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Case-study: Effectiveness of problem based learning in mathematics learning

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Abstract: This study aims to determine the effectiveness of Problem Based Learning (PBL) to improve mathematics learning outcomes. This research uses a literature study approach with reference data including several previous studies that are combined and analyzed for generalization. This research uses content data analysis techniques on several valid information based on context. context. The results of the combination and analysis that have been carried out will be generalized. This research contains educational problems, especially in mathematics learning due to Covid-19, the nature of education, the definition of mathematics learning and the form of Problem Based Learning (PBL), as well as research evidence regarding the effectiveness of the application of Problem Based Learning (PBL) in mathematics learning. The results obtained are that the Problem Based Learning (PBL) model is proven to be more effective in improving student learning outcomes in mathematics learning. By utilizing the Problem Based Learning (PBL) method, students can improve their learning outcomes. Students will be faster in understanding the material. In addition, with Problem Based Learning (PBL) students are also trained to always think critically in solving problems in everyday life.

INTRODUCTION

According to Siagian (2016), education is crucial in life because with education each individual can identify their potential and can optimize this potential so that a new, more advanced individual is formed. Education in UUSPN article 1 paragraph 1 (2003) means "Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and State". Meanwhile, as quoted from Tarigan, Alvindi, Wiranda, Hamdani, & Pardamean (2022), according to KH. Hajar Dewantara, education is a demand or obligation for all the nature contained in every child so that later he becomes an element of society capable of achieving maximum safety and happiness. In the 1945 Constitution of the Republic of Indonesia Article 31 paragraph 1 states that "Every citizen has the right to education". So it can be

concluded that education is a right and in the form of activities carried out consciously by each individual to advance himself.

Every educational activity is always related to learning. Quoted from Fakhrurrazi (2018), according to Hamalik (2016), learning means an activity consisting of a combination of human factors including students and teachers, material factors such as learning tools, infrastructure or infrastructure factors or facilities in the form of buildings and classrooms, as well as processes that are interrelated and influential in order to achieve a learning goal. achieve a learning goal. Quoted from Syaadah, Arya, Silitonga, & Rangkuty (2022), the learning process can occur anywhere and anytime. learning process can occur anywhere and anytime, both formally in educational institutions, non-formally such as private schools, or informally as happens in the community. For formal learning formal learning includes various fields of science, one of which is mathematics.

According to Fitriana and Aprilia (2021), math is often the least preferred learning or even many tend to choose not to follow the lesson or even tend. In line with Kurniawan and Soetiowati (2022), the Covid-19 pandemic that occurred in Indonesia has created many problems. Online learning that was implemented at that time made it more difficult for students to capture the material so that there was academic stress in all learning outcomes including in mathematics learning and now education in Indonesia is still difficult to achieve and now education in Indonesia is still lagging behind other countries. Various ways have been tried by the government and educators to get the best solution such as problem-based learning or Problem Based Learning.

Quoted from Aldiansha, Sani, & Suryani (2021), According to Maskur et. al. (2020), Problem Based Learning (PBL) is a type or form of learning that is applied with critical thinking methods in the problem solving process. Quoted from Chatini (2023, Problem Based Learning (PBL) is a way of learning activities that invites students to solve complex problems in everyday life. Indicators of this learning model are metakognition, elaboration, interpretation, induction, identification, investigation, exploration, conjecture, synthesis, generalization, and inquiry (Lia & Mardhiyana, 2023). So it can be concluded that Problem Based Learning (PBL) is a form of learning activity that is loaded in the process of solving problems with critical thinking. Based Nafiah (2014), on research conducted it is concluded that the Problem Based Learning (PBL) model is useful for improving the achievement of student learning outcomes that contain cognitive, affective or emotional, and psychomotor elements. In addition, also from Nafiah, based on research by Oon-Seng Tan (2008) resulted in that Problem Based Learning (PBL) can train students to solve problems in life through the process of identification, learning, and thinking independently.

Therefore, this study was conducted with the aim of increasing the effectiveness of the application of Problem Based Learning (PBL) in terms of learning outcomes in the mathematics learning process through critical thinking insolving mathematical problems in everyday life.

METHOD

The research used a leatherative method through a literature study approach and literature study. In accordance with the opinion of Mardalis (1999), literature studies are carried out through the process of collecting reference data including a number of previous studies and then combined and analyzed so that they can be generalized. This study uses literature sources, both books and scientific articles in the form of journals from 1999 to 2023. In accordance with what Kuhlthau said in "Teaching the Library Research Process" (2022), the results of combining and analyzing a number of previous studies are used to be able to conclude how to increase the effectiveness of the application of Problem Based Learning (PBL) in the process of learning mathematics. This research process was implemented according to the following stages:

a. Theme selection
b. Deepening information
c. Research direction
d. Data source collection
e. Presentation or submission of data
f. Report preparation

In accordance with Krippendoff (1933), this research applies content data analysis techniques in obtaining valid information that can be scrutinized or considered again based on context. In line with the opinion of Sabarguna, & Subirosa (2005), during the analysis process, various stages of selection, comparison, merging or combination, and separation will be applied so that relevant conclusions can be drawn. In addition, based on Sutanto (2005), the examination of each source of literature and supervision of supervisor feedback to maintain the accuracy of the assessment process, avoiding and minimizing inaccuracies. that arise due to lack of human or library writers.

RESULT AND DISCUSSION

Education and its quality are often at the forefront of a conversation. Taken from Kurniawati (2022), according to Suryadi & Tilaar (1993), quality education is the ability of an educational institution to maximize the function of various educational resources in order to optimize the learning potential of students. With a good and advanced quality of education, a harmonious individual will be formed. However, in Indonesia the reality is different. Quoted from Ndasung (2021), the quality or quality of education in Indonesia is still lagging behind when compared to other countries. This is still closely related to the impact of the Covid-19 pandemic that hit Indonesia in early March 2020 until 2022. The distance or online learning process implemented during the pandemic has made it very difficult for students to understand the material being taught, one of which is learning material in math.

Quoted from Ayu, Ardianti, & Wanabuliandari (2021), mathematics plays an important role in life, because it can develop students' potential in understanding learning materials more efficiently. In addition, according to Waskitaningtyas (2016), mathematics also functions as a means of training students in logical, critical, analytical, and structured thinking. Meanwhile, according to Acharya (2017), states "Mathematics is one of the most important subjects in our human life", which means that mathematics is the most important science for human life. Because math has a level of complexity that is different from other learning. So mathematics is

a science that is useful for developing the potential for logical, critical, analytical, and structured thinking in humans so that it is included in the crucial science for human life. According to Amallia & Unaenah (2018), there are still many students who view math as a difficult subject matter. According to Fauzi & Nurfauziyah (2021), the problem is further exacerbated by the presence of an online learning process during the pandemic which has further increased the number of students who do not understand or do not understand math. In fact, it can be said that the quality of mathematics learning in Indonesia has declined due to the pandemic.

Apart from the pandemic and online learning, there are also other factors causing difficulties during the math learning process. According to Anggraeni, Muryaningsih, and Ernawati (2020), difficulties in learning Based on the above understanding, the relevant and effective method in the mathematics learning process is Problem Based Learning (PBL). According to Leary (2012), Problem Based Learning (PBL) is a search-based learning method that focuses on students and facilitates getting problem solving skills. Meanwhile, according to Grant & Tamim (2019), Problem Based Learning (PBL) is a learning model based on the theory of social constructivism, through students as the focus of learning, which is characterized by the construction of various views of science through various representations, as well as social activities such as joint discovery, group learning, support (scaffolding), and evaluation. So it can be concluded that this is a way of learning that focuses on problem solving and its application in life to improve the skills of each individual.

Quoted from Sofiyah & Wulandari (2018), Problem Based Learning (PBL) is a learning system where students are introduced to problems that need to be solved. Through the stages of problem solving, students can increase their knowledge, optimize problem solving skills and self-regulated learner or independent learning abilities. In the Problem Based Learning (PBL) learning process, all activities that learners do must be structured and systematic. Because it is necessary to solve problems or when faced with challenges in daily life and career. According to Marra, Jonassen, Palmer, & Luft (2014), Problem Based Learning (PBL) has several characteristics, namely problem-focused, student-centered, self-directed, encourages self-reflection, and facilitates learning. Quoted from Zuliani, Rean, & Rizkiyanah (2023), according to Sani (2012), there are five stages of Problem Based Learning (PBL) syntax for students as follows:

a. The problem introduction stage, where learners will be listened to the problem or problem to be solved
b. The learning arrangement stage, where learners will be directed to define tasks related to the problem either individually or in groups
c. Guidance and investigation stage, where learners will be asked to collect relevant data or information to solve the problem. or relevant information to do problem solving
d. Stage of development and presentation of work, where learners compile a report of the results of solving the problems obtained both individually and in groups. problem solving results obtained both individually and in groups and then presented in front of the class. present in front of the class.
e. The analysis and evaluation stage, where other groups will summarize the presentation of their friend's group. presentation of their friend's group

As quoted from Tyas (2017), according to Arends (2008), there are five syntaxes of Problem Based Learning (PBL) for educators. Learning (PBL) for educators as follows:

a. The problem introduction stage, where the educator introduces the objectives of learning activities, and mention all the things that will be used in the learning activity as well as motivate the learners to get involved in problem solving.
b. The stage of organizing learners to research, at this stage the educator will assist participants in finding and obtaining accurate information to research problem solving. in finding and obtaining accurate information to research the problem solving given.
c. The stage of assisting learner research, at this stage the educator will supervise as well as assist the implementation of research or experiments conducted by learners in researching the given problem assist the implementation of research or experiments conducted by students in finding solutions to the problems discussed.
d. The stage of developing work or reports, at this stage the educator helps the learners to plan and prepare their work in the form of an appropriate report.
e. The analysis and evaluation stage, in this stage the educator helps students to reflect on the research and methods used.

In accordance with the two syntaxes of Problem Based Learning (PBL) above, the roles of educators and students are interrelated in learning activities, especially those that apply Problem Based Learning (PBL) in it. Meanwhile, Problem Based Learning (PBL) is proven to be an effective learning method in improving student learning outcomes, as in the following five studies:

a. According to research results from Eismawati, Koeswanti, & Radia (2019), Application Problem Based Learning (PBL) has been proven to improve mathematics learning outcomes regarding flat shapes from grade 4 students at SD Negeri 1 Ngasinan, Semarang. Where in stage I 44% of students were declared complete in understanding the material, then In stage II, there were 64% of students who had completed the material on flat shapes.
b. According to research results from Vitasari, Joharman, & Suryandari (2013), Application Problem Based Learning (PBL) has been proven to be successful in improving mathematics learning outcomes for 5th grade students at SD Negeri 5 Kutosari. Where in stage I the average score of students birada at 54.2% which then experienced an increase in stage II of 31.2% to 85.4%.
c. According to research results from Novi Andriastutik (2013), Application of Problem Based Learning (PBL) has been proven to improve mathematics learning outcomes of 6th grade elementary school students 6 Where the students' completeness score which was initially 44% increased to 72%.
d. According to research from Lider (2022), the implementation of Problem Based Learning (PBL) is assisted. The Quizizz application has proven to be effective in improving students' mathematics learning outcomes 6th grade at SD Negeri 5 Sangsit. Where at this stage I present the completeness of the participants' learning outcomes students reached 68% then increased further in stage II to 94%.
e. According to research from Karmani (2021), the application of Problem Based Learning (PBL) in Grade 5 students at SD Negeri 2 Karangrowo succeeded in improving learning outcomes in fraction calculation operations material. Where in stage I the students' completeness is at 70.83% then increased in stage II to 87.5%.

From the five studies above, it can be concluded that Problem Based Learning (PBL) succeeded in improving student learning outcomes in mathematics learning activities. As for according to Widjajanti (2021), that a teacher or educational staff must continuously train their sensitivity to be able to help students appropriately and on target and to be able to see each individual participant students or groups who need help more than others. So, it's not just the

participants students whose knowledge will increase, but also educators, because of the adjustments they make by educators will upgrade the potential of every educator.

According to Hamdani (2011), Problem Based Learning (PBL) itself has a number of advantages include students being directly involved in learning activities so that they gain more knowledge useful, students are forged to be able to collaborate with other students and students can solve problems from various other sources. Apart from that, quoted from Darwai & Purana (2021), Hamruni (2012) said that Problem Based Learning (PBL) also has three weaknesses, namely: (1) when students do not have interest and believe that the problem being discussed is difficult completed then students will not want to try; (2) Problem Based Learning (PBL) requires quite a lot of time to prepare; (3) If students do not understand problems faced, students will be reluctant to learn about these problems. So Based on the strengths and weaknesses presented above, it can be concluded that it is Problem Based Learning (PBL) is indeed effective and very beneficial for students, but the learning process is Problem Based Learning (PBL) must be interesting and require sufficient time for preparation achieved learning objectives.

CONCLUSION

Based on the research results, researchers can draw the conclusion that the quality of education in Indonesia still needs to improve further, especially in mathematics learning. To improving education, especially in mathematics learning, can apply Problem Based Learning (PBL). The Problem Based Learning (PBL) model has proven to be more effective in improving participant learning outcomes students in mathematics learning. This is supported by several data from research results that have been carried out carried out by previous authors. By utilizing the Problem Based Learning (PBL) method, students will understand the material more quickly. Apart from that, with Problem Based Learning (PBL) participants students are also trained to always think critically in solving problems in everyday life.

REFERENCE

Acharya, B. R. (2017). Factors affecting difficulties in learning mathematics by mathematics learners. *International Journal of Elementary Education*, *6*(2), 8-15.

Amallia, N., & Unaenah, E. (2018). Analisis kesulitan belajar matematika pada siswa kelas III sekolah dasar. *Attadib: Journal of Elementary Education*, *2*(2), 123-133. https://doi.org/10.32507/attadib.v2i2.414

Anggraeni, S. T., Muryaningsih, S., & Ernawati, A. (2020). Analisis faktor penyebab kesulitan belajar matematika di sekolah dasar. *Jurnal Riset Pendidikan Dasar (JRPD)*, *1*(1), 25-37. http://dx.doi.org/10.30595/.v1i1.7929

Arends, R. I. 2008. Learning to Teach. Yogyakarta: Student Library

Ayu, S., Ardianti, S. D., & Wanabuliandari, S. (2021). Analisis faktor penyebab kesulitan belajar matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(3), 1611-1622..

Eismawati, E., Koeswanti, H. D., & Radia, E. H. (2019). Peningkatan hasil belajar matematika melalui model pembelajaran problem based learning (PBL) siswa kelas 4 SD. *Jurnal Mercumatika: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *3*(2), 71-78. Doi: https://doi.org/10.26486/jm.v3i2.694.

Fakhrurrazi, F. (2018). The nature of effective learning. *At-Tafkir*, *11*(1), 85-99.

Fitriana, D., & Aprilia, A. (2021). Mindset Aawal Siswa Terhadap Pembelajaran Matematika Yang Sulit Ddan Menakutkan, *1*(2), 28-40. Diambil dari https://pedirresearchinstitute.or.id/index.php/Pedirjournalelementaryeducation/article/view/69.

Grant, M. M., & Tamim, S. R. (2019). PBL in K–12 Education. *The Wiley Handbook of Problem-Based Learning*, 221-243.. https://doi.org/10.1002/9781119173243.ch10.

Hamalik, O. (2016). Proses Belajar Mengajar (Vol. 18). *Bumi Aksara*.

Hamdani, H. (2011). Teaching and Learning Strategy. *Bandung: CV Pustaka Setia*.

Hamruni, (2012). *Learning Strategies*, Yogyakarta : Insan Madawi.

Karmani, K. (2021). Peningkatan Aktivitas dan Hasil Belajar Operasi Hitung Pecahan Melalui Problem Based Learning. *Journal of Education Action Research*, *5*(3), 361–367. https://doi.org/10.23887/jear.v5i3.34572

Kuhlthau, (2022). *Teaching the Library Research Process*, London: The Scarecrow Press, Inc.

Kurniawan, & Setiowati, (2022). The Effect of Online Learning Methods on Academic Stress Students. *Gusjigan Counseling Journal*, 8(1), 22-28,

Kurniawati, F. N. A. (2022). Meninjau permasalahan rendahnya kualitas pendidikan di Indonesia dan solusi. *Academy of Education Journal*, *13*(1), 1-13.

Leary, H. M. (2012). *Self-directed learning in problem-based learning versus traditional lecture-based learning: A meta-analysis*. Utah State University..

Lia, L. C. U., & Dewi Mardhiyana. (2023). Evektifitas Pembelajaran Matematika dengan Model Pembelajaran Problem Based Learning Berbasis Powerpoint terhadap Kemampuan Pemahaman Konsep Matematika SMP N 4 Pekalongan pada Materi Statistika. *Buana Matematika : Jurnal Ilmiah Matematika Dan Pendidikan Matematika*, *13*(1), 47–58. https://doi.org/10.36456/buanamatematika.v13i1.7787.

Lider, G. (2022). Penerapan model pembelajaran problem based learning berbantuan aplikasi quizizz untuk meningkatkan prestasi belajar matematika siswa kelas VI semester 1 SD Negeri 5 Sangsit. *Indonesian Journal of Educational Development (IJED)*, *3*(1), 189-198. https://doi.org/10.5281/zenodo.6575177

Mardalis, (1999). *Research Methods A Proposal Approach*, Jakarta: Bumi Aksara.

Marra, R. M., Jonassen, D. H., Palmer, B., & Luft, S. (2014). Why problem-based learning works: Theoretical foundations. *Journal on Excellence in College Teaching*, *25*.

Maskur, R., Rahmawati, Y., Pradana, K., Syazali, M., Septian, A., & Kinarya Palupi, E. (2020). The Effectiveness of Problem Based Learning and Aptitude Treatment Interaction in Improving Mathematical Creative Thinking Skills on Curriculum 2013. *European Journal of Educational Research*, *9*(1), 375-383.

Nafiah, Y. N., & Suyanto, W. (2014). Application of problem-based learning models to improve critical thinking skills and student learning outcomes. *Journal of Vocational Education*, *4*(1), 125-143.

Ndasung, D. J. . (2021). Pendidikan di Indonesia Pada Masa Pandemi Covid-19. *Jurnal Pendidikan Tambusai*, *5*(2), 3014–3018. Retrieved from https://jptam.org/index.php/jptam/article/view/1334

Novi Andriastutik, S. (2013). *Penerapan Model Problem Based Learning (PBL) Pada Pembelajaran Matematika dalam Upaya Meningkatkan Hasil Belajar Matematika Siswa Kelas 5 Semester II Sekolah Dasar Negeri 6 Sindurejo Tahun Ajaran 2012/2013* (Doctoral dissertation, Program Studi Pendidikan Guru Sekolah Dasar FKIP-UKSW). http://repository.uksw.edu/handle/123456789/4380.

Sabarguna, & Subirosa, (2005). *Data Analysis in Qualitative Research*, Jakarta: UI Press.

Sani, R. A. (2012). Pembelajaran Saintifik Untuk Implementasi Kurikulum 2013. Jakarta: Bumi Aksara

Siagian, M. D. (2016). Kemampuan koneksi matematik dalam pembelajaran matematika. *MES: Journal of Mathematics Education and Science*, *2*(1). Doi: https://doi.org/10.30743/mes.v2i1.117

Suryadi, Ace dan H.A.R. Tilaar. (1993). Analisis Kebijakan Pendidikan: Suatu Pengantar. Bandung: PT. Rosdakarya

Sutanto. (2005). *Counseling Theory and Peace Psychotherapy*, Malang: UM.

Syaadah, R., Ary, M. H. A. A., Silitonga, N., & Rangkuty, S. F. (2023). Pendidikan Formal, Pendidikan Non Formal Dan Pendidikan Informal. *PEMA (JURNAL PENDIDIKAN DAN PENGABDIAN KEPADA MASYARAKAT)*, *2*(2), 125–131. https://doi.org/10.56832/pema.v2i2.298.

Tan, O. S. (2008). Problem-based learning: Some insights into pedagogical leadership and administrative challenges. In *Leadership for Learning* (pp. 205-221). Brill. https://doi.org/10.1163/9789087903909_013.

Tarigan, M., Alvindi, A., Wiranda, A., Hamdany, S., & Pardamean, P. (2022). Ki Hajar Dewantara's Educational Philosophy and the Development of Education in Indonesia.Mahaguru: Journal of Primary School Teacher Education, 3(1), 149–159. https://doi.org/10.33487/mgr.v3i1.3922

Tyas, R. (2017). Difficulties in Applying Problem Based Learning in Mathematics Learning. *Tecnoscienza*, *2*, 43-52.

Vitasari, R. (2013). Peningkatan Keaktifan dan Hasil Belajar Matematika Melalui Model Problem Based Learning Siswa Kelas V SD Negeri 5 Kutosari. *Kalam Cendekia PGSD Kebumen*, *4*(3).

Zuliani, R., Rean, G. T., & Rizkiyanah, P. (2023). Meningkatkan Hasil Belajar Ipa Melalui Model Problem Based Learning (PBL) Pada Siswa Kelas IV SDN Pasar Baru 1 Kota Tangerang. Technical and Vocational Education International Journal (TAVEIJ), 3(2), 147-155.. https://doi.org/10.556442/taveij.v3i2.354