Judul Artikel: Problem based learning using manipulative materials to improve student interest of mathematics learning

Terbit di: Journal of Physics: Conference Series, Vol. 1157 [Proceedings of International Conference on Mathematics and Science Education 2018], Tahun 2019

Journal of Physics: Conference Series

Country	United Kingdom - SIR Ranking of United Kingdom
Subject Area and Category	Physics and Astronomy Physics and Astronomy (miscellaneous)
Publisher	Institute of Physics
Publication type	Journals
ISSN	17426588, 17426596
Coverage	2005-ongoing
Scope	The open access Journal of Physics: Conference Series (JPCS) provides a fast, versatile and cost-effective proceedings publication service.

65

H Index

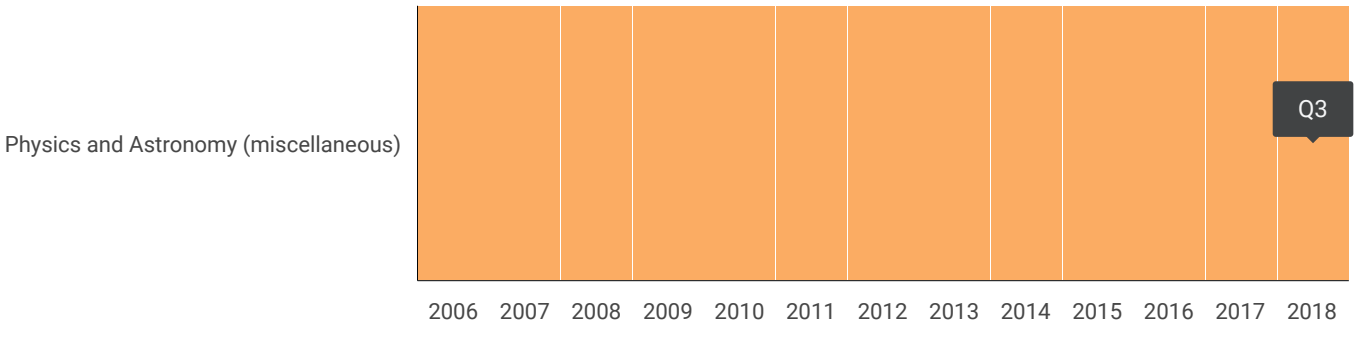
Homepage

How to publish in this journal

Contact

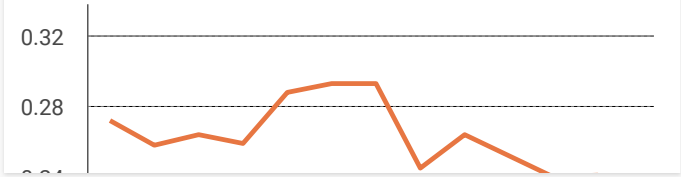
Join the conversation about this journal

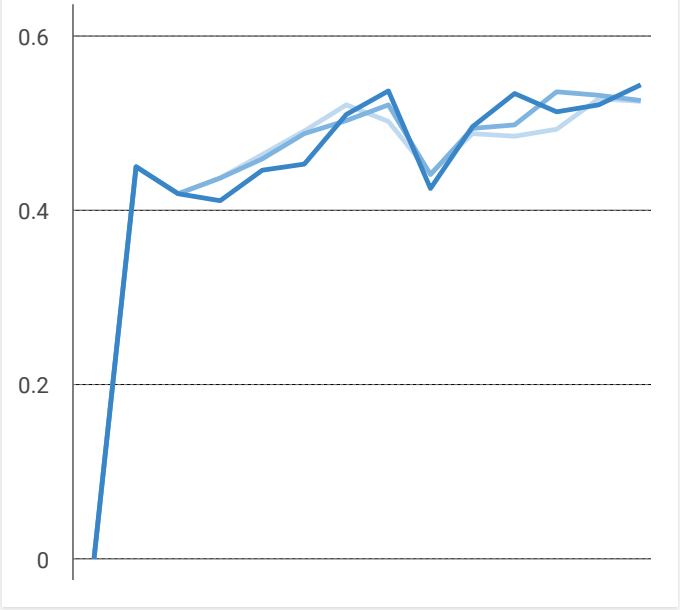
Quartiles



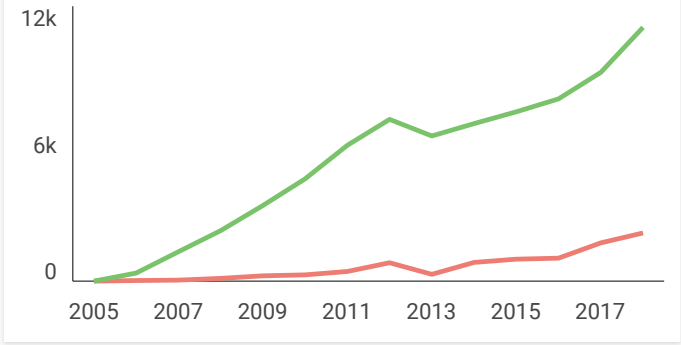
SJR

Citations per document

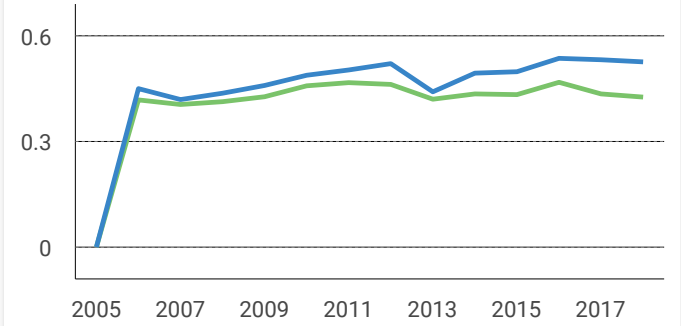




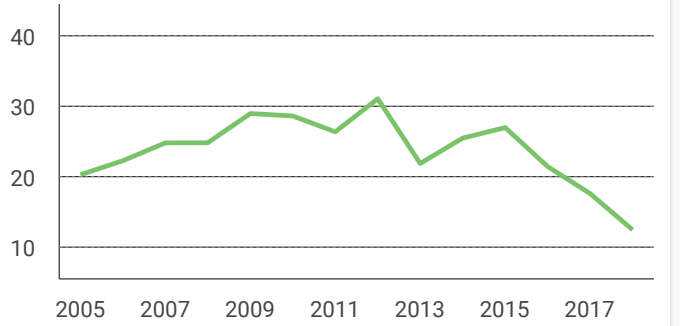
Total Cites Self-Cites



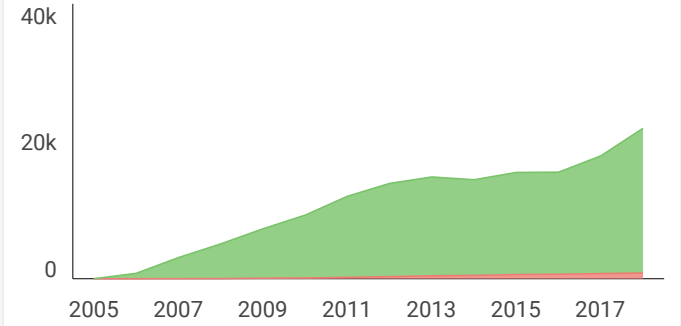
External Cites per Doc Cites per Doc



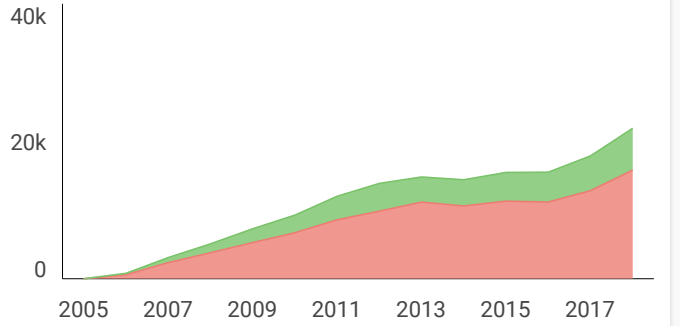
% International Collaboration



Citable documents Non-citable documents



Cited documents Uncited documents



← Show this widget in your own website

Just copy the code below and paste within your html code:

<a href="https://www.scimag

Source details

Journal of Physics: Conference Series

Scopus coverage years: from 2005 to 2019

Publisher: Institute of Physics Publishing

ISSN: 1742-6588 E-ISSN: 1742-6596

Subject area: Physics and Astronomy: General Physics and Astronomy

View all documents > Set document alert Save to source list Journal Homepage

CiteScore 2018
0.51
Add CiteScore to your site

SJR 2018
0.221

SNIP 2018
0.454

CiteScore CiteScore rank & trend CiteScore presets Scopus content coverage

CiteScore 2018 Calculated using data from 30 April, 2019

$$0.51 = \frac{\text{Citation Count 2018}}{\text{Documents 2015 - 2017*}} = \frac{\text{11,243 Citations}}{\text{21,896 Documents}}$$

*CiteScore includes all available document types View CiteScore methodology > CiteScore FAQ >

CiteScore rank

Category	Rank	Percentile
Physics and Astronomy	#167/216	
General Physics and Astronomy		

View CiteScore trends >

CiteScoreTracker 2019

Last updated on *06 February, 2020*
Updated monthly

$$0.56 = \frac{\text{Citation Count 2019}}{\text{Documents 2016 - 2018}} = \frac{\text{17,309 Citations to date}}{\text{31,134 Documents to date}}$$

Metrics displaying this icon are compiled according to Snowball Metrics ↗, a collaboration between industry and academia.

International Conference on Mathematics and Science Education (ICMScE 2018)

Preface

Higher order thingking and communication skills are some of the most important features to develop in mathematic and science education. As parts of the 21st century skills, both significantly-necessary skills are a framework for leading educators to project their educational goals toward critical thinking, creativity, collaboration, and ICT literacy achievement.

International conference on Mathematics and Science Education (ICMScE) was held by School of Postgraduate Studies, Universitas Pendidikan Indonesia, supported by its vice rector of research, business, and partnership. The conference aimed at strengthening mathematics and science education to promote students' 21st century skills. The conference was conducted in Bandung, Indonesia on May, 5th, 2018, and attended by more than 700 participants from mathematics and science education fields.

Four experts from Australia, South Korea and Malaysia contributed to give their knowledge and experiences on relevant themes. Audience came from several countries such as Indonesia, Brunei Darussalam, South Korea, India, Thailand, the Philippines and Zimbabwe. More than 600 papers were presented in the conference. With respect to more than 300 papers selected, The ICMScE committee herewith would congratulate the authors whose papers were published in this conference series. The committee hopes that all the findings and knowledge shared in this venture give beneficial impacts on the quality of mathematics and science education.

The Editors
Dr. Ade Gafar Abdullah
Dr. Asep Bayu Dani Nandiyanto
Irvan Permana, M.Pd.
Rika Rafikah Agustin, M.Pd.
Sutarno, M.Pd.
Saprudin, M.Pd.

LIST OF COMMITTEE

Chairman

Dr. H. Sufiyani Prabawanto, M.Ed

Leader Executive

Irvan Permana , M.Pd.
Erwin, M.Pd.
Ridwan, S.Pd.

Steering Committee

Prof. Dr. H. R. Asep Kadarohman, M.Si.,
Prof. Dr. Didi Sukyadi, M.A.
Prof. H. Yaya Sukjaya Kusumah, M.Sc., Ph.D.
Prof. Dr. Hj. Anna Permanasari, M.Si.
Prof. Dr. Disman, M.S.
Siti Fatimah, S.Pd, M.Si, Ph.D.

International Advisor Boards

Prof. Dr. Didi Suryadi, M.Ed, Universitas Pendidikan Indonesia, Indonesia
Prof. Lew Hee-Chan, M.Ed, Ed.D, Korea National University of Education Seoul, South Korea
Prof. Seoung-Hey Paik, Ph.D, Korea National University of Education Seoul, South Korea
Prof. Dr. Minsu Ha, Korea National University of Education Seoul, South Korea
Prof. Dr. Cheng Ming Yu, Universiti Tunku Abdul Rahman, Malaysia
Prof. Les Kirkup, University of Technology Sidney
Prof. Dr. Hj. Rr. Hertien K. Surtikanti, Universitas Pendidikan Indonesia, Indonesia
Prof. Dr. Hj. Nuryani Y. Rustaman, M.Pd, Universitas Pendidikan Indonesia, Indonesia
Prof. Dr. Liliasari, M.Pd, Universitas Pendidikan Indonesia, Indonesia
Prof. Dr. Phil. Ari Widodo, M.Ed, Universitas Pendidikan Indonesia, Indonesia

Scientific Committee

Prof. Dr. Asep Kadarohman, M.Si., Universitas Pendidikan Indonesia
Prof. Dr. Didi Sukyadi, M.A., Universitas Pendidikan Indonesia
Prof. Yaya Sukjaya Kusumah. M.Sc. Ph.D., Universitas Pendidikan Indonesia
Prof. Dr. Anna Permanasari, M.Si., Universitas Pendidikan Indonesia
Siti Fatimah, M.Si., Ph.D., Universitas Pendidikan Indonesia
Dr. Nahadi, M.Pd., Universitas Pendidikan Indonesia
Dr. Dadi Rusdiana, M.Si., Universitas Pendidikan Indonesia
Dr. Riandi, M.Si., Universitas Pendidikan Indonesia
Dr. Bambang Supriatno, M.Si., Universitas Pendidikan Indonesia
Dr. rer. nat. Ahmad Mudzakir, M.Si., Universitas Pendidikan Indonesia
Dr. Taufik Ramlan, M.Si., Universitas Pendidikan Indonesia
Dr. Dr. Ade Ghafar Abdullah, M.Si, Universitas Pendidikan Indonesia
Dr. Eng. Asep Bayu Dani Nandianto, M.Eng., Universitas Pendidikan Indonesia
Dr. Yayan Sanjaya, M.Si., Universitas Pendidikan Indonesia
Dr. Winny Liliawati, M.Si., Universitas Pendidikan Indonesia
Dr. Elah Nurlaelah, M.Si., Universitas Pendidikan Indonesia
Fitri Khoerunnisa, Ph.D., Universitas Pendidikan Indonesia

Organizing Committee

Muhammad Satriawan, M.Pd., Universitas Pendidikan Indonesia
Muhammad Syaipul Hayat, M.Pd., Universitas Pendidikan Indonesia
Rika Rafikah Agustin, M.Pd., Universitas Pendidikan Indonesia
Jumrodah, M.Pd., Universitas Pendidikan Indonesia
Saprudin, M.Pd., Universitas Pendidikan Indonesia
Sutarno, M.Pd., Universitas Pendidikan Indonesia
Thoha Firdaus, M.Pd., Universitas Pendidikan Indonesia
Cece Sutia, M.Pd., Universitas Pendidikan Indonesia
Al Faris Putra Alam, S.Pd., Universitas Pendidikan Indonesia
Evi Roviati, M.Pd., Universitas Pendidikan Indonesia
Wieka Septiana, M.Pd., Universitas Pendidikan Indonesia
Rosmiati, M.Pd., Universitas Pendidikan Indonesia
Theresia Florentina Dholo, M.Pd., Universitas Pendidikan Indonesia
Maulidiya, S.Pd., Universitas Pendidikan Indonesia
Juli Firmansyah, M.Pd., Universitas Pendidikan Indonesia
Nilam Suri Rahmayani, M.Pd., Universitas Pendidikan Indonesia
Kadek Dwi Hendratma Gunawan, M.Pd, Universitas Pendidikan Indonesia

Table of contents

Volume 1157

February 2019

Previous issue Next issue

Accepted papers received: 24 December 2018
Published online: 12 March 2019

View all abstracts

Issue 3

Papers

Problem based learning using manipulative materials to improve student interest of mathematics learning

Problem based learning using manipulative materials to improve student interest of mathematics learning

K D P Meke[1*], J Jailani[2], D U Wutsqa[2], and H D Alfi[3]

[1] Program Pascasarjana Pendidikan Matematika, Universitas Negeri Yogyakarta, Jl. Colombo No.1, Yogyakarta 55281, Indonesia
[2] Departemen Pendidikan Matematika, Universitas Negeri Yogyakarta, Jl. Colombo No.1, Yogyakarta 55281, Indonesia
[3] SMPK Mater Inviolata, Jl. Don Lorenzo, Balela, Larantuka 86214, Indonesia

[*]konstantinus.denny2016@student.uny.ac.id

Abstract. This classroom action research reviews about the using of Problem Based Learning (PBL) with the use of manipulative materials to improve students interest in mathematics learning. PBL provides an opportunity for students to learn mathematical activities related to real life problems with use of small groups in the classroom. The manipulative material will help students understand abstract ideas of mathematics, and make learning mathematics more interesting, challenging, active and can increase student interest in mathematics. Thus, applying PBL with the use of manipulative materials can improve student interest in mathematics learning.

1. Introduction

Mathematics are a structured science, in which there are ideas, and concepts that are interconnected. Mathematics are a science with abstract basic objects, arranged hierarchically, one concept becomes the basis for learning the next concept, applied in everyday life, and used as a concept in solving the problem [1]. In the process of learning mathematics at school, students are expected to be able to explain the interrelationships between the information they get and who they have experienced, and are expected to apply it appropriately in attitude, knowledgeable, skilled when they learn [2]. In addition to cognitive aspects, the process of learning mathematics also certainly influenced by the affective aspects of students. There are four most important affective characteristics in students that must be developed and considered during the process of learning mathematics one of which is the interest in learning mathematics [3]. interest in learning has an important role in the learning process of mathematics [4]. Students' interest in learning especially on the process of learning mathematics an important factor that determines learning outcomes [5].

Interest contains cognitive aspects (knowledge and information responses about mathematical objects or activities as a form of concern), and emotions (participation and the experience was accompanied by a certain sense, such a sense of fun, which contributes to the high willingness and desire to perform an activity, including in mathematics) [6]. The interest appears from the response in which the student aware of their interest in an object or activity, which then begins to find out or begins to want to be actively involved in it [7]. In learning mathematics, students' interest in learning can be seen in the tendency of students to give attention, feel interested and actively participate to learning mathematics [8,9].

Less of interest can lead to students having difficulty in completing mathematics [10]. The abstract nature of the object in learning mathematics makes the students difficult to learn. Students who have difficulty understanding the concept will have difficulties for the next level, making students less likely to be interested and less active when doing math learning activities. Ideas in mathematics learning process that can increase students' interest in learning mathematics is to use real-life problems as learning materials in the classroom. In addition, small groups in the classroom and use of other sources of learning and mathematics such as puzzles and manipulative materials can arouse students' interest in learning mathematics [11]. Therefore problem based learning (PBL) becomes one of the recommended learning.

Problem based learning is student centered learning as a learning objective, where the learning process based on analysts, resolutions, and discussions about the issues provided. Problem based learning as a teaching based on ideals of student centered constructivism. Teachers help students to focus on solving problems in real life [12]. Problem Based Learning (PBL) enables students to think critically, creatively and monitor their understanding [13]. Problem-based learning requires students to work together in groups to solve complex and authentic problems that help develop content knowledge and problem solving, reasoning, communication, and self-assessment skills [14]. Problem-based learning studies have focused on student learning, student roles, teacher roles, problem design, and use of technology and visual material [15]. Research on problem based Learning is more effective than direct learning in terms of achievement of competency standards, motivation, and interest in learning mathematics students [16].

In learning with Problem Based Learning (PBL), before starting to solve the problem, students are given the opportunity to understand the problem. In this case the problem often encountered students are pouring their abstract ideas into concrete representation that allows them to find a solution. For help students understand abstract material or introduce new concepts, it takes manipulative material in mathematics learning [17]. Manipulative material are tangible objects that students can explore, arrange, move around, group, sort, to show a deeper understanding and use to measure as they model mathematical concepts and problems [18,19].

Using manipulative materials will help students understand abstract ideas of mathematics, prove mathematical ideas and make learning mathematics more interesting, challenging, and motivate students to learn actively, make learning mathematics more interesting and fun, and build student confidence [20,21]. Reveals that students who learn from concrete examples will more easily divert or apply their knowledge into similar concrete contexts in their lives [22]. Cooperative learning using effective manipulative visual materials both in terms of learning achievement and in improving the appreciation or interest of learners towards mathematics [23]. Matching the manipulatives to mathematical concept is the most important step that any teacher during lesson preparation. The use of manipulative material in mathematics learning needs to be accompanied by an understanding of the relationship between the object and the mathematical ideas it describes [24]. This is because mathematics is an abstract subject that connects to the real world through physical representation which is the approach of abstract ideas [25].

Based on the description, then the implementation of Problem Based Learning with the use of manipulative material is important to be studied. This research collaborated between Problem Based Learning (PBL) model of learning in the application process using manipulative material. Problem-based learning with the use of manipulative materials is expected to help students find solutions to real-life daily issues raised in learning so that students have high learning attitudes toward mathematics and learning and improve student's cognitive achievement.

2. Research Method

This type of research is a classroom action research (PTK) conducted collaboratively between mathematics teacher and researcher. The subjects of this research is students of class VIII in Mater Inviolata Larantuka junior high school (Larantuka is a small town located along the coastline whose inhabitants are plural communities, with their main livelihoods are farming and fishing) totaling 40 students consisting of 21 female and 19 male. The types of data collected in this study include both qualitative and quantitative as follows. Qualitative data consists of lesson plans, field notes, observer

records, and documentation. Quantitative data consists of questionnaire data of student learning interest in mathematics learning, observation data, student learning outcomes. Questionnaire of student interest consists of 20 items of statement consisting of 13 positive statements and 7 negative statements that have been validated by 4 supervisor. Indicators of student interest used in this research questionnaire are: Student attention, feelings of pleasure or interest of students during mathematics learning, and student activity in learning mathematics [7,8,9,10,11]. Example statement on questionnaire for the student attention in positive statement; "I listen to teacher guidance during math lessons". Example statement on questionnaire for feelings of pleasure or interest of students during mathematics learning in positive statement; "I am enthusiastic when the math teacher gives students the opportunity to discuss".

This classroom action research in Probability for grade VIII students procedure consisting of initial observations and two cycles each using four action components: planning, action and observation and reflecting [26]. First cycle with 3 action talked about sample space and possible sample points of an event, theoretical probability, and experimental probability of an event. The second cycle with 3 action talk about comparing theoretical and experimental probability, the complement probability and expectation.

Activities in the initial observation were to give a questionnaire of student learning interest, pretesting and observing the learning process undertaken by the teacher including the methods used by the teacher and analyzing the problems related to the research focus. Activity in the planning stage is to compile the questionnaire of interest in learning mathematics of students, arrange the flow of problem based learning using manipulative materials in "Probability" for student grade VIII consisting of 5 steps: student oriented to problem, organize students to learn, Individual or guided investigation group, develop and present the result, and Analyze and evaluate the problem solving process [13]. In addition at this stage the researchers compose student worksheets, test questions, observation sheets and field notes.

In Action and observation, researchers take action using the planning guides that have been made. All activities that occur during the learning process are observed by the school's math teacher. In order to obtain more accurate information, the researchers have prepared the observation sheet as a guide in the preparation of records of activities in the field. The data obtained from the observations were then analyzed, and reflected. Reflection is a discussion between supervisor, researchers, and teachers of mathematics concerned Discussion aims to evaluate the processes that occur, deficiencies, or all matters relating to the actions undertaken and learning achievement used for data deduction.

Data analysis technique obtained in this research is the result of questionnaire of student learning interest, the result of observation analysis and field note presented descriptively, and the average written test conducted at the end of the action. Results of questionnaire interest in learning, categorized as in table 1:

Table 1. Result category of Student Interest

Score (X)	Category
$X > 80$	very high
$66{,}67 < X \leq 80$	high
$53{,}33 < X \leq 66{,}67$	medium
$40 < X \leq 53{,}33$	low
$X \leq 40$	very low

Source: Azwar (2015) [27]

This research is said to be successful if there is an increase in student learning interest for each cycle and achieve the target that has been made that is $X > 53{,}33$ with an average achievement of 80%, and score for student cognitive reaching reach 80%.

3. Result and Discussion

3.1. Result

The result of questionnaire analysis of students interest in learning mathematics at the end of cycle 1 and cycle 2 showed a significant improvement when compared with the result of questionnaire analysis at initial observation. The result of comparison of students learning interest can be seen in table 2 below:

Table 2. Result category of Student Interest Cycle 1

Score (X)	Category	Initial Observation	Cycle 1	Cycle 2
$X > 80$	very high	0%	5%	22,5%
$66,67 < X \leq 80$	high	2,5%	42,5%	67,5%
$53,33 < X \leq 66,67$	medium	32,5%	50%	10%
$40 < X \leq 53,33$	low	42,5%	2,5%	0%
$X \leq 40$	very low	22,5%	0	0%

From the table, the average achievement of students' interest in the first cycle of 70.95% increased significantly compared to the initial observation of 51%. students in the high category a total of 17 students after the action on cycle 1 increased from 1 student at the initial observation. The average of students' cognitive achievement the action in cycle 1 was 83.17 (76.92% reached KKM = 70), an increase compared to the initial test given at initial observation of 46.73 (0% reaching KKM = 70). from the action cycles 2, obtained an average achievement of student interest in mathematics at 81.025%. The average cognitive achievement of students after being given action on cycle 2 of 82, 78 (92.5% reached KKM = 70).

3.2. Discussion

The use of manipulative materials was applied in finding real-life solutions on student worksheets. First example, students are ask to find the solution and conclusion about comparing theoretical and experimental probability. The given problem is to determine who has the greatest opportunity for 3 candidates out of 30 students who run for classroom leader. Student using one red ball as first candidate, one yellow ball as second candidate , and one blue ball as third candidate and take 30 randomly to get the value of experimental probability and compare with the value of theoretical probability to got the conclusion. This manipulatie material following by Kelly in 2006 state manipulative material are objects that students can explore and to show a deeper understanding and use to measure as they model mathematical concepts and problems[19].

For the second example, student must make a list of 2 portion luch menu that can be ordered at the school cafeteria when they just have a money Rp. 9000.00. The school cafeteria provides three types of food, namely and price list following in table 3.

Table 3. Lunch Menu and Price List

Menu	Price List
Nasi Campur	Rp. 5.000,00
Nasi Goreng	Rp. 4.000,00
Bakso	Rp. 4.500,00

Student using red postcard as nasi campur, yellow postcard as nasi goreng , and green postcard as bakso and make a list of two portion menu from the event of theoretical probability to got the conclusion.. This mean use of manipulative material in mathematics learning needs to be accompanied by an understanding of the relationship between the object and the mathematical ideas it describes as stated by Mink in 2010.

Based on the analysis of interest in learning and cognitive tests of students in cycle 1 achievement criteria have not met the target of research. From the results of reflections made based on the observation sheet, and field notes. it is seen that in the learning process of the first meeting of this cycle 1, students are less responsive to learning by using PBL with manipulative use. This is because students are not familiar to solve the problem in real life, and apply it in the concept of mathematical calculations. But the students are actually starting to give more attention, and are interested in the issues raised in the student worksheets because the issues are close to their daily lives. This can be seen from students' enthusiasm to ask questions and use other learning resources to find solutions to the problems. The results of this observation support the results of Astutik research in 2017 that real life problem on problem based learning is more effective than direct learning in terms achievement of motivation, and interest in learning mathematics students [18]

Students look to give more attention and interest in learning process both at the second meeting of cycle 1 and cycle 11, when using manipulative materials. Students feel helpful because they can apply the calculations of mathematical concepts to find solutions to the abstract concepts given in the problem. These finding result support De Bock, et al result in 2011 that students who learn from concrete examples will more easily divert or apply their knowledge into similar concrete contexts in their lives [25]. These findings also support the results of Cope research in 2015 that manipulatives have the potential to help concrete abstract ideas, help students solve problems, and make math lessons more interesting and fun [22].

From the cognitive learning outcomes of students in learning shows a significant improvement. The use of manipulative materials improves students' ability on the cognitive aspects of their application to real-world problems. This can be seen from the results of cognitive learning in cycles 1 and 2. This finding supports the results of Sasongko and Jailani research in 2014 which states that learning planning using manipulative materials meets effective criteria with 90% (KKM = 60) [26]. In this study, the cognitive learning outcomes in cycle 1 had mean = 83.17 slightly higher than cognitive learning outcome in cycle 2 had mean = 82,78. This is because the material learning in cycle 2 covers more difficult than the cycle 1. However, if viewed from the criteria of students' completeness meet the value of KKM = 70, seen a significant increase between the cycle 1 = 76.92% and cycle 2 = 92, 5%.

Some of the problems in this study are: (1) limited study time to control the learning process of students in class and due along with the holiday of Easter. (2) few students are still not good in applying the use of manipulative materials. (3) little context of issues raised in learning can not be applied using manipulative materials. so that the teacher have to creative in connect the manipulative material to the real world problem

4. Conclusion

Implementation of the probem based learning model with the use of manipulative materials in learning provides experience in students to increase student learning interest so that the model can be applied in the learning process. Real life issues raised make students appreciate and pay more attention to the learning process of mathematics. Students are also more interested and happy to be actively involved in the learning process through the use of manipulative materials. Manipulative materials help students to understand the abstract concept that exists in the given problem. Students are able to find the mathematical concepts used to find solutions to the problem. This makes students more actively participate in the learning process of mathematics

The use of problem based learning model with the use of manipulative material in learning can also improve students' cognitive results so that the model can be applied in the learning process. In addition, the probem-based learning model with the use of manipulative materials also makes the subject teachers more creative and innovative in planning the learning process of mathematics in the classroom, because teachers are required to be able to apply the problems in the real world and relate them to the manipulative materials that can be used as symbols of the concept abstracts that exist in the problem.

Acknowledgments

With the completion of this article, then the authors say thank to the headmaster of SMP Mater Inviolata Larantuka, mathematics teachers of SMP Mater Inviolata as observer, and the supervisor who helps the

author in the preparation of learning planning, questionnaire interest in learning mathematics students and students cognitive tests.

References

[1] Sriraman B and English L 2010 *Theories of Mathematics Education* (London: Springs) p 214
[2] National Council of Teacher f Mathematics 2000 *Principles and Standars for School Mathematics* (Reston, VA: The National Council of Teacher of Mathematics, Inc) p 4
[3] Mardapi D 2008 *Teknik Penyusunan Instrumen Tes dan Nontes* (Yogyakarta: Mitra Cendekia Press) p 105
[4] Schukajlow S, et al 2012 *Educational studies in Mathematics* 79 215-237
[5] Lianghuo F, et al 2005 *Paper presented at the The 3rd ICMI Regional Conference on Mathematics Education in China* (Singapore: Nanyang Technological University) p 1
[6] Fathurrohman M and Sulistirini 2012 *Belajar dan Pembelajaran* (Yogyakarta: Teras) p 175
[7] Harackiewicz J M and Hulleman C S 2010 *Social and Personality Psychology Compass* 4 42-55
[8] Elliot S N, et al 2000 *Educational Psycology: Effective Teaching, Effective Learning* (Boston: The Mc Graw- Hill Companies, Inc) p 394
[9] Ormrod J E 2003 *Educational psychology developyng learners (4th ed)* (Upper Saddle River, NJ: Pearson Education) p 399
[10] Blanco L and Garrote M 2007 *Eurasian Journal Mathematics Sains and Technology Education*, 3 p 221-229.
[11] Woolfolk A 2007 *Educational Psychology (10th ed)*. (Boston, MA: Pearson Education) p 384
[12] Mac Math S Wallace J and Chi Xiaohong 2009 *A research-into-practice series produced by a patnership between the Literacy and Numeracy Secretariat and the Ontario Association of Deans of Education* (Toronto: University of Toronto) p 1
[13] Sungur S and Tekkaya C 2006 *The journal of educational research*, 99 p 307-317
[14] White H 2000 Stanford University Newsletter on Teaching, 11 p 1-8
[15] Jonassen D H and Hung W 2008 *Interdisciplinary Journal of Problem based Learning* 2 p 6-28
[16] Astutik H S 2017 Jurnal Riset Pendidikan Matematika 4 (1) p 56-66
[17] Fennema E and Romberg T A 1999 *Mathematics Classrooms that Promote Understanding* (New Jersey: Lawrence Erlbaum Associates, Inc) p 29
[18] Posamentier A S Smith B S and Stepelman J 2010 *Teaching secondary mathematics: teaching and enrichment unit. (8th ed)* (Boston: Allyn & Bacon) p 6
[19] Kelly C A 2006 *The Montana Mathematics Enthusiast* 3 p 184-193.
[20] Cope L 2015 *Delta Journal of Education.* 5 p 10-19
[21] Kamina P and Iyer N N 2009 *Nera Conference Proceeding* (Boston: Nera Inc) p 1-10
[22] De Bock D, et al 2011 *Journal for research in mathematics education* 42 p 109-126
[23] Sasongko H W and Jailani 2014 *Pythagoras: Jurnal Pendidikan Matematika* 9 p 136-146
[24] Mink D V 2010 *Strategies for teaching mathematics*. (CA: Shell Education) p 71
[25] Berger E J 1973 *Instructional aids in mathematics* (Washington, D.C: NCTM) p 266
[26] Kemmis S McTaggart R and Nixon R 2014 The Action Research Planner: Doing Critical Participatory Action Research (London: Springer) p 18
[27] Azwar S 2015 Penyusunan skala psikologi edisi 2. (Yogyakarta: Pustaka Belajar) p 13