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RESEARCH ARTICLE

IMPROVING CREATIVE THINKING SKILLS OF JUNIOR HIGH SCHOOL STUDENTS WITH THE MATHEMATICAL LEARNING MODEL OF NUMBERED HEADS TOGETHER

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ABSTRACT

Creative thinking skills in mathematics are widely recognized for their critical importance in terms of learning a range of mathematical contents through problem-solving approaches. As fundamental means of developing mathematical knowledge, such skills should therefore be of serious concern and have a prominent role in the education of K-12 students, Junior High School students in this regard. This research presented efforts, by applying Numbered Heads Together (NHT) as a cooperative learning alternative, which enabled such a wide range of students in different environments to sufficiently comprehend such skills and later to extend them. Quasi-experimentally designed with Control Group Pre-Test and Post-Test Design, this research sampled 130 8th grade students of two schools in Ambon, with each representing high-ranked and medium-ranked schools. The hypothesis, that NHT set off such skills, was tested at 95% significance level. The research ultimately found that; (1) the students' creative thinking skills were different in the experimental class and control class; (2) learning with NHT was better than conventional method.

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INTRODUCTION

Mathematics has increasingly become a core subject since primary school, which plays a vital role to prompt and sustain logical, analytical, systematic and critical thinking as well as creative and cooperative learning. In a certain subject area, Mathematics often brings up a network concept as it represents as a set of procedural concepts that correlates those of other mathematical fields. Applying mathematical notions with such related fields is notoriously challenging for most students (Widdiharto, 2008: 6). The challenge arises from the fact that lesson plans designed by teachers correspond exceedingly closely with textbooks that provide them what-to-do and when-to-do procedures. While it is important to note that textbooks are important arsenals for teaching, they sometimes do well with problem solutions but is less effective on applications. As teachers greatly remain focused on textbooks, they cannot manage to assemble knowledge pieces into a coherent whole. At the same time, they fail to recognize students' interests and strengths as they concentrate on how to teach, not on how students learn. Students, as a result, do not tap well into a more complex conception, say creative thinking.Such teacher-text relationship most likely leads to the fact that teachers do not consider supplementary tools or material sources in the class.

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They should make up other decisions of how they use the textbooks. While textbooks provide structures for students' learning, they have their own shortcoming; a few of themare out of date and incomprehensive. Teachers accordingly need to resort to such sources as websites or CD-ROMs and strategies that best suit students' needs and in turn enhance their problem-solving skills. Such will enable students to figure out how to critically think, solve problems, evaluate evidences, analyze arguments and generate hypotheses – all of which are essential in Mathematics. Students might grab those aforesaid skills on their own, immediately. A few might not. This may be especially intricate for those who get used to more support and direction. It will be helpful for all students to find out how they are responsible for their learning and the need to play a more active role in their own learning. Learner-centered teachers pay attention to learning. They challenge students' assumptions on learning and boost them to take responsibility for decisions they make on learning; how they arrive at problem-solving, how they are engaged in collaborative efforts and how they revise and look over their answers. Students consequently do not have to struggle to copy or imitate what teachers demonstrate and how they deal it. While teachers are probably students' best role models, this is bound to demotivate students – preventing them from being creative and open to new ideas and methods. Ruseffendi (2006) classifiedten factors that influence the success in the learning process i.e., students' intelligence, students' preparedness, students' talent, students' willingness, students' interest,

presentation models of materials, teachers' attitudes, learning environment, teachers' competences and out-of-school settings. Understanding those factors may provide evidence of ways that teachers perceive as a professional development course that deals with activities which seem to affect how well students can gain a particular skill and primary tenets that instruct whether a particular effort in learning is effective or not. The thing about education is that it is gardually changing, and teachers need to consistently adapt to new approaches. One of those is convergence teaching in Mathematics where teachers nurture learner-centric strategy in current classroom contexts and meticulously seek to instill approaches into mathematical fields that generate convergent thinking among students. With convergent thinking, students are stimulated to gain myriad pieces of data or evidence and later come up with a single solution. Such thinking is increasingly necessary for students to explore and gain higher-order competencies in Mathematics.

In light of the preceding, knowledge is actively established by students, instead of being passively acquired by the teachers. This refers to constructive mathematics learning with an emphasis on how well students learn mathematics when they attempt to construct their own mathematical conceptions. Its basic tenets, in other words, are to create experiences that engage students to arrive at mathematical ideas and problem-solving on their own and to provide them rich environments that implicate their own evaluation and application of mathematical models. Brown (2001) used such strategy to help students discover new ideas to the solution. He suggested that a given task should be challenging and assumed that students are not recipients of knowledge, rather agents of knowledge creation. What is important for students therefore is not only the introduction of context that encourages them to participate fully, but also how effective their roles are on the context. This study used Numbered Heads Together, a model that requires active students in collaborative efforts and help improve learning achievement and attitudes toward mathematics. This study was conducted at Junior High Schools in Ambon which included experimental class and class VIII2 (control group) 2014/2015 to overview the students' enhancement and achievement in creative thinking skills in mathematics and to cope with their difficulties in such mathematical learning.

RESEARCH METHODS

This study is a quasi-experimental design, which Ruseffendi (2010) claimed as an experimental design that deals with group selection without any randomly-assigned groups – treating the subject as it is. The design requires Control-Group Pre-Test and Post-Test Design (Tuckman, 1978; Ruseffendi, 2010). Such design was used to classify research subject, treatment and data collection for each school.

O	X	O
O		O

O: Measurement tests of mathematical reasoning skills of students (pre-test and post-test)
X: Treatment of Learning through NHT

Figure 1. Experimental Design of Comparison Group Pre-Test & Post Test

The research instrument consisted of pre-test and post-test given in each class to measure the students' creative thinking skills in Mathematics and see the impact on their achievement in mathematics learning, most notably in problem solving. Then, the data obtained by calculating the average and the percentage of each indicator were presented in descriptive analysis.The population in this study covered the entire students of class VIII at junior high school,academic year 2014/2015, in Ambon. Two schools in the sample consisted of high-ranked school, SMPN 4, and medium-ranked school, SMPN 2. The two classes used in this studywere class VIII1 as the experimental class (learning with NHT) and class VIII2 as the control class (learning with Conventional Learning) at SMPN 4 – both with 34 students.

RESULTS AND DISCUSSION

Data of student's creative thinking skills in Mathematics were presented by the calcultion of mean and standard deviation in the following table: As seen in the table, students who learned with NHT had pre-test mean of 11.21, higher than that of students who learned with CL, which stood at 8.88. Likewise, the post-test mean of students with NHT was higher than that of students with CL, 28.09 and 24.88, respectively. The same pattern can be seen in the average values <g>; the average value of students with NHT was slightly higher than that of students with CL, 0.50 and 0.44, respectively. Overall, there was an increase in the medium category.Meanwhile, the indicators of students' creative thinking skills in Mathematics are presented in Table 2. As previously introduced, such indicators include; 1) Fluency; 2) Flexibility; 3) Originality; and 4) Elaboration. Those indicators were presented in the test items. There are 10 test items that were used to reveal the students' achievement that reflected their learning outcomes based on those 4 indicators. Questions 1a, 8b and 10a overviewed the students' achievementbased on indicator 1. Questions 2a, 3a, 3b, 7a, 7c and 9a overviewed their achievement based on indicator 2. Question 6a overviewed their achievement based on 3 indicators, whilequestions 4b and 5a overviewed their achievement based on the whole 4 indicators. The average percentage of the students' achievement based on the indicators is shown in the following table:

Of all the test items, the lowest percentage in the experimental class and control class was in Question 7c and 8b, which concerned with Indicators 1 & 2.Both of the questions contained a quite complex task for the students. Based on Indicator 1, students wererequired to extend their ideas in solving the task. As for Indicator 2,they were required to formulate a link between the facts in the relevant mathematical models and to reach a solution out of it. The maximum score for Question 7c was 8, while the students' achievement both in the experimental class and in the control class earned 1 as the lowest and 4 as the highest score.The maximum score for Question 8b was 8; the lowest score both in the experimental class and in the control class was2 and the highest was6. Based on the results, the students' achievements of creative thinking skills in Mathematics in both classes were in the low category when it dealt with Question 7c and 8b with Indicators 1 and 2.The mean increase in the students' creative thinking skillsin Mathematics with NHT in the experimental class was 0.43 while the average increase of the students' creative thinking skillsin Mathematicswith CL in the control class was 0.39. Based on 7c and 8b, the students managed to declare the situation of the problem in the picture and the facts but had a hard time declaring the problem by using pictures and facts in resolving questions correctly.

Table 2. Mean Increase of Students' Creative Thinking Skills in Mathematics

	Group Data	N	$\bar{X}$&SD	Creative Thinking Skills in Mathematics						
				NHT			CL			
				Pre	Post	<g>	N	Pre	Post	<g>
School Ranking	High	34	$\bar{X}$	11,21	28,09	0,50	34	8,88	24,88	0,44
			SD	2,20	4,31	0,13		1,92	2,72	0,06
	Medium	31	$\bar{X}$	11,32	27,45	0,48	31	8,52	21,58	0,09
			SD	2,21	3,11	0,48		2,16	2,95	0,08

Ideal Maximum Score of Critical Thinking Skills in Mathematics = 45

Table 3. Data Recapitulation of Average Percentage of Students' Creative Thinking Skills in Mathematics

Group Data	Average Percentage of Ability Creative Skills in Mathematics											
	Indicator 1			Indicator 2						Indicator3	Indicator 4	
	1a	8b	10a	2a	3a	3b	7a	7c	9a	6a	4b	5a
Experiment Class	0,80	3,69	1,45	2,40	2,45	2,51	0,89	3,57	1,68	2,03	1,72	1,85
	80,00%	46,15%	48,21%	60,00%	61,15%	62,69%	89,23%	44,62%	55,90%	50,77%	57,44%	92,31%
Control Class	0,78	3,65	1,43	1,91	1,82	1,91	0,86	3,48	1,63	1,91	1,58	1,80
	78,46%	45,58%	47,69%	47,69%	45,38%	47,69%	86,15%	43,46%	54,36 %	47,69%	52,82%	90,0 %

This indicates that theywere not able to take advantage of images and facts to solve the problem. Such indication is confirmed with the results of interviews of the students that admitted they were less careful and had a difficulty determining the base, the height and the area of the triangle in the picture, which led them to a wrong completion. It is obvious that, as the hypothesis suggested, the enhancement and achievement of students' creative thinking skills in the experimental class were better than those in the control class. This was likely as the learning models provided in both classeswere different. Such better enhancement and achievement did not necessarily signify that the students in the experimental class mastered all of the four indicators of creative thinking skills in Mathematics.

Several students in the experimental class were found to deal with difficult test questions that led them to poor scores. As a matter of fact, some of them considered the test to be more challenging than what their teachers provided in their day-to-day lessons. This is most likely due to the fact that their learning strategies in classroom were different from those in the test; they were reluctant to work on the problems in the way other than what their teachers demonstrated, i.e., using their own methods and ideas. Their ways of thinking during the test-taking consequently generate less-precise answers. As constructivism theory has previously put it, the students must actively construct their own knowledge, rather than simply acquire it, and explore new ideas or different ways to break down the concept. With NHT learning models, learning begins with an overview of the topics. However, at this stage, teachers are not to rush through the beginning of a lesson, rather elicit what students know about the topic before presenting them new ideas.Creative thinking skills encourage the students to think a priori; they revisit past experiences and incorporate them into the on-going discussions. This is in accordance with the opinion of Munandar (2002) that the characteristics of fluency skills are providinga decent number of ideas, answers or questions before introducing new information. The second stage is the initial review of the topics that requires flexibility. With flexibility, students are able to focus on their ability to adapt to new ideas, improvise them and shift approaches to meet different kinds of challenges. This stage deals with students' ability to anticipate and to positively respond to changing circumstances, having alternative options while keeping calm in the face of difficulties.The third stage is the in-depth review of the topics that will be discussed in detail.

Creative thinking skills at this stage depend on original thinking that allows the students to explore collaborative arrangements in a group that involves recognition and employment of different perspectives. With such diversity, they challenge one another's ideas with a back-up of evidence and approriate logic until they achieve consensus. Despite potential disagreement, they resolve frictions, solve a problem and make up a decision. Originality, as stated by Munandar (2002), refers to the ability to create new and unique expressions that fit with the challenge at hand. The fourth stage is the review. Creative thinking skills at this stage requires elaborative skills that let students revise and refine the ideas. Elaboration of the topic heavily relies on relevant and specific details to construct the topic. Without this attention to details, students struggle to demonstrate what they are thinking. Munandar (2002) added that elaboration enriches and develops an idea or product and itemizes a situation in detail so that it gets more attractive. As NHT is an essential application in mathematics learning, it is expected to be the integral part of curriculum so those four components or indicators in creative thinking skills are optimally improved. The enhancement and achievement of the students, as supported by this study, are such advantages of NHT that supports high-level tasks and generates meaningful learning experiences.

Conclusion

The conclusion of this study is as follows:

- Students' creative thinking skills with NHT had better enhancement and achievement than those with CT, with the medium category showing overall improvement.
- Nurturing interdependence among group of students and individual accountability within each student with NHT was more applicable for the majority of students notably the under-achievers in learning Mathematics.

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