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The effectiveness of project based learning with creative mind-map tasks for improving mathematical connection ability and student curiosity

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Abstract

This study aimed to know the effectiveness of PjBL learning model with creative mind-map assignments on student's Mathematical Connection Abilities and student's curiosity. Population in this study was students of grade VIII SMP Negeri 1 Margorejo Pati year 2017/2018 with a true experimental design types posttest-only control design and samples were chosen randomly. Analysis of data used the proportion test and t-test. The results showed that (1) the ability of student's mathematical connection of the subject who have gained PjBL learning model with creative mind-map assignments have achieved the classical completeness; (2) the mathematical connection abilities of students who have gained PjBL learning model with creative mind-map assignments is higher than students who have gained expository models and (3) the curiosity of students who have gained PjBL learning model with creative mind-map assignments is higher than students who have gained expository models.

1. Introduction

The World of Education, especially in Indonesia, is currently focusing on the quality of education in the improvement of Teaching and Learning Activities, both in primary and secondary schools, involving teachers and students who have different abilities, skills, characteristics and backgrounds. The existence of these differences makes learning as an educational process requires a variety of models, methods, strategies, approaches and techniques so that students can master the material well and deeply.

The form of government attention to the ability of students to mathematics is the Minister of Education and Culture Regulation No. 58 of 2014 concerning the curriculum of Junior High Schools (SMP). One of the characteristics of mathematics learning according to the Permendikbud is that there is a connection between one material with another, ie the material to be studied must meet or master the previous material. This is in accordance with the call of The National Council of Teachers of Mathematics (NCTM) (2000) regarding the need to develop understanding and use of mathematical connections in students' mathematical ideas or thinking. NCTM states that learning programs in schools ranging from Pre-Kindergarten to Class XII should enable students to recognize and use connections between ideas or ideas in mathematics, understand how the connections or connections of ideas in mathematics and arrange them to produce a coherent relationship, and recognize and offer mathematics in the context of problems outside mathematics.

One of the steps teachers can take to create learning that can build students' positive perceptions of mathematics is to relate everyday concept experiences to mathematical concepts or vice versa, look for everyday experiences of mathematical concepts, change everyday language into mathematical language . This ability in mathematics is usually called mathematical connection ability, so the ability of mathematical connection is important to concretize mathematical material learned by students. In addition to mathematical connection skills, another important

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aspect that must be considered in the process of learning mathematics is the positive attitude or views of students towards mathematics. In the Minister of Education and Culture Regulation No. 58 of 2014 concerning Junior High School Curriculum also outlines the core competencies for junior high school mathematics that is understanding and applying knowledge (factual, conceptual, and procedural) based on their curiosity about science, technology, art, culture related to phenomena and events in mathematics subjects. This means that curiosity is important in the process of learning mathematics.

Based on the above, mathematical connection ablity and curiosity student are very important goal of learning mathematics. With mathematical connection ability, students can generate creative ideas in solving problems let alone the ability to connect problems. Meanwhile, the existence of curiosity will make students continue to strive to continue to study more deeply and extensively something that is learned, seen, heard, felt and experienced, especially in learning mathematics.

The test score data on the Pythagorean theorem material of VIII grade students of SMP Negeri 1 Margorejo Pati in the last three years showed low results. Based on observations, students still have difficulty in linking between mathematical material. This shows that the students' mathematical connection ability is also low. So that one of the causes of low student learning outcomes is the lack of students' mathematical connection abilities.

Table 1. Percentage of Completeness in Pythagorean Theorem Material in the Last Three Years.

Criteria	Year 2013/2014	Year 2015/2016	Year 2016/2017
< 75	46,65%	48,875%	56,75%
≥ 75	53,35%	51,125%	43,25%

This show that students are still experiencing difficulties in the pythagorean theorem material. The teacher also stated that the teaching and learning process in the classroom was quite optimal, but students still had difficulty in solving pythagorean theorem problems related to problems of daily life. Students also still have difficulty in connecting between objects and concepts in mathematics. In addition, students also still have difficulty in determining what formula will be used if faced with problems related to everyday life problems.

Based on the above, researchers conducted observations and interviews with students of the problems that have been raised by the teacher. Researchers see that students have difficulty in connecting between concepts previously known by students with new concepts that students will learn. The difficulties of students in learning mathematics mentioned above are elements of mathematical connection ability. So the results of the interviews and observations show that there is a mathematical connection ability of VIII grade students of SMP Negeri 1 Margorejo, which is still not optimal.

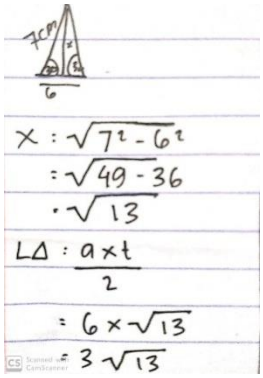

Figure 1. Example results of student answers

Based on observations, the researcher found that in some of the students' answers, students were still wrong in working out the answers. This error is mainly about understanding the previous material which is not strong enough. This appears in the example above where students are still confused about distinguishing the length of the base of a right triangle to calculate the vertical side using the Pythagorean theorem. This means that students are still lacking in the ability to connect between mathematics material that has been delivered.

In addition, researchers also see that students have low curiosity in learning mathematics. This can be seen when most students make less effort to continue to study more deeply and extensively in learning mathematics. For example when the teacher has explained the pythagorean theorem material in learning, no one asks or gives reciprocal responses to the teacher about the material that has been explained. Then it can be said that students have less curiosity.

One of the problems arises because mathematics learning at this time is still dominated by active teachers in the class where students do not bring up the ability to concretize the material at

all. The increasingly swift flow of information no longer allows us to position teachers as omniscient and assume that students need to be entered with various facts of knowledge and information. Learning methods like this do not provide opportunities for students to develop and find their own understanding creatively and connect their understanding to the internal or external environment, so that learning mathematics becomes meaningless. The implication is that the information presented is difficult to absorb, process, and store properly by the student's memory system so there is a lack of curiosity to find out more about the material. For this reason, a learning model that can be used to solve the problem is needed, one of the learning models that can be used to solve the problem is the project based learning (PjBL) model.

Wena (2009: 114) states that Project Based Learning is a learning model that provides an opportunity for teachers to manage learning in the classroom by involving project work. Mathematics learning in class involving project work requires students to work in the classroom, outside the classroom or as homework assignments. Usually the teacher always gives math assignments in the form of questions, summarizes, or does experiments. The task is believed to provide learning experiences, and increase student understanding. Creative mind-map assignments are one form of assignments that might be given to students with the aim that students besides understanding mathematical concepts, it is also expected that students have a comprehensive understanding of the whole material, as well as the application of these concepts and are also expected to increase student curiosity to learn more about the material being taught.

The method of assigning creative mind-maps assignments emphasizes more on originality and synergy, both when mapping their thoughts in the form of hand notes or mind sets when dealing with a mathematical problem. This is based on the analysis of Buzan (2009: 49) regarding the principle of synergy in the work of the human brain in thinking and storing information, that is, we are accustomed to understanding that our thinking processes are arranged in simple addition mathematical principles, where each time we add a new single data or new thoughts into the brain, we only add one ingredient to our brain's memory system. Even though the potential of the human brain to produce mind maps of one information that enters our brains is unlimited. Learning with creative mind-map assignments emphasizes internalization of what is taught so that it is embedded and functions as a conscience and is internalized and practiced in daily life by students. Creative mind map assignments will increase students' knowledge, learning experience and creativity

This study aims to determine the effectiveness of PjBL learning models with creative mind-map assignments to students 'mathematical connection abilities and curiosity, with indicators of effectiveness as follows: (1) students' mathematical connection abilities using PjBL learning models with creative mind-map assignments can achieve classical learning completeness, (2) the average mathematical connection ability of students using the PjBL learning model with creative mind-map assignments is higher than the average mathematical connection ability of students using the expository model; and (3) the level of student curiosity using the PjBL model with a creative mind-map assignment is higher than the level of student curiosity with the expository model.

2. Methods

This research is an experimental research. This research design uses true experimental design with posttest-only control design. The research design in this study can be seen in Figure 2.

$$R \times O_2$$

$$R \quad O_4$$

Figure 2. Research Design

Information:

R : random sample classes

X : the treatment given

O_2 : influence of treatment

O_4 : influence of no treatment

(Sugiyono, 2012).

The population in this study were all eighth grade students of SMP Negeri 1 Margorejo Pati in the academic year 2017/2018. Class sampling is done using cluster random sampling techniques. The sample taken in this study is two classes, where one class is an experimental class, and one class is a control class. The experimental class will be treated in the form of learning PjBL models with creative mind-map assignments, while the

control class will be treated in the form of expository learning model. After taking a sample randomly selected students of class VIII C as the experimental class and students of class VIII B as the control class

The variables contained in this study are grouped into two namely independent variables and the dependent variable. The independent variables in this study are learning using the PjBL model with creative mind-map assignments, while the dependent variables are mathematical connection ability and student curiosity.

Data collection methods used were the documentation method, the test method, and the questionnaire method (questionnaire). The documentation method is used to obtain data on the names and number of students who are members of the population and to determine sample members, midterm grades of mathematics in odd semester VIII for the academic year 2017/2018, minimum completeness criteria in mathematics, and to know the student's initial state of learning mathematics. The test method is used to obtain data about the mathematical connection ability of students in the pythagorean theorem material after receiving treatment, both students from the experimental class and the control class. While the questionnaire method was used to collect data on students' curiosity after receiving treatment, both students from the experimental class and the control class.

After getting the data in the form of the value of the results of tests of mathematical connection ability and scores of students' curiosity, testing is conducted to test the truth of the proposed hypothesis. The test includes classical learning completeness test that is the proportion test in the class that receives learning with the PjBL model with a creative mind-map assignment, the average equation test for mathematical connection ability to find out whether there are differences in mathematical connection ability between students in the class who are learning in the form of PjBL models with mind-map creavite assignments with students in the class with learning in the form of expository models and which one is better and test the equation of the average level of student curiosity to find out whether there are differences in the level of curiosity between students in the class who are learning in the form of PjBL models with creative mind-map assignments with students in the class who are learning expository models and which ones are better.

3. Results & Discussions

After being given treatment for four meetings for each class, the fifth meeting held a mathematical connection ability test and filling the scale of curiosity. The results of the mathematical connection ability test of the experimental class and control class students can be seen in the following Table 2.

Table 2. Student Mathematical Connection Ability Data

	Class	
	Experiment	Control
Number of Students	21	20
The Highest Score		
The Lowest Score	97	90
Average		
Standard Deviation	62	67
Variance		
Completeness	80,33	75,15
	8,29	6,59
	68,69	43,53
	80,9	50

While the results of the level of curiosity of the experimental class and control class students can be seen in Table 3 below.

Table 3. Data on Student Curiosity Level

	Class	
	Experiment	Control
Number of Students	21	20
The Highest Score	84	80
The Lowest Score		
Average	65	54
Standard Deviation		
Variance	77,67	72,2
	5,792	7,691
	33,56	59,16

The results of the research that have been done show that the learning of PjBL model with creative mind-map assignments is effective. This is obtained by testing the research hypothesis, namely:

3.1. Hypothesis 1

Hypothesis 1 test results conducted a proportion test (z test) to measure the PBL learning model with the mind-map creative task achieving classical learning completeness. Based on the results of the z test obtained $z_{score} = 0{,}629$, with $\alpha = 5\%$ obtained $z_{table} = 0{,}1736$. So $z_{hitung} \geq z_{tabel}$ then H_0 rejected, it means mathematical connection ability of the experimental class students achieve classical completeness. Based on the learning completeness test above, it was concluded that students who obtained PjBL learning models with creative mind-map assignments achieved classical completeness in mathematical connection ability.

This achievement is caused by several things including students feeling enthusiastic in following the lessons. Because they learn in their respective groups to create a creative mind-map project. With the process of making a creative mind-map project, it can improve students' mathematical connection ability, because in the process of making this creative mind-map project students are encouraged to connect the interconnection of sub-materials in Pythagorean material as a whole. This is consistent with Ausubel's learning theory which states that learning is said to be meaningful if the information to be learned by students is arranged according to the cognitive structure owned by students. Whereas in the control class there is no grouping of students to make a project so that the achievement of mathematical connection ability of each student is lacking, only students with high cognitive ability can quickly associate material, whereas those with low cognitive are slow in linking material. It is therefore appropriate that the advantages of the Project Based Learning model increase students' ability to be more active in solving complex problems (Suhana, 2012).

3.2. Hypothesis 2

Hypothesis 2 test results performed an average similarity test (t test) to find out whether the average student learning outcomes on the mathematical connection ability of the experimental class students were better than the control class. Based on the t test results obtained $t_{score} = 2{,}208$, with $\alpha = 5\%$ obtained $t_{table} = 1{,}685$. So $t_{score} > t_{table}$ then H_0 rejected, it means that the average mathematical connection ability test results of the experimental class students are better than the control class.

Possible factors that cause differences in the average mathematical connection ability between students in the experimental class and control class students are: (1) In the PjBL learning model with creative mind-map assignments, the teacher assigns projects in the form of assignments with creative mind-map works which is felt to be attractive to students thereby increasing students' mathematical connection abilities in learning. Whereas in the expository learning model, the teacher does not provide a project in the form of a creative mind-map task so that students' mathematical connection abilities are lacking. This corresponds to the meaningful learning theory of Ausubel and also Bruner's learning theory which puts forward the learning process as a holistic result. (2) In the PjBL learning model with the creative mind map task the interaction between the teacher and students increases in the form of questions and answers in the process of making the project so that the transfer of material from teacher to student becomes smoother which will ultimately make it easier for students to understand the learning material. While in expository learning, the teacher explains and discusses the problem classically so that it tends to be boring and decreases students' curiosity and mathematical connection abilities. This corresponds to Piaget's theory of learning through active learning and learning through his own experience making students understand every concept of learning material. (3) The existence of group discussions in making project assignments makes students not ashamed in discussing and expressing their opinions. Through discussion communication will be established where students share ideas and opinions in the completion of the project provided by the teacher. So that also spurred students' mathematical connection abilities. Whereas in expository learning, students tend to work on assignments given by the teacher individually. This is in accordance with Bruner's learning theory which puts forward the learning process, through this learning process students will be able to master the material.

Conversely in learning that uses the expository model applied to the control class makes students less active in learning. Students tend not to ask when the learning process takes place even though students are not honed in their ability to understand the subject matter. This is what makes students not so curious so that they are less motivated and ultimately affect their poor mathematical connection ability.

3.3. Hypothesis 3

Hypothesis 3 test results performed an average similarity test (t test) to find out whether students' curiosity about the mathematics learning activities of the experimental class is better than the control class. Based on the t test results obtained $t_{score} = 2{,}579$, with $\alpha = 5\%$ obtained $t_{table} = 2{,}02$. So $t_{score} > t_{table}$ then H_0 rejected, it means that the curiosity of the experimental class students is higher than the control class.

The average curiosity of students with the PjBL model with creative mind-map assignments was 77.67 while the average curiosity of students with the expository model was 72.2. Then it can be concluded that the curiosity of students in the class taught using the PjBL model with a mind mind map assignment is higher than in the class taught using the expository model

In the experimental class the PjBL learning model is given with the help of a creative mind map. Students form groups of 3-5 students. Next, the researcher gave the project assignment in the form of making a crative mind map. In the process of making these researchers monitor the process of developing a creative mind-map project created by students. After the project assignments are completed, each group presents to the class about the work that has been made. The other group listened and asked if there were things that were not yet understood. The work in the form of a creative mind-map is a tool for students to learn pythagorean material that students have felt is difficult and confusing. Furthermore, at the fifth meeting the researchers held a test to measure students' mathematical connection abilities in the Pythagorean material.

With the process of making creative mind-map assignments can improve students' mathematical connection ability, because in the process of making creative mind-map assignments projects students are encouraged to connect the interconnection of sub-materials in Pyhtagoras material as a whole. So by making this creative mind-map project make learning meaningful. This corresponds to meaningful learning from Ausubel Learning Theory, where the existence of a creative mind-map project assignment using the Project Based Learning learning model can improve students' mathematical connection ability in connecting and linking sub-material linkages in Pyhtagoras material. Besides that, with the creative mind-map project assignments can also increase the curiosity of students who have been curiosity of students based on the opinions of teachers who teach in this class and the researchers observed for themselves that students' curiosity is still lacking. Increased student curiosity is marked by the enthusiasm of students in working on this project task. Not just enthusiasm, but students do questions and answers to researchers about the part of the material to be written on the creative mind-map project. High student curiosity is also characterized by a high score of student curiosity questionnaire in the experimental class rather than in the control class.

High student curiosity after the treatment in the form of providing Project Based Learning with creative mind-map assignments proves Bruner's learning theory. Where in Bruner's theory the best step to learn mathematics is to recognize the concepts and structures included in the material being discussed, through giving this creative mind-map assignment students find out and recognize the concepts and structure of Pythagorean material in the form of images, symbols and charts as outlined in the task of this creative mind-map. In addition, assigning creative mind-map project assignments can train the iconic and symbolic stages in accordance with Bruner's theory. So the final result of student curiosity on mathematics learning material can be increased.

4. Conclusion

Based on the results of research and discussion, it is concluded that the learning model of Project Based Learning with creative mind-map assignments is effective on mathematical connection abilities and curiosity of Grade VIII students on Pythagorean material, because it meets the following three indicators of effectiveness: (1) Mathematical connection ability of students those who obtain learning with the PjBL model with creative mind-map assignments can achieve classical learning completeness, (2) Mathematical connection skills of students who obtain learning with the PjBL model with creative mind-map assignments are better than mathematical connection abilities of students who obtain learning with expository models ; and (3) The curiosity of students who get learning with the PjBL model with creative mind-map assignments is better than the curiosity of students who get learning with expository models.

Suggestions from the authors include the following. (1) Learning with Project Based Learning models with creative mind-map assignments can be used as an alternative to

developing mathematical connection skills and students' curiosity in Pythagorean material in junior high schools (SMP) because learning with Project Based Learning models with creative mind assignments map is proven to be able to make mathematical connection ability and student curiosity better than expository learning models. (2) In applying the Project Based Learning model with a creative mind-map assignment, the teacher needs to pay attention to the timeliness of the project work process by students because this learning model is related to the project assignments so that students are expected to be able to finish in accordance with the planned time. In addition, teachers pay attention to student activeness because the process of learning success also depends on the activeness of students in making projects in each group so that learning is expected to run optimally.

References

Ainurrizqiyah, Z. (2015). Keefektifan Model PjBL dengan Tugas Creative Mind-Map untuk Meningkatkan Koneksi Matematik Siswa. Skripsi. Semarang: FMIPA UNNES.

Arifin, Z. (2012). Evaluasi Pembelajaran. Bandung: Remaja Rosdakarya.

Baumgarten,Elias.(2001).Curiosity as a Moral Virtue. International Journal of Applied Philosophy.International Journal of Applied Philosophy,15(2). Retrieved from https://philpapers.org/go.pl?id=BAUCAA-2&proxyId=none&u=http%3A%2F%2Fwww-personal.umd.umich.edu%2F~elias%2Fcuriosity.pdf

Buzan, T. (2009). Buku Pintar Mind Map. Jakarta: Gramedia.

Depdikbud. (2014). Permendikbud Nomor 58 Tahun 2014 Tentang Kurikulum Sekolah Menengah Pertama. Jakarta: Depdiknas.

Hendriana, Heris, et al.(2014).Mathematical Connection Ability And Self-Confidence.International Journal of Education. 8(1).Retrieved http://ejournal.upi.edu/index.php/ije/article/view/1726/1176

Rahman, M.B.H.A. et al. (2009). Project Based Learning (PjBL) Practices at Politeknik Kota Bhar. Jurnal Ilmiah, 2(4).

Saminanto & Kartono.(2015).Analysis of Mathematical Connection Ability In Linear Equation With One Variable Based On Connectivity Theory.International Journal of Education and Research. ISSN 2411-5681

Sari, A.A. & Jarnawi, A.D. (2008). Pengaruh Pemberian Tugas Creative Mind Map setelah Pembelajaran Terhadap Kemampuan Kreativitas dan Koneksi Matematik Siswa. Prosiding Seminar Nasional Matematika dan Pendidikan Matematika. ISSN 978-979-16353-1-8

Sugandi, A., et al. (2004). Teori Pembelajaran. Semarang: UPT MKK UNNES.

Sugiyono. (2010). Statistika untuk Penelitian. Bandung: Alfabeta.

Suhana, Cucu. (2014). Konsep Strategi Pembelajaran (Edisi Revisi). Bandung: Refika Aditama.

Suherman, Erma, et al. (2003). Common Textbook Strategi Pembelajaran Matematika Kontemporer (Edisi Revisi). Bandung: JICA UPI.

Sumarmo, Utari. (2006). Pembelajaran Ketrampilan Membaca Matematika Pada Siswa Sekolah Menengah. Jurnal UPI. Retrieved from http://math.sps.upi.edu/?p=64.

Tarigan, Daitin. & Sinaga, E.M. (2015). Perbedaan Hasil Belajar Siswa dalam Pendekatan Realistik dengan Pendekatan Ekspositori pada Mata Pelajaran Matematika Kelas IV SDN 101880 Tanjung Morawa. Jurnal Kreano Unnes. ISSN 2442-4218

Wardani.(2010). Implikasi Karakteristik Matematika dalam Pencapaian Tujuan Mata Pelajaran Matematika di SMP/MTs. Yogyakarta: PPPPTK Matematika.

Wena.(2009).Strategi Pembelajaran Inovatif Kontemporer. Jakarta: Bumi aksara.

Widiyatmoko, A. & S.D. Pamelasari.(2012). Pembelajaran Berbasis Proyek untuk Mengembangkan Alat Peraga IPA dengan Memanfaatkan Bahan Bekas Pakai. Jurnal Ilmiah, 1(1) 51-56.

Widyatini, T. (2014). Penerapan Model Project Based Learning (Model Pembelajaran Berbasis Proyek) dalam Materi Pola Bilangan Kelas VII. Yogyakarta: PPPPTK Matematika.