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THE USE OF LIVEWORKSHEETS AND PROBLEM BASED LEARNING (PBL) MODELS IN IMPROVING STUDENTS' CRITICAL MATHEMATICAL THINKING SKILLS

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Abstract

Mathematics is one of the subjects given to students starting from elementary school to college. Mathematics learning aims to develop students in thinking logically, analytically, regularly and critically. Problem Based Learning (PBL) is a teaching method that presents real-world situations in the learning process with the aim of improving students' critical thinking skills in interactive learning. Interactive learning using Liveworksheets allows teachers to present material in a more interesting and challenging way, so that students are more actively involved in the learning process. This study aims to determine: (1) the effectiveness of using Liveworksheets in improving students' mathematical critical thinking skills, (2) the effectiveness of the Problem Based Learning (PBL) learning model in improving students' mathematical critical thinking skills. The preparation of this article uses the SLR (Systematic Literature Review) method where the articles collected are only articles published within a maximum of the last 6 years (2019-2025). Based on the results of this study, it was found that the use of Liveworksheets in the Problem Based Learning (PBL) learning model can improve students' mathematical critical thinking skills.

Keywords: ***Liveworksheets. Mathematical Critical Thinking Skills. Problem Based Learning.***

Introduction

Mathematics is one of the subjects given to students starting from elementary school to college. Mathematics learning aims to develop students in critical thinking logically, analytically, systematically. Mathematics learning in schools is often considered a difficult lesson, so most students are afraid of it.(Lisa & Rachmani, 2025). Not only is it considered a difficult lesson but students who experience difficulties will feel pressured when learning, such as feeling afraid or losing students' self-confidence. According to (Russeffendi, 1992) Mathematics for children in general is a subject that is not liked, if not a hated subject. This can result in learning mathematics becoming less enjoyable.

Problem Based Learning(PBL) is a teaching method that presents real-world situations in the learning process, with the intention of improving students' critical thinking skills. In Problem Based Learning (PBL), real problems are given and they are asked to find solutions through various learning resources, either independently or by working together. This encourages students' active involvement in the information search process. The application of problem-based learning makes the learning process more meaningful for students, so that the information learned is easier to remember. In this model, students are challenged to demonstrate a high level of creativity in solving problems, which also encourages students to develop deeper critical thinking skills.

The combination of technology that has an impact on the existence of a combination that is difficult to distinguish between physical, biological, and digital dimensions occurs in the current era. To face this era, people in the world have begun to be required to balance technological progress and knowledge, the form of its application is by developing their hard skills and soft skills through the technology that is developed. One form of its implementation in the world of education is the use of the Liveworksheets application in mathematics learning to improve various critical and mathematical thinking skills of students. Liveworksheets is a website that provides a variety of interactive learning tools and media designed to help students understand the concepts taught. Through various interactive activities, Liveworksheets can help students hone their critical thinking skills, especially in the context of mathematics learning. Liveworksheets media is very easy to use to find out students' critical thinking skills. In its activities using Liveworksheets media, it can be accessed by students independently or through teacher guidance. With this application, it is hoped that it can make it easier for students to master a mathematics learning material without any

pressure or fear. Liveworksheets can also make the learning atmosphere more enjoyable so that it can increase the level of self-confidence of each student. Based on the background above, this study aims to determine: (1) the effectiveness of using Liveworksheets in improving students' critical mathematical thinking skills, (2) the effectiveness of the Problem Based Learning (PBL) learning model in improving students' critical mathematical thinking skills.

Method

The method used in compiling this article uses the SLR (Systematic Literature Review) method. The purpose of the SLR (Systematic Literature Review) is to identify the best techniques with specific procedures, technologies, methods, by collecting various information from a comparative study. According to Siti Rochmah in the journal IPTEK Media Komunikasi Teknologi, it is stated that in the SLR (Systematic Literature Review) method there are several processes that must be carried out, including: 1) determining the Research Question (RQ); 2) determining the Search Query (SQ); 3) Screening Paper (SQ) which is obtained by reading the abstract and contents of the article and then determining the relevant articles to be processed; 4) conducting a keyword search with an abstract that produces a clarification scheme; 5) conducting data extraction and a systematic review process of the articles obtained.

The steps written above, start from compiling Research Questions (RQ). The Research Questions (RQ) compiled include (RQ1) Effectiveness of the wordwall website in improving students' mathematical critical thinking skills; (RQ2) Effectiveness of the Problem Based Learning (PBL) learning model in improving students' mathematical critical thinking skills. Articles are obtained from collecting several journal articles from Google Scholar. Keywords are critical thinking skills, Problem Based Learning (PBL) models and wordwall websites. The articles collected are only articles published in the last 6 years (2019-2025). Various articles that have been collected, selecting the last 6 articles with the keywords used.

The next step is Screening Paper (SP), the data obtained is evaluated according to the following criteria. SP in this study includes (SP1) Was this article published in 2019-2025; (SP2) Is there a definition and purpose of the research used in the article; (SP3) Is there supporting data in the article about the research being carried out. Then from the articles that have been classified, the data will be reviewed and analyzed to support this research. In addition, during the study there were also several changes as a form of refining the equivalent words for the search keywords.

Results and Discussion

The discussion in this study found 10 articles whose analysis results are shown in table 1 and table 2 related to the keywords that have been used, namely containing a study of articles related to Liveworksheets in the problem based learning (PBL) learning model on students' critical mathematical thinking skills. Table 1 shows the grouping of articles related to the use of Liveworksheets in improving students' critical mathematical thinking skills. The reviewed articles are included in the following table.

The format of research results and discussion are not separated. The research data presented has been processed, not raw data. Research results can be presented with the support of tables, graphs or images as needed, to clarify the presentation of results verbally. In the discussion, there is a link between the results obtained and the basic concept or hypothesis.

Table 1. Use of Liveworksheets in Improving Students' Mathematical Critical Thinking Skills.

Author, Year	Journal/Proceedings, Publication Category	Research result
(Argarini et al., 2023)	Prismatika: Journal of Mathematics Education and Research	The results of the practicality obtained showed that the student worksheet met the practical criteria with a percentage of 82.25%. The effectiveness results obtained showed that the student worksheet met the effective criteria, namely that 80% of students had a score of more than or equal to 75. Based on the results of the study, it can be concluded that the student worksheet based on liveworksheet to improve students' critical thinking skills in social arithmetic material is declared valid, practical, and effective.
(Ranindita et al., 2024)	Journal of Didactic Mathematics	The developed electronic LKPD media has gone through a feasibility test with an average total score of 4.62 which is included in the very feasible category, a practicality test with an average percentage of teacher response questionnaires and student response questionnaires of 93.65% and included in the very practical category, and an effectiveness test with an N-Gain value of 0.71 which is included in the high category. So, the electronic LKPD media created in this study has been feasible, practical, and effective.
(Nirvana, 2024)	HOTS Research Journal of Mathematics Education	The results of the study indicate that E-LKPD assisted by liveworksheets meets the criteria of valid, practical, and effective. This shows that ELKPD has a significant impact on students' critical thinking and can be used as a reference in the learning process.
(Paramitha & Afandi, 2025)	IHSAN: Journal of Islamic Education	that the REACT learning model assisted by Liveworksheet has a significant effect on improving students' critical mathematical thinking skills. The results of the statistical test show that the paired sample t-test obtained a Sig. value of 0.00, which means that there is a significant increase between the average value of critical mathematical thinking skills before and after being given the REACT learning model assisted by Liveworksheet. The magnitude of the increase obtained from the N-Gain value of 0.5396 indicates that the increase that occurred is in the moderate category. This model makes students more active in connecting concepts with real experiences, collaborating in problem solving, and developing critical thinking skills more effectively.
(Munika et al., 2021)	Journal Mathematics Education	The results of the validity test have an average of 3.33 by design experts with a very valid category, 3.27 by mathematics learning experts with a very valid category and 3.11 by material experts with a valid category. The

results of the feasibility test on a small scale obtained a percentage of 81% with a very feasible category and 86% in large-scale trials with a very feasible category. The results of the effectiveness test obtained a percentage of completion of 100% in small-scale trials and 86% in large-scale trials so that both obtained an effective category. The conclusion of this study is that E-LKPD based on Problem Based Learning accompanied by interactive mathematics quizzes is valid, feasible and effective and can improve students' critical thinking skills.

Based on the article presented, it can be concluded that the use of Liveworksheets on students' mathematical critical thinking skills makes learning more effective and efficient because it can improve critical thinking skills which is in line with research by Argarini & Najibah (2023) stating that the results of the practicality obtained showed that student worksheets met practical criteria with a percentage of 82.25%. The effectiveness results obtained showed that student worksheets met effective criteria, namely that 80% of students had a score of more than or equal to 75. Based on the results of the study, it can be concluded that student worksheets based on liveworksheets to improve students' critical thinking skills in social arithmetic material are declared valid, practical, and effective.

Research from Ranindita et. Al. (2024) stated that the electronic LKPD media developed had gone through a feasibility test with an average total score of 4.62 which is included in the very feasible category, a practicality test with an average percentage of teacher response questionnaires and student response questionnaires of 93.65% and included in the very practical category, and an effectiveness test with an N-Gain value of 0.71 which is included in the high category. So, the electronic LKPD media created in this study is feasible, practical, and effective.

Research from Nirwana & Andriani (2024) stated that the results of the study showed that E-LKPD assisted by liveworksheets met the criteria of being valid, practical, and effective. This shows that ELKPD has a significant impact on students' critical thinking and can be used as a reference in the learning process.

Research from Paramitha & Afandi (2025) stated that the REACT learning model assisted by Liveworksheet had a significant effect on improving students' critical mathematical thinking skills. The results of the statistical test showed that the paired sample t-test obtained a Sig. value of 0.00, which means that there was a significant increase between the average value of critical mathematical thinking skills before and after being given the REACT learning model assisted by Liveworksheet. The magnitude of the increase obtained from the N-Gain value of 0.5396 indicates that the increase that occurred was in the moderate category. This model makes students more active in connecting concepts with real experiences, collaborating in problem solving, and developing critical thinking skills more effectively.

Research from Munika et. Al. (2021) stated that the results of the validity test had an average of 3.33 by design experts with a very valid category, 3.27 by mathematics learning experts with a very valid category and 3.11 by material experts with a valid category. The results of the feasibility test on a small scale obtained a percentage of 81% with a very feasible category and 86% in large-scale trials with a very feasible category. The results of the effectiveness test obtained a completion percentage of 100% in small-scale trials and 86% in large-scale trials so that both obtained an effective category. The conclusion of this study is that E-LKPD based on Problem Based Learning accompanied by interactive mathematics quizzes is valid, feasible and effective and can improve students' critical thinking skills.

Mathematical critical thinking skills include the ability to analyze, evaluate, and solve mathematical problems logically. Students who have mathematical critical thinking skills are able to: 1) identify and formulate problems, 2) apply mathematical concepts to find solutions, 3) interpret results and make conclusions based on data. Liveworksheets is an effective tool for improving students' mathematical critical thinking skills. By providing interactive activities and supporting analysis and evaluation, Liveworksheets helps students not only understand mathematical concepts, but also apply them in more complex situations. Through the use of this platform, teachers can create a learning environment that stimulates critical thinking, preparing students to face academic and everyday life challenges.

Next, table 2 contains a grouping of articles related to the problem-based learning (PBL) learning model in improving students' critical mathematical thinking skills. The reviewed articles are included in the following table 2.

Table 2. Problem Based Learning (PBL) Learning Model in Improving Students' Mathematical Critical Thinking Skills.

Author, Year	Journal/Proceedings, Publication Category	Research result
(Hanif & Harjono, 2022)	PROXIMAL Journal of Mathematics Research and Education	The use of problem based learning (PBL) models is effective in improving students' critical mathematical thinking skills and mathematics learning outcomes.
(Amalia & Dewi, 2024)	Prisma, Proceedings of the National Mathematics Seminar	The Problem Based Learning (PBL) model applied in learning can improve students' critical thinking skills. The application of the problem based learning model can also be integrated with interesting learning media so that together it can improve students' critical thinking skills. Examples of appropriate learning media are multimedia-based learning, question cards, augmented reality, and STEM-based learning. Problem based learning can develop students' critical thinking skills than other learning models such as conventional learning models, discovery learning, problem solving, and direct learning. So based on the results of the data obtained, the Problem Based Learning (PBL) model can improve students' critical thinking skills.
(Fanani et al., 2024)	Proceedings of the International conference on Lesson Study	That the Problem Based Learning (PBL) model in differentiated learning is able to improve students' critical thinking skills. This study also shows that there is an increase in critical thinking skills in the number of students, namely in the medium or higher category.
(Nisa, 2019)	Horizon of the Pendas Journal	Shows an increase in critical thinking skills and learning outcomes of grade 5 students of SDN 1 Ngambakrejo after the implementation of the Problem Based Learning (PBL) learning model. This is evidenced by an increase in students' critical thinking skills, namely in the first cycle stage the average value was 62.3. Furthermore, in the second cycle there was an increase in the average value to 77. There was also an increase in student learning outcomes, this is indicated by the completeness of student learning outcomes in the first cycle stage of 11 students with a percentage of 40.7 and increasing in the second cycle to 19 students with a percentage of 70.3.
(Azizah et al., 2019)	Imaginary: Journal of Mathematics and Mathematics Education	The results of the study showed that at a significance level of 5% it can be concluded that (1) there is a difference in students' mathematical critical thinking skills between learning with PBL, guided inquiry, and conventional models; (2) students' mathematical critical thinking skills with PBL

	and guided inquiry models are better than conventional models; (3) there is no difference in students' mathematical critical thinking skills between learning with PBL and guided inquiry models; (4) there is a positive influence between student activity in PBL and guided inquiry learning models on students' mathematical critical thinking skills; (5) individual and classical learning completion of PBL and guided inquiry classes is achieved. So that the PBL and Guided Inquiry learning models are effective for students' mathematical critical thinking skills.

Based on the results of the review of the article above, it was concluded that learning using the problem based learning (PBL) model on students' critical mathematical thinking skills can make learning more effective. Research by(Hanif & Harjono, 2022)shows that the use of the problem based learning (PBL) model is effective in improving students' critical mathematical thinking skills and mathematics learning outcomes.

Amalia & Dewi, (2024)stated that the Problem Based Learning (PBL) Model applied in learning can improve students' critical thinking skills. The application of the problem based learning model can also be integrated with interesting learning media so that together it can improve students' critical thinking skills. Examples of appropriate learning media are multimedia-based learning, question cards, augmented reality, and STEM-based learning. Problem based learning can develop students' critical thinking skills than other learning models such as conventional learning models, discovery learning, problem solving, and direct learning. So based on the results of the data obtained, the Problem Based Learning (PBL) model can improve students' critical thinking skills.

Research by(Fanani et al., 2024)stated that the Problem Based Learning (PBL) model in differentiated learning is able to improve students' critical thinking skills. This study also shows that there is an increase in critical thinking skills in the number of students, namely in the medium or higher category.

Research by(Nisa, 2019)stated that there was an increase in critical thinking skills and learning outcomes of grade 5 students of SDN 1 Ngambakrejo after the implementation of the Problem Based Learning (PBL) learning model. This is evidenced by an increase in students' critical thinking skills, namely in the first cycle stage the average value was 62.3. Furthermore, in the second cycle there was an increase in the average value to 77. There was also an increase in student learning outcomes, this is indicated by the completeness of student learning outcomes in the first cycle stage of 11 students with a percentage of 40.7 and increasing in the second cycle to 19 students with a percentage of 70.3.

Further research by Azizah et. Al. (2019) stated that the results of the study showed that at a significance level of 5% it can be concluded that (1) there is a difference in students' mathematical critical thinking skills between learning with the PBL model, guided inquiry, and conventional models; (2) students' mathematical critical thinking skills with the PBL and guided inquiry models are better than the conventional model; (3) there is no difference in students' mathematical critical thinking skills between learning with the PBL and guided inquiry models; (4) there is a positive influence between student activity in PBL and guided inquiry learning models on students' mathematical critical thinking skills; (5) individual and classical learning completion of PBL and guided inquiry classes is achieved. So that the PBL and Guided Inquiry learning models are effective for students' mathematical critical thinking skills. Problem based learning(PBL) is a highly effective approach to developing students' critical thinking skills. By providing authentic and relevant learning experiences, Problem Based Learning (PBL) helps students become better critical thinkers, ready to face real-world challenges. Through complex and collaborative projects, students learn not only concepts, but also the thinking skills needed to evaluate, analyze, and solve problems. Based on the discussion above, the Problem Based Learning model assisted by Liveworksheets has a significant effect on students' critical thinking skills in the human excretory system material. Therefore, this research is expected to be useful for teachers as a reference in improving students' critical thinking skills.

Conclusion

Based on the discussion of literature reviews of several articles published in the last 6 years (2019-2025), it can be concluded that; 1) the use of Liveworksheets in improving students' critical mathematical thinking skills creates effective learning as seen from learning becoming more enjoyable because it is supported by interesting and non-monotonous facilities, 2) the application of the problem based learning (PBL) learning model in improving

students' critical mathematical thinking skills also makes learning more effective because choosing the right learning model can help students develop critical thinking skills in themselves and problem based learning (PBL) is considered effective because learning is centered on students and teachers are only facilitators. Learning using the Liveworksheets application and the application of the problem based learning (PBL) learning model is considered effective in improving mathematical critical thinking skills. Therefore, the use of the Wordwall Website in the Problem Based Learning (PBL) learning model can improve students' mathematical critical thinking skills.

REFERENCES

Amalia, I. R., & Dewi, N. R. (2024). Analisis Model Pembelajaran Problem Based Learning Untuk Meningkatkan Berpikir Kritis Peserta Didik. *PRISMA, Prosiding Seminar Nasional Matematika*, *7*, 281–289. https://proceeding.unnes.ac.id/prisma

Argarini, D. F., Najibah, D., & Utomo, I. B. (2023). *Meningkatkan Kemampuan Berpikir Kritis Siswa*. *6*(1), 221–231.

Azizah, L. I. R., Sugiyanti, S., & Happy, N. (2019). Efektivitas Model Pembelajaran Problem-Based Learning (PBL) dan Guided Inquiry terhadap Kemampuan Berpikir Kritis Matematis Siswa. *Imajiner: Jurnal Matematika Dan Pendidikan Matematika*, *1*(4), 30–36. https://doi.org/10.26877/imajiner.v1i4.3853

Fanani, M. A., Wafiroh, Z., & Yaqin, M. H. (2024). Penerapan Model Problem Based Learning (PBL) dalam Pembelajaran Berdiferensiasi untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik pada Pelajaran Matematika. *Proceeding International Conference on Lesson Study*, *1*(1), 537. https://doi.org/10.30587/icls.v1i1.7426

Hanif, N., & Harjono, N. (2022). Penerapan Model Pembelajaran Problem Based Learning (PBL) untuk Meningkatkan Kemampuan Berpikir Kritis dan Hasil Belajar Matematika Siswa SD. *Educativo: Jurnal Pendidikan*, *1*(1), 334–341.

Lisa, S., & Rachmani, N. (2025). *Penggunaan Wordwall Website Pada Model Pembelajaran Problem Based Learning (PBL) Terhadap Kemampuan Berpikir Kritis Matematis Siswa*. *8*, 332–337.

Munika, R. D., Marsitin, R., & Sesanti, N. R. (2021). E-LKPD Berbasis Problem Based Learning Disertai Kuis Interaktif Matematika untuk Meningkatkan Kemampuan Berpikir Kritis. *Jurnal Tadris Matematika*, *4*(2), 201–214. https://doi.org/10.21274/jtm.2021.4.2.201-214

Nirwana, N. I. & A. (2024). Pengembangan E-LKPD Interaktif Berbantuan Liveworksheets untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Riset HOTS Pendidikan Matematika*, *4*(September), 1210–1225.

Nisa, H. U. (2019). Media Publikasi pada Bidang Pendidikan Dasar. *Jurnal Cakrawala Pendas*, *5*(1), 1–7.

Paramitha, P. R., & Afandi, M. (2025). *Pengaruh Model Pembelajaran React (Relating , Experiencing , Applying , Cooperating , Transferring) Berbantuan Liveworksheet Terhadap Kemampuan Berpikir Kritis Matematis*. *3*(April), 122–130.

Ranindita, M. R., Dewi, P. K., & Mahayukti, G. A. (2024). Optimalisasi Penggunaan Liveworksheet untuk Meningkatkan Kemampuan Berpikir Kritis Siswa pada Materi Bilangan Bulat. *Jurnal Didactical Mathematics*, *6*(April), 109–118.

Rohmah, S. (2019). *Analisis Regresi Kecerdasan Emosional Terhadap Kemampuan Komunikasi Matematis Siswa Dalam Menyelesaikan Masalah Pokok Bahasan Operasi Bentuk Aljabar Kelas Vii Mts Pemnu Talang Padang* (Doctoral dissertation, UIN Raden Intan Lampung).

Ruseffendi, E.T, dkk. (1992), Pendidikan Matematika 3, Jakarta : Depdikbud. Wragg, E.C. (1997). Keterampilan Mengajar Di Sekolah Dasar, Jakarta : Gramedia.