THE EFECTIVENESS OF NUMBERED HEADS TOGETHER WITH GUIDED DISCOVERY LEARNING AND JIGSAW II WITH GUIDED DISCOVERY LEARNING VIEWED FROM ADVERSITY QUOTIENT

Qurrotul 'Ain[1], Tri Atmojo Kusmayadi[2], Budi Usodo[3]

[1,2,3] Post Graduate Program of Mathematics Education, Sebelas Maret University
(qurrotulain30@gmail.com[1]), (tri.atmojo.kusmayadi@gmail.com[2]),
(budi_usodo@yahoo.com[3])

Abstract

This research was a quasi-experimental research with 2×3 factorial design aimed to find out the influence of learning model NHT with guided discovery learning and Jigsaw II with guided discovery learning for students' mathematics achievement. The population of this study were all of the eleventh grade students of Junior High School in Karanganyar regency and sampling was done by stratified cluster random sampling. The data was collected by test, questionnaire, and documentation.The test of hypothesis used two-way analysis of variance with unequal cell, past analysis of variance with Scheffe' method and significance level was 0.05. Based on hypothesis test, it could be concluded that (1) the learning model of Jigsaw II with guided discovery learning approach results students' mathematics achivement better than NHT with guided discovery learning., (2) students' mathematics achievement with the climbers type was as good as students' mathematics achievement with the campers type, and students' mathematics achievement with the campers type result better than students' mathematics achievement the quitters type, (3) for each learning model, students' mathematics achievement with the climbers type was as good as with students'mathematics achievement with the campers type, and students' mathematics achievement the campers type result better than students' mathematics achievement the quitters type, (4) for each category AQ, the learning model of Jigsaw II with guided discovery learning approach results better than students' mathematics achivement learning model NHT with guided discovery learning.

Keywords: Jigsaw II, Numbered Heads Together, Guided Discovery Learning, Adversity Quotient, Mathematics Achievement

Introduction

Education is a conscious attempt of humankind to enhance and broaden knowledge. Education is one of important elements in science and technology progress whereas the progress itself is determined by human resources. Skilled human resources are considered to be able to create agents of nation's advancement. In general, advanced nation in terms of science and technology use to carry out renewal and enhancement quality of education. The quality of education in Indonesia is still considered in low rank compared to other power countries. It is known by reviewing domestic education quality from the result of National Examination of State Junior High School academic year 2014/2015 as can be seen in the following Table 1.

Table 1 The Comparison of State Junior High School National Examination's Average Score

Score Exam	Bhs. Indo	English	Mathematics	Science
Average	72.15	60.40	56.60	60.34
Lowest	2.0	2.0	2.5	2.5
Highest	100.0	100.0	100.0	100.0

Source: PAMER UN 2015

Data from the total National Examination subjects shows that the lowest average score is from mathematics subject. The low average score in mathematics obtained from low mathematics score in numbers of regency in Indonesia for example Central Java province although third position in National Examination for average score mathematics 50,91 which is far lower than average score National Examination 56,60.(PAMER 2014/2015).

Mathematics' low score can happen due to the students' lack of understanding in the subject. One of the examples is in principal of relation and function. According to PAMER 2014/2015 data, average score in this material is only 43.76 which is still far from the national average. It can possibly occur because the principal of relation and function requires students to understand comprehensively and precisely in determining the difference among mapping, drawing function, and examining function value. Besides that, teachers' role in this learning also affects the level of students' achievement, so that it is necessary to apply the appropriate learning model whereas the learning process is student-centered, for instance by applying cooperative learning model. Zakaria dan Iksan (2007),

> *The experimental section was instructed using cooperative learning methods and the control section section was instructed using the traditional lecture methods. Cooperative group instruction showed significantly better result in mathematics achievement and problem solving skills.*

Cooperative learning in mathematics class can give positive effects for students. They can trade information amongst one another in solving mathematics problems (Oludipe, 2012: 4). Shimazoe and Aldrich (2010) assert that cooperative learning in class can stimulate students to become more responsive toward the learning, and they can also participate in learning process actively. Student's activeness in learning process is one of the important factors that influence student's mathematics learning achievement. In addition, the proper teacher's decision in choosing applied learning model is also significant. One of cooperative learning models that can be applied in order to increase student's mathematics learning achievement is Numbered Heads Together (NHT). Lince (2016) research states that NHT learning model which is applied effects the student's creative and active thinking in mathematics learning.

Besides applying NHT learning model, there is also another learning model that can be applied by teachers which is Jigsaw II cooperative learning model. Sahin (2010),

> *jigsaw II technique was more effective than instructional teacher centered teaching … group completely learn their subject topics by fulfilling their responsibilities, try to make their friends understand topic, have effective interaction with their friends, and are all actively involved in the process.*

According to Sahin, Jigsaw II learning is more effective than direct learning. Group of experts in Jigsaw II cooperative learning model uses their discussion and tries to explain to the other group member in which they interact and participate in learning process. Jigsaw II cooperative learning model has particular strengths in student's discussion activity, which is not only does the student learn the material, but they are also given responsibility regarding a certain topic which later on must be delivered to the other group member, and the expert student should understand comprehensively every material that will be explained to the other member. NHT and Jigsaw II learning models invite students to be active in learning process. Through group studying, students are able to trade information and knowledge. Hence, to achieve as much mathematics learning achievement as possible, the researcher will modify the existed NHT and Jigsaw II learning models with guided discovery learning.

Ahour and Mostaface (2015) assert that discovery learning develops the cognitive skill such as to relate, to equalize, and to hypothesize which is able to aid students to increase their understanding while they are learning. Discovery learning is divided into free discovery learning and guided discovery learning. In this research, the researcher tried to modify with guided discovery learning. According to Yuliani and Saragih (2015), guided discovery learning supports students to understand the concept and think critically in mathematics. Guided discovery learning is not a teacher's guidance that must be followed by students but is merely instructions on how the work needed. This modification is expected to diminish students' difficulty in learning mathematics, to advance students' understanding, and to increase students' mathematics learning achievement. Cohen (Huda, 2015: 20) asserts that students' learning achievement highly depends on the type of assignments they acquire and how they solve those assignments. Therefore, in this research, NHT learning model with guided discovery learning and Jigsaw II model with guided discovery learning are applied.

Another factor that affects the low mathematics achievement is the teachers who need to discover each student's ability in responding the learning. It is important to consider because every student has different responsive level ability toward learning material. In this case, student's ability is well-known as Adversity Quotient (AQ). AQ is the ability/potency which motivates a person to turn obstruction and difficulty into opportunity. Stoltz (2004) divides AQ into three types, which are climbers, campers, and quitters. Angelopoulos, et al (2002) state that AQ is able to find out how a person commits an act in certain circumstance, how he/she overcomes chances and the what impacts of his/her act are. Thus, AQ knows how students with different types respond the learning in class. Different types of AQ influence the understanding of Junior High School students grade VIII, particularly in relation and function material. Climber type includes students who struggle enthusiastically to obtain maximal achievement result. Camper type includes students who satisfied enough with what they have obtained. Quitter type includes students who quit to attempt being better and dislike challenges.

This research aims to (1) find out which model gives the better mathematics achievement between NHT model with guided discovery learning and Jigsaw II model with guided discovery learning, (2) find out which type of students does achieve the better mathematics achievement, whether it is the climbers type, the campers type, or the quitters type, (3) find out for each learning model, which type of students does achieve the better mathematics achievement, whether it is the climbers type, the campers type, or the quitters type, (4) find out for each category AQ, which model

does give the better mathematics achievement between NHT learning model with guided discovery learning or Jigsaw II with guided discovery learning.

The benefits of this research is expected to enhance the mathematics learning theory related to NHT model with guided discovery learning, Jigsaw II model with guided discovery learning, and AQ, also their influence toward student's mathematics achievement. By determining how much the power and influence on mathematics achievement of students, it is expected to designate the importance of NHT learning model with guided discovery learning, Jigsaw II learning model with guided discovery learning, and AQ, also their influence toward mathematics achievement of students.

Findings and Discussion

The population of this research is all students in State Junior High School in Karanganyar Regency year 2016/2017. Based on the result of National Examination of Junior High School in Karanganyar Regency year 2014/2015, it is obtained that the average score of mathematics is 47.6184 ($\bar{X}$) standard deviation is 8.1575 (s). According to the data, it is obtained there are 9 schools considered in high category, 21 schools in moderate category, and 15 schools in low category. It took two classes from each category to apply NHT learning model with guided discovery learning (control class) and Jigsaw II learning model with guided discovery learning (experiment class).

After sampling process was done, the researcher collected data to determine the initial students' ability in control class and experiment class. The meant data was score on daily test of Final Exams for population normality test, population homogeneity test, and population balance test. Normality test was conducted three times using Lilliefors test with significance level of 0.05. It showed that L_{obs} was less than $L_{0.05;n}$ the decision of H_0 was accepted. Therefore, the populations of Jigsaw II with guided discovery learning class and NHT with guided discovery learning class came from normal distributed population. After that, homogeneity test was taken using Bartlett test with significance level of 0.05. It showed that ${\chi^2}_{obs}$ was less than ${\chi^2}_{0.05;2}$ and H_0 was accepted. Therefore, the populations of Jigsaw II with guided discovery learning class and NHT with guided discovery learning class had homogenous (similar) population variance. After population was stated coming from normal distributed and homogenous variance population, balance test was conducted using one way analysis of variance with unequal cell and significance level of 0.05. It showed that F_{obs} was less than $F_{0.05;2;281}$ and H_0 was accepted. Therefore, the population of Jigsaw II with guided discovery learning class and NHT with guided discovery learning class had equal initial mathematics ability.

Mathematics achievement test data was obtained from mathematics achievement test instruments which were the students' achievement gained from carrying out a test consisting of 20 questions. The score and mathematics achievement of students in Jigsaw II with guided discovery learning class and NHT with guided discovery learning class are summarized in Table 2 as follow.

Table 2 Data on Mathematics Achievement of Students Based on Learning Models

Learning Model	*n*	Min	Max	$\bar{X}_{\text{marginal}}$	*SD*
Jigsaw II with guided discovery learning	94	40	100	71.3298	13.0585
NHT with guided discovery learning	94	40	95	65.0521	14.0581

Data of students' AQ score was obtained from AQ questionnaires instrument as many as 40 statements consisting of 20 positive statements and 20 negative statements. The summarized data was served in Table 3 as follow.

Table 3 Data on Mathematics Achievement of Students Based on AQ

Adversity Quotient	*n*	Min	Max	$\bar{X}_{marginal}$	*SD*
Climbers	70	40	95	73.1731	12.6036
Campers	151	40	100	69.5876	14.1176
Quitters	63	40	80	58.4146	9.8386

Analysis of variance prerequisite test consists of population normality test and homogeneity test of population variance. It needs the score of mathematics achievement test data to undertake the test. Population normality test was carried out by using Lilliefors test with significance level of 0.05, this test was done five times. The calculation showed that all L_{obs} was less than $L_{0.05;n}$. Therefore, it is obtained that all research samples came from normal distributed population. Homogeneity test was undertaken twice by using Bartlett test with significance level of 0.05. The calculation showed that $\chi^2{}_{obs}$ was less than $\chi^2{}_{0.05;(k-1)}$ thus, H_0 was accepted. It proves that the variance of inter-sample population in AQ is homogenous.

After the analysis of variance prerequisite test was fulfilled which was normal and homogeneous, hypothesis test was done by two way analysis of variance with unequal cell and significance level of 0.05. The summary can be seen in Table 4 as follow.

Table 4 Two Way Analysis of Variance with Unequal Cell

Source	*SS*	*df*	*MS*	F_{obs}	F_{α}	Decision
Learning Model (*A*)	1361.8724	1	1361.8724	8.6034	3.84	H_{0A} rejected
Adversity Quotient (*B*)	9430.6224	2	4715.3112	29.7882	3	H_{0B} rejected
Interaction (*AB*)	488.7277	2	244.3638	1.5437	3	H_{0AB} accepted
Error (*G*)	29126.2006	184	158.2946			
Total (*T*)	40407.4231	189				

Based Table 4, it is obtained that H_{0B} is rejected. Hence, it is needed to undertake inter-column average comparison test to determine which type of AQ can give better mathematics achievement amongst the climbers, the campers, and the quitters. The summary of data is served as can be seen in Table 5.

Table 5 Inter-Column Average Comparison Test

H_0	F_{obs}	F_{table}	decision
$\mu_{.1} = \mu_{.2}$	2.7492	6	H_0 accepted
$\mu_{.1} = \mu_{.3}$	31.5442	6	H_0 rejected
$\mu_{.2} = \mu_{.3}$	22.7274	6	H_0 rejected

Information: $\mu_{.1}$: average of mathematics achievement for climbers type of AQ; $\mu_{.2}$: average of mathematics achievement for campers type of AQ; $\mu_{.3}$: average of mathematics achievement for quitters type of AQ.

The result based on Table 4 for H_{0A} is rejected, the calculation is $F_{a\ obs}$= 8.6034 with DK_a = {F | F > 3.84}, because F_{obs}= 8.6034 is included into member of critical area, H_{0A} is rejected and marginal average of Jigsaw II with guided discovery learning 71.3298 is more than marginal average of NHT with guided discovery learning 65.052. It can be concluded that students who were applied with Jigsaw II with guided discovery learning have better mathematics achievement compared to those who were applied with NHT with guided discovery learning. It could be explained Jigsaw II with guided discovery learning member of groups was divided heterogeneously, afterwards from the set groups, they would be set into another group which was expert group. Before expert group discussed, all students was given times to read the material provided by expert group. Then, with guided discovery learning, each student would understand the material more comprehensively. Hence, it was better applying Jigsaw II learning model with guided discovery learning than NHT learning model. In accordance with the research conducted by Sahin (2010) in his research shows that Jigsaw II is a kind of cooperative learning which gives positive influence toward student's learning achievement and attitude in class. Kam-wing (2004) states that Jigsaw II is an effective cooperative learning in which in discussion activity expert group is expected to solve given problems through the ideas of the member.

In Jigsaw II learning model with guided discovery learning, every each of group members is given assignment to concern on a certain topic called expert group. Every each of expert group will discuss with the other group members to study similar topic, and they are demanded to comprehend the topic they acquire. Afterwards, expert group return to their previous group (initial group) to explain the topic they have discussed to the other group members. Then, the teacher gives quiz that must be answered individually for group appreciation. It is what makes Jigsaw II learning model with guided discovery learning better than NHT with guided discovery learning.

Then for H_{0B} based on Table 4 the calculation is $F_{b\ obs}$= 29.7882 with DK_b={F | F > 3.00}, because F_{obs}= 29.7882 is included into member of critical area, H_{0B} is rejected. So does inter-column average comparison test based on Table 6, it is obtained that in $\mu_{.1} = \mu_{.2}$ test decision of H_0 is accepted and because $F_{.1-.2\ obs} = 2.7492 < F_{table} = 6$, it can be concluded that students with climbers type of AQ acquire as well mathematics achievement as students with campers type of AQ. In $\mu_{.1} \neq \mu_{.3}$ test decision of H_0 is declined and because marginal average of climbers 71.1731 is more than marginal average of quitters 69.5876 and $F_{.1-.3\ obs} = 31.5442 > F_{table} = 6$, it can be concluded that students with climbers type of AQ acquire better mathematics achievement than students with quitters type of AQ. In $\mu_{.2} \neq \mu_{.3}$ test decision of H_0 is declined and because marginal average of campers 69.5876 is more than marginal average of quitters 58.4146 and $F_{.2-.3\ obs} = 22.7274 > F_{tabel} = 6$.

It could be explained students with climber type of AQ acquire as good mathematics achievement as students with camper type of AQ do, and students with camper type of AQ acquire better mathematics achievement than students with quitter type of AQ do. It is due to the well-activeness showed by students with climber type of AQ. They actively ask about the material that they have not yet understood, and they have ideas to solve problems so groups with climber type of AQ students can comprehend more thoroughly in learning process. Parallel with Stoltz (2004: 24), a climber is positive that everything can be accomplished. This is what makes students

with climber type of AQ acquire better learning achievement than students with quitter type of AQ.

Meanwhile, students with camper type of AQ acquire better learning achievement than students with quitter type of AQ. This is because students with camper type of AQ are more active in discussion activity and they tend to have a will to solve the given problems better than students with quitter type of AQ. Sloltz (2004: 24) asserts that camper have restricted ability, however they slowly make attempts to achieve success. Therefore, students with climber type of AQ acquire learning achievement as good as students with camper type of AQ. In the other hand, students with camper type of AQ acquire learning achievement better than students with quitter type of AQ.

Then based on Table 4 for H_{0AB} the calculation is $F_{ab\ obs}$= 1.5437 with $DK_{ab} = \{F|F > 2.37\}$, because $F_{ab\ obs}$= 1.5437 is not included into member of critical area so H_{0AB} is accepted. It can be understood that there is no interaction between the influence of learning models and the influence of AQ type. The relevancy amongst each type of AQ for any learning models toward mathematics achievement of students is explained as follow. Since further test was not conducted, it can be concluded that for each learning models viewed from types of AQ climbers, campers, and quitters, mathematics achievement of students who were given material by Jigsaw II learning model with guided discovery learning is better than NHT model with guided discovery learning. The relevancy between each learning models for any types of AQ toward mathematics achievement is explained as follow. Since further test was not conducted, it can be concluded that in Jigsaw II learning model with guided discovery learning and NHT learning model with guided discovery learning, students with AQ climbers accomplished as good as students with AQ campers, and students with AQ campers accomplished better mathematics achievement that students with AQ quitters.

Conclusions

Based on the results, it was concluded that.

1. The learning model of Jigsaw II with guided discovery learning approach results students' mathematics achivement better than NHT with guided discovery learning.

2. Students' mathematics achievement with the climbers type was as good as students' mathematics achievement with the campers type, and students' mathematics achievement with the campers type result better than students' mathematics achievement the quitters type.

3. For each learning model, students' mathematics achievement with the climbers type was as good as with students'mathematics achievement with the campers type, and students' mathematics achievement the campers type result better than students' mathematics achievement the quitters type.

4. For each category AQ, the learning model of Jigsaw II with guided discovery learning approach results better than students' mathematics achivement learning model NHT with guided discovery learning.

References

Ahour, T. & Mostaface, L. (2015). The Impact Focused Discovery Approach on EFL Learners Speaking Ability. *Modern Journal of Language Teaching Method*, 5 (1), 10-21. http://www.mjltm.com/library/Class/download.php ?download=noresume&filename=Vm9sMV9Jc3N1ZTJfT2N0MjAxMS56aXA= &orgin=Vol1_Issue2_Oct2011.zip&i=28

Angelopoulos, P. A., Houde, S. J. R. J., Thompson, M. M., McCreary, D. R., Blais, A. R. & Pasto, L. (2002). *Empirical Review of Stoltz 'Adversity Quotient (AQ) Training for Optimal Response to Adversity', a Review of the AQ Literature and Supporting Studies.* Canada: Defence R & D. http://www.dtic.mil/dtic/ tr/fulltext/u2/a408478.pdf

Huda, M. (2015). *Cooperative Learning, Metode, Teknik, Struktur, dan Model Penerapan.* Yogyakarta: Pustaka Pelajar.

Kam-wing. C. (2004). Using Jigsaw II in Teacher Education Programmes. *Hong Kong Teachers' Centre Journal*, 3 (1), 91-97. http://edb.org.hk/hktc/ download/journal/j3/9.pdf

Lince, R. (2016). Creative Thinking Ability to Increase Student Matematics of Junior High School by Applying Models Numbered Heads Together. *Journal of Education and Practice*, 7 (6), 206-212. http://files.eric.ed.gov/fulltext /EJ1092494.pdf

PAMER 2014.2015. Final Exam Report Senior Hingh School Academic Year 2014/2015 Publish BNSP.

Oludipe, D. I. (2012). Gender Difference in Nigerian Junior Secondary Students' Academic Achievement in Basic Science. *Journal of Educational and Social Research*, 2 (1), 93-99.https://www.researchgate.net/publication/256840488 _Gender_Difference_in_Nigerian_Junior_Secondary_Students'_Academic_Achi evement_in_Basic_Science

Sahin, A. (2010). Effect of Jigsaw II Technique on Academic Achievement and Attitudes to Written Expression Course. *Academic Journals (Educational Research and Reviewer)*, 5 (12), 777-787. http://www.academicjournals.org /article/article1379656063_Sahin.pdf

Shimazoe, J. & Aldrich, H. (2010). Group Work Can Be Gratifying: Understanding & Overcoming Resistance to Cooperative Learning. *College Teaching: Routledge Taylor & Francis Group*, 58 (2), 55-57. http://eric.ed.gov/?id= EJ877837

Stoltz. P. (2004). *Adversity Quotient: Mengubah Hambatan Menjadi Peluang*. Terj. T. Hermaya. Jakarta: Gramedia.

Yuliani, K. & Saragih, S. (2015). The Development of Learning Devices Based Guided Discovery Model to Improving Understanding Concept and Critical Thinking Mathematically Ability of Students at Islamic Junior High School of

Medan. *Journal of Education and Practice*, 6 (24), 116-128. http://files.eric.ed.gov/fulltext/EJ1078880.pdf

Zakaria, E. & Iksan, Z. (2007). Promoting Cooperative Learning in Science and Mathematics Education: A Malaysian Perspective. *Eurasia Journal of Mathematics, Science & Technology Education*, 3 (1), 35-39. Diperoleh 19 Juli 2016, dari http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2729.2004.00092.x/