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The Ability Solve Geometry Problems in Spatial Intelligence Through Project Based Learning-Ethnomathematics Assisted by Augmented Reality Apk

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Abstract

This study aims to find patterns of students' geometry problem-solving abilities after applying learning based on augmented reality-based learning-ethnomatemics apk in terms of spatial intelligence. This study uses a mixed method with explanatory sequential design. The population is students of class VIII Al-Madina Islamic junior high School Semarang 2018/2019 school year. The subjects in this study were students of class VIII selected based on three categories of spatial intelligence, namely high, medium and low. Data collection techniques using tests of students' geometry problem solving abilities, spatial intelligence tests and interviews. The results of this study are learning using project-based learning-ethnomatematics and learning using effective project-based learning-ethnomatatics assisted with augmented reality apk, averaging the three different sample classes, and description of geometry problem solving abilities in terms of students' spatial intelligence in the high, medium, and low categories in project-based learning-ethnomatematics assisted with augmented reality apk obtained the result that the level of spatial intelligence of students may not necessarily describe the level of problem solving ability.

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INTRODUCTION

Some things that affect the achievement of the objectives of learning mathematics by students one of which is that if the ability of mathematics can be mastered by students well. According to (NCTM, 2000) some abilities that students must achieve in learning mathematics one of which is problem solving (mathematics problem solving). According to Torio (2015) one of the goals in learning mathematics is to make students an effective problem solver. Problem solving abilities often receive special attention because according to (Prabawa and Zaenuri, 2017; Ulya, 2015) problem solving is of the essence, cannot be separated from mathematics and has a role as the core of the domain of competence in the implementation of mathematics learning processes.

In fact, according to Kaur (2014) states that in learning mathematics, students often have difficulty doing problem solving activities, even intelligent students also experience it. According to Nur and Rahman (2013) states that students 'weaknesses in developing reasoning power result in weaknesses in students' problem solving abilities. Some countries also conduct research to improve their problem solving abilities including research conducted by Hwang, Hung and Chen (2013) in Taiwan, then Kratas and Baki (2013) in Turkey. Other research is based on the results of the PISA (Program for International Student Assessment) study conducted in 2015, ranked 69th out of 76 countries (OECD, 2015).

According to Khotimah (2013: 2) states, "There are still many students who experience difficulties in learning geometry." According to the results of the 2015 National Examination, geometry subjects are at a low presentation (Anjarsari, et al, 2017). Based on the analysis of PUN (National Examination Preparation) also showed that only 44.75% of students were able to solve geometry problems. This is also consistent with the results of the preliminary study of the geometry problem-solving ability of Al-Madina Islamic junior high School students given to 30 students with an average value of 4.933 and a standard deviation of 2.448.

Prabowo and Ristiani (2011: 73) state that problems in the field related to geometry in schools are due to the high level of abstractness of geometric objects and the lack of visualization abilities of abstract objects or objects in students' minds which is one of the elements of spatial ability that must be possessed student. According to Zevenbergen, et al (2004: 314) states that the activities of geometry that can develop skills include visualization. Aszalos & Bako (2004: 2) states that to solve spatial geometry problems visual or spatial intelligence is needed. According to Gardner (2011: 77-292) states that there are 6 intelligence including spatial intelligence.

Augmented Reality (AR) learning media will be used in learning geometry to help students visualize images. According to Mustika, et al (2015) revealed in his research that AR is a concept of a blend of Virtual Reality with World Reality. According to Sunjaya (2015) in his research said Augmented Reality is a technology that involves overlaying computer graphics in the real world, where three-dimensional virtual worlds can be brought to the real-world environment in real-time. In the AR learning process, it can be used to present geometric shapes that are no longer abstract but become tangible shapes, so that the elements in geometry can be clearly seen.

Project Based Learning (PjBL) based on projects is assessed in accordance with augmented reality learning media. According to Wicaksana et al (2017: 169) PjBL is designed to be used in complex problems that require student investigation to understand it. PjBL learning model or project-based learning is a learning model that uses projects or activities as a medium that engages students in transferring knowledge and skills through a process of discovery with a series of questions arranged in assignments or projects (Ambarwati, 2015; Lestari, 2017; Hosnan 2014: 319). Project-based learning is a way of learning that uses problems as a first step in gathering and integrating new knowledge based on experience in real activities (Widyantini, 2014). According to Febriana (2017: 375) project-based learning has great potential to provide a more interesting and meaningful learning experience for students.

PjBL learning models will be more meaningful if combined with ethnomatematics. Ethnomatematics is the mathematical practice of cultural groups that can be identified and can be considered as a study of mathematical ideas found in each culture (D'AAmbrosio, 1985). Ethnomatematics uses broad mathematical concepts related to various mathematical activities, including grouping, counting, measuring, designing buildings or tools, playing, determining locations, making graphics, or using visual aids (Rachmawati, 2012).

The superiority of the PjBL-ethnomatematics model is coupled with the help of AR media which can help students in illustrating 2-dimensional images into images that look real and can move. AR media helps students in matching real shapes with shapes in geometry. Project-assisted assignments make students learn to solve real-life problems with ethnomatematics. If students can understand geometry well, it is hoped that it can improve students 'spatial intelligence, so as to improve students' geometry problem solving abilities. The problem solving ability in this study was measured based on Polya's stages and NCTM indicators. The stages of problem solving used in this study are the Polya stages. According to Polya (1973: 6-19) there are four steps that must be taken to solve a problem namely understanding the problem, planning the problem solving, carrying out the problem solving and re-examining the results obtained. The PjBL steps used are (Wati, 2018): (1) analyzing the problem, (2) creating a design and project implementation schedule (3) carrying out research (4) preparing a draft / prototype of the product (5) measuring, assessing and improving the product (6) finalization and publication of the product.

METHOD

This study uses a combination method (mixed method) with an explanatory sequential design. The population in this study were students of class VIII Al-Madina Semarang Islamic junior high School in 2018-2019 school year.

In quantitative research is used to determine the effectiveness of project-based learning-ethnomatematics learning and project-based learning-ethnomatematics learning assisted by augmented reality apk. The data used is the result of the geometry problem-solving ability test. The sample in this study was class VIII B as an experimental class 1, class VII C as an experimental class 2 and VII A as a control class selected using cluster random sampling technique. Quantitative data analysis techniques were tested using tests of normality, homogeneity, and effectiveness tests which included the classical completeness test, the influence test, the average difference test of the three classes using the Anova test.

Qualitative research was conducted to determine the pattern of geometry problem solving abilities in terms of students' spatial intelligence based on each category. The data used are the results of spatial intelligence tests. The subjects in this study were students of class VIII C as many as 30 students who were determined by purposive sampling techniques which were then categorized based on three categories of spatial intelligence namely high, medium, and low. Qualitative data were obtained using four stages, namely data validity, data reduction, data presentation and conclusion drawing. Test the validity of the data on the credibility of the data using triangulation techniques in which data testing is done by checking the data at the same source but with different techniques namely tests and interviews.

RESULTS AND DISCUSSION

The results of the analysis of the effectiveness of project-based learning learning-ethnomatematics on the ability to solve students' geometry problems indicate that the results of the calculation of individual completeness tests show that $sig = 0.002 = 0.2\% < 5\%$. So it can be concluded that the average student who was given project-based learning learning-ethnomatematics reached KKM that is 68. Completion test proportion obtained z_{hitung} value was 0.2108 for the significant level $(\alpha) = 5\%$ obtained $z_{0,475}$ value was 1.96. Because the value of z_{hitung} is $-1.96 < 0.2108 < 1.96$ then $-z_{(0.5\,(1-\alpha))} < z_{hitung} \leq z_{(0.5\,(1-\alpha))}$, it means that H_0 is accepted. So, the proportion of students who obtain project-

based learning-ethnomatematics has achieved mastery equal to 75%. Furthermore, to test the effect of spatial intelligence on the ability to solve geometry problems in the classroom learning project based learning-ethnomatematics obtained $sig = 0{,}000$. It is clear that $sig < 5\%$, then H_0 is rejected and accepts H_1. So it can be concluded that there is an influence between spatial intelligence on the geometry problems solve ability in class learning based on learning-ethnomatematics. The magnitude of influence obtained $0.419 = 41.9\%$. This value indicates that the variable of spatial intelligence of students influences the ability to solve students' geometry problems by 41.9%.

In the project-based learning learnig-ethnomatematics assisted by augmented reality apk shows the results of individual completeness test shows that $sig = 0.00 = 0\% < 5\%$. So, it can be concluded that the average student who was given a project based learning based on augmented reality assisted with augmented reality apk reached KKM which is 68. Completeness test the proportion obtained z_{hitung} value is 1.897 for the significant level $(\alpha) = 5\%$, obtained $z_{0,475}$ value is 1,96. Because the value of z_{hitung} is $-1.96 < 1.897 < 1.96$ then $-z_{(0.5\,(1-\alpha))} < z_{hitung} \leq z_{(0.5\,(1-\alpha))}$, it means that H_0 is accepted. So, the proportion of students who get project based learning based on augmented reality assisted augmented reality apk has achieved completeness equal to 75%. While the test of the influence of spatial intelligence on the geometry problems solving ability in class learning based on learnig-ethnomatematics assisted with augmented reality apk obtained $sig = 0{,}000$. It is clear that $sig < 5\%$, then H_0 is rejected and accepts H_1. So it can be concluded that there is an influence between spatial intelligence with the geometry problems solving ability students. The magnitude of influence obtained $0.541 = 54.1\%$.

Anova test shows a sig value of $0.001 = 0.1\% < 5\%$ then H_0 is rejected or accepts H_1. So, one of the students' average geometry problem solving abilities is different. The sig value in grade 1 (ethnomatematics project-based learning) with grade 2 (augmented reality APK-based ethnomatematics-based learning) is $0.048 < 0.05$ with an average ability to solve different students' geometry problems. The sig value in class 1 (ethnomatematics project-based learning) with grade 3 (control class using discovery learning) is $0.048 < 0.05$ with the average ability of solving different students' geometry problems. The sig value in class 2 (ethnomatemics project-based learning assisted with augmented reality apk) with class 3 (control class using discovery learning) is $0{,}000 < 0.05$ with an average solution of solving different students' geometry problems. In the table the value of sig can be seen among all three different classes. The average in grade 2 (learning based on augmented reality APK-ethnomatematics-based learning) is 80.87, which shows the average highest problem solving ability of other students. So the classroom with augmented reality-aided project-ethnomatematics based learning results in better student geometry problem solving ability.

In the qualitative analysis of this study, spatial intelligence is grouped into 3 groups, namely high, medium and low spatial intelligence. The results of the spatial intelligence experimental class 2 showed the results of 30 students showed 9 students with high spatial intelligence, 12 students with moderate spatial intelligence, and 9 students with low spatial intelligence.

Based on the analysis results, it was found that from 9 students with high spatial intelligence there were 8 students who had high geometry problem solving abilities, 1 student who had moderate geometry problem solving abilities, and none of the students had low geometry problem solving abilities. Students who have high spatial intelligence and high problem solving abilities of 8 people can fulfill all four stages of problem solving abilities. Students are able to understand problems, students are also able to plan problem solving, students are able to carry out problem solving and students are able to re-examine the results obtained. Whereas 1 student who has moderate problem solving ability, can only fulfill 3 stages of problem solving ability namely students are able to understand the problem, students are also able to plan problem solving and students are able to re-examine the results obtained.

In students with a spatial intelligence category of 12 students, there are 5 students who

have the high geometry problem solving ability , there are 5 students who have the medium geometry problem solving ability, and 2 students who have the low geometry problem solving ability. Students who have high spatial intelligence and problem solving abilities Students are able to solve problems, Students are also able to solve problems, Students are able to solve problems and students are able to return the results obtained. While students who have medium problem-solving ability, are less precise in determining the final results so they do not meet when solving problems. Students who have low problem-solving ability are less precise in determining a solution plan that can solve problems properly.

In students with low spatial intelligence as many as 9 students, there are no students who have high geometry problem solving abilities, it takes 1 student with moderate geometry problem solving abilities and 8 students with low geometry problem solving abilities.

Students who have low spatial intelligence and problem solving ability can only solve two problem-solving solutions well, namely students are able to solve problems and students can also solve problems. This causes students to be wrong in applying the formula used. While students who have low problem solving ability, can only solve one problem with the ability to solve well, namely understanding problems

CONCLUSION

Based on the research results of 30 students found a pattern that the level of spatial intelligence of students does not describe the level of problem solving ability. The higher the spatial intelligence of students is not necessarily high in problem solving ability, the medium spatial intelligence may not necessarily have a moderate problem solving ability and the lower the spatial intelligence of students is not necessarily low in problem solving ability.

REFERENCES

Ambarwati. 2015. "Keefektifan Model Project Based Learning Berbasis GQM Terhadap Kemampuan Komunikasi Matematis dan Percaya Diri Siswa Kelas VII". *Journal of Mathematics Education.* 4(2).

Anjarsari, Elly., Hobri., Irvan, Muhtadi., & Sunardi. 2017."Spatial Intelligence on Solving Three Dimensional Geometry Object Through Project Based Learning".*The International Journal of Social Sciences and Humanities Invention,* 4(8): 3817-3822

Aszalos, Laszlo. dan Maria Bako. 2004. "How Can We Improve The Spatial Intelligence?" 6th *International Conference on Applied Informatics Eger, Hungary.* Januari 27-31

D'Amborsio,U.1985. "Ethnomathematics and Its Place in the History And Pedagogy of Mathematics". *For the Learning of Mathematics Journal*. Vol 5(1), 44-48

Febriana, R. 2017. The Effectiveness of Project Based Learning on Students' Social Attitude and Learning Outcomes. *Jurnal Pendidikan Teknologi dan Kejuruan,* 23 (4), 374 – 382.

Gardner, Howard. 2003. *Multiple Intelegence: Kecerdasan Majemuk Teori dalam Praktek*. Alih Bahasa: Alexander Sindoro. Batam: Interaksara

Hosnan, M. 2016. *Pendekatan Saintifik dan Kontekstual dalam Pembelajaran Abad 21*. Bogor: Ghalia Indonesia.

Karatas & Baki. 2013. "The Effect of Learning Environments Based on Problem Solving on Students' Achievements of Problem Solving.International Electronic" *Journal of Elementary Education*

Kaur, S. & Jain, R. 2014."Impact Of Work Environtment On Job Satisfaction". *Jaipur.* 4(1).

Khotimah, K. 2013. *Meningkatkan Hasil Belajar Geometri Dengan Teori Van Hiele*. Yogyakarta

Lestari, K, E., & Mokhammad, R, Y. 2017. *Penelitian Pendidikan Matematika.* Bandung : Refika Aditama.

Mustika, C. G. Rampengan, R. Sanjaya, And Sofyan, 2015."Implementasi Augmented Reality Sebagai Media Pembelajaran Interaktif," *Citec J.*, 2(4).

NCTM. 2000. *Excecutive Summary Principles And Standart For School Mathematics*. USA: NCTM

Polya, George. 1973. *How to Solve It – A New Aspect of Mathematical Method (Second Edition).* New Jersey: Princeton University Press.

Prabawa, E.A., & Zaenuri. 2017. "Analisis Kemampuan Pemecahan Masalah Ditinjau Dari Gaya Kognitif Siswa pada Model *Project Based Learning* Bernuansa Etnomatematika". *Unnes Journal of Mathematics Education,* 6(1): 120-129.

Prabowo, A & Ristiani, E. 2011. "Rancang Bangun Instrumen Tes Kemampuan Keruangan Pengembangan Tes Kemampuan Keruangan Hubert Maier dan Identifikasi Penskoran Berdasarkan Teori Van Hielle". *Kreano, 2* (2): 72-87

Rachmawati, Inda. 2012. "Eksplorasi Etnomatematika Masyarakat Sidoarjo". *Ejournal Unnes*

Sunjaya, H. 2015."Teknologi Augmented Reality Berbasis Android Dalam Pembuatan Brosur Interaktif," *Integritas Politek Negeri Medan*, 1(4): 110–114.

Tario, M. Z. C. 2015."Development Of Instructional Material Using Algebra As A Tool In Problem Solving". *International journal of education and research*. 2(10):569-586.

Ulya, H., Kartono., Retnoningsih, A. 2015."Analysis of Mathematics problem solving ability of junior high schoolstudents viewed from students cognitive style". *International journal of education and research*. 2(10):577-582.

Wati, Laily Fitria. 2018. "Model Pembelajaran Project Based Learning Berbasis Potensi Lokal Pada Mata Pelajaran Prakarya Dan Kewirausahaan".*JTP2PS,* 03:39-47.

Wicaksana, Y., Wardono, & Ridlo, S. 2018. Analisis Kemampuan Literasi Matematika dan Karakter Rasa Ingin Tahu Siswa pada Pembelajaran Berbasis Proyek Berbantuan Schoology. *PRISMA, Prosiding Seminar Nasional Matematika,* 1: 416 – 425.

Widyantini, Untung TS, Joko P, & Estina E. 2014. *Laporan Penelitian Pengembangan Model Pembelajaran Project Based Learning(PjBL) dalam Pembelajaran Matematika.* Yogyakarta: PPPPTK matematika.

Zevenbergen, R; Dole, S., & Wright, R.J. 2004. *Teaching Mathematic in Primary School.* Crown nest NSW:Allen & Unwin