THE EXPERIMENTATION OF MIND MAPPING-BASED NUMBER HEAD TOGETHER (MMNHT) AND MIND MAPPING-BASED THINK PAIR SHARE (MMTPS) IN THE TOPIC OF QUADRATIC FUNCTION

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Abstract

This article is motivated by my previous research. Based on the fact, it can be said that this kind of innovation in model learning is very potential to be used in schools. This study is quasi-experimental research aimed to identify differences in the effect of each model of learning on students' learning achievement. The study used subjects from the whole population of the Tenth Grader sof high schools in Magetan in the academic year of 2016/2017. Those samples were chosen through stratified cluster random sampling. The data in the study were collected using test, questionnaire, and documentation, and then, were analyzed using Lilliefors, Barlett, and one way ANOVA (pre-requisite tests) and one way ANOVA (Hypotheses test). Based on the hypotheses test result that mathematics learning achievement of the tenth graders of public high school in Magetan who were treated with Mind Mapping-based NHT have better achievement than Mind Mapping-based TPS or Mind Mapping-based direct and Mind Mapping-based TPS have better achievement than Mind Mapping-based direct.

Keywords: Number Head Together (NHT), Think Pair Share (TPS) Mind Mapping, Quadratic Function.

Introduction

Teaching is the process of using appropriate method in order to the predetermined goals. Teaching is a conscious and purposeful activity. Oriented to the predetermined goals and aimed to earn desirable behavior, teaching activities usually take place in the institutes of educations. Altunay (Tuna and Kacar,2004: 74) revealed that… "if designed according to students' interests, needs, talents and skills, the student-centered teaching environment creates successful individuals". However, based on the results of interviews conducted with the math teachers in public high schools in Magetan, 70% of them are still using direct learning model. The resources, in such method, centered on teachers so the students are less active during learning activities. The condition leads to the students' lack of confidence as there is no activities for them to present their work.

In Indonesia, mathematics is one of compulsory subjects learned. Mathematics is still a subject that is considered difficult and boring to many students. According to Woodard (2004), weaker students feel anxiety toward mathematics, and this anxiety affects their performance in mathematics. There are still many problems in mathematics learning, such as, low students' achievement as in the material of equation and quadratic function. Students' comprehension concerning equations and quadratic functions in the abilities tasted resolving the problem in equations or quadratic functions using discriminant (28.02%) in City/Regency, (38.87%) in province, and

45.88% in national. Thus, efforts should be made to improve their comprehension so that their learning achievement can be increased. For that reason, this research focuses on the material of equations and a quadratic function.

Given such conditions, then, one of the efforts that should be done is to apply innovative learning model which can enhance the activity of the students like what is in the cooperative learning model. Tran (2014; 137) revealed that... "cooperative learning stimulated cognitive activities, promoted higher levels of achievement and knowledge retention". From these statements, it can be concluded that cooperative learning stimulates cognitive activity, improve performance, and the ability to remember. Many several types of cooperative learning. In this research, the writer uses Number Head Together (NHT)and Think Pair Share (TPS).

Number Head Together (NHT) is one of cooperative learning models that as alternative to the traditional teaching. Number Head Together (NHT) firstly designed by Spenser Kagen as an alternative to the traditional classroom structure. Baker (2013: 6) saying that Number Head Together (NHT) creates a positive dependence and accountability because each individual has the potential to be responsible for the success of the group when his number was called. Arends (2008: 16) revealed that… "in referring questions to the whole class, the teacher uses a four-step structure, among others: numbering, questioning (asking questions), head together (think together), and answering. Think Pair Share (TPS) first developed by Professor Frank Lyman at the University of Maryland. Arends (2008: 15) revealed that… "there are three step in learning to use Think Pair Share (TPS), among others: thinking, pairing, and sharing.

Back to the focused material of the study, by applying Mind Mapping students will likely be easier to understand the concept of equation and quadratic function. Buzan (2012: 4) revealed that… "Mind Mapping is a way of noting a creative, effective, and literally will map our minds". Budd (Jones, *et al*. 2012: 2) says that Mind maps allow students to create a visual image to enhance their learning and can be used as a meta-cognitive tool that allows them to make connections to material in meaningful ways.

Brinkman (Madu and Metu, 2012: 247-248) gave some rules for making mind-map. The rules are as follows: a) use a large sheet of paper, place the topic of the map at the centre, b) from the topic draw a main branch for each of the main ideas linked to the topic, c) write keywords relating to the main ideas directly as the lines, d) starting from the main branches draw further lines (sub branches) for secondary ideas (sub topics) and so on, e) the order follows the principle-from the abstract to the concrete, from the general to the specific, f) use colours when drawing a mind map, g) add sketches, symbols such as little arrows, geometric figures, exclamation marks or question marks, as well as self defined symbols.

As stated by Mona and Adbkhalick (Adodo, 2013: 165) that Mind Mapping is important, effective and useful for students to understand various concepts. Moreover, if it is combined with cooperative learning model Number Head Together (NHT) and Think Pair Share (TPS), which uses a constructivist approach, then, the result might be better. Like what is presented in a study conducted by Tee, *et al*. (2014: 30) which concluded that Mind Mapping contribute significantly to students' learning regarding the implementation of constructivist approach in the classroom.

Thus, Mind Mapping and Number Head Together (NHT) are combined; and to elucidate the administration procedures of Mind Mapping-based NHT (MMNHT). In general, there are nine steps in implementing Mind Mapping-based NHT (MMNHT) in learning process; (1) Core Material Delivery (done by teacher), (2) Mind Map Making (done by students), (3) Grouping (4-5 students in each group) and Numbering,

(4) Questioning, (5) Heads Together Process, (6) answering, (7) Classroom discussion, (8) Rewarding, (9) Conclusion and Closing.

Meanwhile, Mind Mapping and Think Pair Share (TPS) are combined; and to elucidate the administration procedures of Mind Mapping-based TPS (MMTPS). In general, there are seven steps in implementing Mind Mapping-based TPS (MMTPS) in learning process; (1) Core Material Delivery (done by teacher), (2) Mind Map Making (done by students), (3) Thinking(4) Pairing (2 students in each group), (5) Sharing, (6) Rewarding, (7) Conclusion and Closing.

In this study, the research problems proposed is between Mind Mapping-based NHT, Mind Mapping-based TPS and Mind Mapping-based Direct, Which one is better?;Related to the research problems, the hypothesis proposed is Mind Mapping-based NHT give better achievement than Mind Mapping-based TPS or Mind Mapping-based direct and Mind Mapping-based TPS give better achievement than Mind Mapping-based direct. This study aimed to identify differences in the effect of each model of learning on students' learning achievement.

Finding and Discussion

This study is a quasi-experimental research. In this study, the independent variables are learning models. Meanwhile, the dependent variable is mathematics learning achievement of students on the material of equation and quadratic function. The target population of this study is the tenth graders (first semester) of public high schools in Magetan in the academic year of 2016/2017 who adheres the curriculum KTSP. As for the sampling, it is done using stratified cluster random sampling technique. In this case, the schools are divided into three categories; high, medium and low based on the average value of National Exam on the subject of mathematics in the academic year of 2014/2015 as presented in Table 1:

Table 1. The Results of Schools Grouping Calculation

No	School Name	Mean Score of National Exam	Category
1	SMAN 3 Magetan	79.90	High
2	SMAN 1 Barat	77.82	High
3	SMAN 1 Kawedanan	74.04	Average
4	SMAN 1 Karas	73.43	Average
5	SMAN 1 Sukomoro	69.80	Low
6	SMAN 1 Parang	68.53	Low
7	SMAN 1 Plaosan	65.59	Low
Mean		72.73	

From the calculations having been done, the mean score(μ) of all schools is 72.73 with a standard deviation (σ) of 5.11. Hence, a school are categorized as high if it has mean score of $>$75.3 and categorized as average if it has mean score between$\geq$ 70.2 and $\leq$ 75.3, meanwhile, low category will be given to the school with

mean score of <70.2. From each category, one school is selected randomly as a representative, so there are three schools being the target of the research. As for the results of randomization, the selected schools are SMAN 1 Barat from high category, SMAN 1 Karas from the average category, and SMAN 1 Sukomoro from the low category. From each selected schools, three classes are taken randomly and are served as sample classes. Each of them is positioned as experimental class in which Mind Mapping-Based NHT is implemented or as control class where Mind Mapping-Based TPS is implemented.

There are several data collection techniques used in this study; 1) documentation (used in checking the distribution score to see if the experimental class I, experimental class II, class control and a trial instrument classes are equal), 2) Test (used to obtain the data of students' learning achievement on the material of equation and quadratic function treated with Mind Mapping-Based NHT and Mind Mapping-Based TPS.

In detail, the test used in this study is a multiple choice quiz consisting of 25 items, but tested as many as 40 items in the trial process. Before it is used to retrieve the data, first, the instrument is tested using content validity test which is done through the process of expert judgment. Meanwhile, to test the advisability of the items, discrimination power test and difficulty level test are done. As the result, it is known that from 40 tested items, there are 25 items having good discrimination power, moreover, there are also 29 items having good level of difficulty. Next, the 25 selected items are tested concerning the reliability of them with the formula of*KR-20*. Based on the calculation, the result obtained is r_{11} = 0. 7945 ($r_{11} > 0.70$) which means that the items are reliable. Thus, the 25 items selected are considered as advisable items to be used as the research instrument to test students' mathematics learning achievement

Similar to the test, the items of questionnaire are, first, tested through several process involving expert judgment, and internal consistency test. The learning styles questionnaire consist of 48 item, with details, 16 questions on visual learning style, 16 questions on auditory learning styles and 16 questions on kinesthetic learning style. Each of the 16 items are consists of 8 positive items and 8 negative items. However, to anticipate any bad item, then, the items tested are made of 60 questions when the internal consistency test is done. The next step of the advisability test is the reliability test done by using Alpha Cronbach's formula. Based on the calculation, the result obtained are $r_{11} = 0.753$ for visual learning style, $r_{11} = 0.803$ for auditory learning style, and $r_{11} = 0.721$ for kinesthetic learning style. Because all of the$r_{11} > 0.70$, then, it can be concluded all the selected items are reliable and are advisable to be used as the research instrument.

Stepping further to the next matter, there are three techniques of data analysis used in this study: 1) Prerequisite test involving normality test using Liliefors formula and Homogenity test using Bartlet Formula, 2) Equality test using One-way Anova, 3) Hypotheses test using One-way Anova, and 4) Post-Anova analysis using Scheffe formula (if there is interaction between learning model and students' learning achievement).

In accordance with, the first test conducted is the equality test between experimental class and control class to know the equality of initial ability. However, before the equality test is conducted, normality and homogeneity test needs to be done. Normality test in this study are conducted for three times; to the student population treated with Mind Mapping-Based NHT, Mind Mapping-Based TPS and Mind Mapping-Based Direct.

By using Liliefors formula at significance level of 5% test results of normality test for the class will treated with Mind Mapping-Based NHT is $L_{obs} = 0.0873$and Mind Mapping-Based TPS is $L_{obs} = 0.0728$with DK = $\{L \mid L > L_{0,05;92}\}$, so the L_{table} is 0.0924. Thus, because the$L_{obs} \notin$DK, H_0 is accepted (the distribution is normal). Meanwhile, for the class treated with Mind Mapping-Based TPS, the L_{obs} is 0.0826 with DK =$\{L \mid L > L_{0,05;88}\}$, so the L_{table} is 0.0944. Hence, it also means that the distribution score of this group is normal.

After the normality tests are concluded, then, the homogeneity of the two groups is tested by using Bartlet formula at the significance level of 5%. Based on the calculation, the result test for the classes will treated with Mind Mapping-Based NHT, Mind Mapping-Based TPS and Mind Mapping-Based Direc is χ^2_{obs} = 0,6555 with DK = $\{\chi^2 | \chi^2 > \chi^2_{0,05;2}\}$, so the$\chi_{table}$ is 5,991. Hence, it can be concluded that H_0 is accepted (The population variances are homogeneous).

Once the population is in normal distribution and homogeneous population variance, then the equality test between the three groups carried out using One-way Anova. The results obtained is F_{obs}= 1,3253 withDK = $\{F|F > F_{0,05;2;269}\}$, so the F_{tabel} = 3. Since $F_{obs} \notin$DK, H_0 is accepted (the initial ability of the two population are equal).

The three groups, the experimental group and the control group, which already passed the prerequisite test are treated with Mind Mapping-Based NHT and Mind Mapping-Based TPS (experimental group) and Mind Mapping-Based TPS (control group) to see their mathematics learning achievement. As explained previously, the normality and the homogeneity between the learning model groups will be tested as well. The results of the normality test of all groups are displayed as in Table 2:

Table 2. The Summary of Normality Test Results

Groups	L_{obs}	L_{table}	Results
Mind Mapping-Based NHT	0.0802	0.0924	H_0 is accepted
Mind Mapping-Based TPS	0.0853	0.0944	$H_0$is accepted
Mind Mapping-Based Direct	0.0923	0.0924	$H_0$is accepted

Based on the test results, it can be concluded that the group of Mind Mapping-Based NHT, Mind Mapping-Based TPS, and Mind Mapping-Based Direct come from populations with normal distribution.

Meanwhile, the result of the homogeneity test of the groups are, for the learning model groups, χ_{obs} = 1,0012with DK =$\{\chi^2 | \chi^2 > \chi^2_{0,05;2}\}$, so$\chi_{tabel}$ = 5,991.Based on these results, it can be concluded that the population in learning model groups and in learning styles groups are homogeneous.

After all of the population are considered having normal distributions and homogeneous in population variance, the hypothesis test is administered. It is conducted by using One-way Anova at the significance level of 5%. The results of the test are displayed as in Table 3.

Table 3. The Summary of Hypothesis Test Results

Source of Variance	df	SS	MS	F_{obs}	F_{table}	Results
Learning Models	2	11927.7935	5963.8968	38.0322	3	H_0 is rejected

Error	269	42182.3241	156.8116
Total	271	54110.1176	

It can be seen from the test results that H_0 is rejected which means that there are differences in mathematics learning achievement between students who are treated with Mind Mapping-Based NHT, Mind Mapping-Based TPS, and Mind Mapping-Based Direct. Stepping forward from the data result, as H_{0A} is rejected, the learning model which gives a better effect on students' learning achievement needs to be known by Scheffe method. The results of the test are displayed as in Table 4.

Table 4. The Summary of Comparison Between Line

H_0	F_{obs}	F_{tabel}	Result
$\mu_{.1} = \mu_{.2}$	26.4165	6	H_{0A} is rejected
$\mu_{.1} = \mu_{.3}$	75.0965	6	H_{0A} is rejected
$\mu_{.2} = \mu_{.3}$	11.7600	6	H_{0A} is rejected

Stepping forward from the data result, as H_{0A} is rejected, the learning model which gives a better effect on students' learning achievement needs to be known. If it seen from the marginal mean, the group of Mind Mapping-Based NHT has the score of 70,8696 and the Mind Mapping-Based TPS has the score of 61,2727. From the data, it can be said that Mind Mapping-Based NHT gives the better achievement than Mind Mapping-based TPS or Mind Mapping-based direct and Mind Mapping-based TPS give better achievement than Mind Mapping-based direct.

In addition, it is clearly seen that the hypothesis (H_0) proposed by the researchers is accepted. Such condition can happens because, in class with Mind Mapping-Based NHT learning model, students are required to cooperate in groups of 4-5 students in solving problems, while for the Mind Mapping-Based TPS class, students are required to think how to solve problems by pairing with friends next to them. It can be said that in Mind Mapping-Based NHT students are given the chance to share ideas more than Mind-Mapping-Based TPS so they achievement will be better. It is in line with what was found by t is also supported by the findings of Baker (2013: 6) saying that NHT creates a positive dependence and accountability because each individual has the potential to be responsible for the success of the group when his number was called. On the other side direct learning model, centered on teachers so the students are less active during learning activities.

Conclusions

Based on the literatures review supported by Anova results to the formulation of the problem, it can be concluded that mathematics learning achievement of tenth grader of public high school in Magetan who are treated Mind Mapping-based NHT have better achievement than Mind Mapping-based TPS or Mind Mapping-based direct and Mind Mapping-based TPS have better achievement than Mind Mapping-based direct.

The results of this study, theoretically, are expected to complement the repertoire of the theory of mathematics regarding Mind Mapping-based NHT and

Mind Mapping-based TPS. While practically, they are expected to broaden students' horizons on how to learn mathematics, communicate in groups and work together in groups. Moreover, they are also expected to be used as inputs for mathematics teachers in determining the learning model corresponding to the characteristics of the subject matter, so that students' mathematics achievement could be improved; and provides a view to the principal and school authorities in determining policies related to learning and teaching mathematics in schools.

References

Adodo, S. O (2013). Effect of Mind Mapping as a Selfon Regulated Learning.*The journal of Social Sciences*, 4 (6), 163-172.

Arends, R.I. (2008). *Learning To Teach*. Terj. Helly Prajitno Soetjipto & Sri Mulyantini Soetjipto. Yogyakarta: Pustaka Pelajar.

Baker, Daniel. Paul (2013). The Effects of Implementing The Cooperative Learning Structure, Numbered Heads Together, in Chemistry Classes at A Rural, Low Performing High School. *Mster Thesis: Louisiana State University*.

Buzan, T. (2012). *Buku Pintar Mind Map.* Jakarta:Gramedia Pustaka Utama.

Jones, B. D., Ruff, C., Snyder, J. D., Petrich, B. & Koonce, C. (2012). The Effects of Mind Mapping Activities on Students' Motivation. *International Journal for the Scholarship of Teaching snd Learning*, 6 (1), 1-21.

Madu, B. C. & Metu, I. C. (2012). Effect of Mind Map as a Note-Taking Approach on Student's Achievements'in Economics. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)*. 3 (3), 247-251.

Tee, T. K., Azman, M. N. A., Mohamed, S., Muhammad, M., Mohamad, M. M., Md Yunos, J., Yee, M. H. & Othman, W (2014). Buzan Mind Mapping: An Efficient Technique for Note-Taking. *The International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering,* 8 (1), 28-31.

Tran, Van. Dat (2014). The Effects of Cooperative Learning on the Academic Achievement and Knowledge Retention. *The International Journal of Higher Education*, 3 (2), 131-140.

Tuna, K. & Kacar, K. A. (2013). The Effect Of 5e Learning Cycle Model In Teaching Trigonometry On Students' Academic Achievement And The Permanence Of Their Knowledge. *International Journal on New Trends in Education and Their ImplicationsJanuary 2013*, 4 (1), 73-87.

Woodard, T (2004). The effects of Math Anxiety on Post-Secondary Developmental Students as related to achievement, Gender, and Age. *Inquiry*, 9 (1), 1-5.