the social context.

Based on results, researcher consider to suggest to (1) apply matematics learning setting Challenge Based Learning to develop student's creative thinking skill and belief in mathematics, and also another

student's math skills; (2) teacher must been give more motivation and approach for camper's students than climber's students to be more active, preseverance, and persistence in solving problem; (3) teacher also have to consider heterogeneity based on Adversity Quotient in implementation cooperative model in class; and (4) this study can be one of references for next study.

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