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Assisted Problem Based Learning Mobile Learning Application to Improve Preservice Counselor Problem Solving Skills

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ABSTRAK

Dalam era digital saat ini, kebutuhan akan keterampilan pemecahan masalah yang efektif semakin mendesak, terutama bagi konselor preservice yang akan berperan penting dalam membantu individu mengatasi berbagai tantangan. Penelitian ini bertujuan untuk menguji efektivitas Pembelajaran Berbasis Masalah (PBL) berbantuan Aplikasi Pembelajaran Seluler (MLA) melalui platform Bikonesia dalam meningkatkan kemampuan pemecahan masalah siswa bimbingan dan konseling (konselor sekolah layanan awal). Metode penelitian ini adalah deskriptif kualitatif dengan menggunakan desain quasi-eksperimen pra-tes pasca-tes desain kelompok kontrol yang dilakukan selama 8 minggu. Subjek penelitian ini adalah mahasiswa jurusan bimbingan dan konseling dalam satu tahun akademik Perlakuan menggunakan proses PBL menjadi lima tahap: Analisis permasalahan dan pembelajaran pembelajaran, Penemuan dan pelaporan, Presentasi dan refleksi solusi, Ikhtisar, integrasi, dan evaluasi. Data dikumpulkan dengan menggunakan Skala Keterampilan Pemecahan Masalah yang dikembangkan oleh peneliti. Data dianalisis menggunakan uji t independen untuk membandingkan data pra-tes Dan pasca-tes. Hasil uji hipotesis menunjukkan bahwa Sig. Hal ini menunjukkan bahwa model Pembelajaran Berbasis Masalah (PBL) berbantuan Aplikasi Pembelajaran Seluler (Bikonesia) berpengaruh signifikan dalam meningkatkan kemampuan pemecahan masalah Konselor Preservice. Peneliti masa depan harus mempertimbangkan atau bahkan menguji beberapa keterampilan secara bersamaan melalui PBL. Implikasi penelitian ini adalah dapat mendorong institusi pendidikan untuk mengintegrasikan teknologi seluler dalam proses pembelajaran, mengingat efektivitasnya dalam meningkatkan keterampilan pemecahan masalah.

ABSTRACT

In today's digital era, the need for effective problem solving skills is increasingly urgent, especially for preservice counselors who will play an important role in helping individuals overcome various challenges. This research aims to test the effectiveness of Application-assisted Problem Based Learning (PBL). Mobile Learning (MLA) through the Bikonesia platform in improving the problem solving abilities of guidance and counseling students (school counselors initial service). This research method is descriptive qualitative by using a quasi-designpre-test post-test experiment control group design which was carried out for 8 weeks. The subject of this research is students majoring in guidance and counseling in one academic year Treatment using the PBL process is divided into five stages: Problem analysis and learning, Discovery and reporting, Solution presentation and reflection, Overview, integration, and evaluation. Data was collected using the Problem Solving Skills Scale developed by researchers. Data were analyzed using an independent t test to compare data stop you And post-test. Hypothesis test results show that Sig. This shows that the model Problem Based Learning (PBL) assisted by Application Mobile Learning (Bikonesia) has a significant effect on improving problem solving abilities Preservice Counselor. Future researchers should consider or even test multiple skills simultaneously through PBL. The implications of this research are can encourage educational institutions to integrate mobile technology in the learning process, considering its effectiveness in improving problem-solving skills.

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1. INTRODUCTION

In today's digital era, the need for effective problem solving skills is increasingly urgent, especially for preservice counselors who will play an important role in helping individuals overcome various challenges. Even though traditional learning methods are still dominant, this approach is often less able to develop analytical and critical skills optimally. Problem-based learning (PBM) has been recognized as an effective method to overcome this weakness by placing students in real situations that require problem solving. However, conventional PBM implementation is often limited by time and resources. As technology advances, mobile learning applications are emerging as an innovative solution to support PBM, offering greater flexibility and accessibility for students. The use of mobile applications in PBM can provide a more interactive and immersive learning experience, allowing preservice counselors to develop problem-solving skills more effectively. Therefore, this research is important for evaluating the effectiveness of problem-based learning supported by mobile learning applications in improving preservice counselors' problem-solving skills, as well as providing insight into the potential for technology integration in counselor education. This article explores whether Problem Based Learning (PBL) assisted by Mobile Learning Applications is effective in improving problem solving skills in guidance and counseling students. Problem Based Learning is a pedagogical strategy where students are presented with real world situations that are open and contextual. They develop knowledge, apply it, and improve problem-solving skills by defining problems, leveraging resources (including prior knowledge and team member experience), and identifying gaps in their knowledge (Juandi & Tamur, 2022; Levy, 2008) PBL instructs students to make efforts to solve problems through various stages of the scientific method, with the hope that students can gain knowledge related to the problem while developing problem solving skills (Masak, 2021; Nurfajriah et al., 2022; Tamhane et al., 2020).

There are five stages in implementing PBL, namely problem orientation for students; organizing students for research; facilitate independent investigations and communications; develop and present work; analyzing and evaluating problem solving processes that involve learning (AhmadBhat & Al Saleh, 2020; Khoiriyah & Husamah, 2018; Warnock & Mohammadi-Aragh, 2021). Problem-based learning models need to be designed to prepare students to achieve learning outcomes that enable them to work and develop in the 21st century (Anazifa & Djukri, 2021; Rietveld & Hout, 2020). Globalization, technology, migration, international competition, market changes, and transnational environmental and political challenges add new urgency to developing the skills and knowledge students need to succeed in the 21st century context (Anna & Saavedra, Darlin & Opfer, 2012). Critical thinking and problem-solving skills are two important attributes to ensure graduates are ready to enter the professional world. Current research focuses on the development and implementation of learning programs designed to improve students' critical analysis and problem solving skills (Anggraini et al., 2020; Gorghiu et al., 2019). Problem Based Learning (PBL) is widely used in various scientific disciplines because it is believed to be effective in improving the skills of students, including students (Asiye & Bilge, 2019; Astuti et al., 2020). PBL is considered effective in increasing knowledge and developing new information obtained by students. The determining factors for the success of PBL, which include, problems as a trigger for learning; student collaboration in small groups; learning under the guidance of a tutor (teacher/lecturer); student-initiated learning; curriculum designed for a limited number of meetings; and (vi) a curriculum that includes sufficient time for independent learning (Bariyyah, 2019; Bhora & Manusiawi, 2021; Hmelo-Perak & E, 2020).

The application of Problem Based Learning is considered effective in improving Problem Solving Skills (PSS) (Choudhary, 2022; Farhan et al., 2019). This approach uses a constructivist methodology, where students attempt to solve everyday problems in a collaborative environment. Through problem-based learning, students can develop problem-solving and critical thinking skills (Ceker & Ozdamli, 2019; Hidayati & Wagiran, 2020). By generating information based on real-life experiences and gaining knowledge about their own learning (Inel et al., 2022). Showed that students involved in PBL demonstrated superior problem solving skills compared to the control group (Zakaria et al., 2021). That PBL is effective in improving students' critical thinking and problem solving abilities (Yew & Goh, 2020). Previous research shows that PBL can be applied as a learning model to improve problem solving skills. In this way, it is hoped that problem solving abilities can be improved through PBL. Implementation of PBL can be done conventionally or by utilizing technology. Meaningful use of technology aligns with constructivist teaching methods. Problem-based learning is a constructivist teaching method in which students acquire knowledge and problem-solving skills through structured investigations and problem-solving activities. Technology often plays an important role in the PBL process (Brodie et al., 2020; Wulandari et al., 2019). One application of technology in the education sector is mobile learning.

Mobile learning refers to the ability to acquire or provide educational content on personal handheld devices such as PDAs, smartphones, and cell phones (Choudhary, 2022; Karantzas et al., 2020). Recent advances in mobile technology have demonstrated significant potential for educational use (Saavedra &

Opfer, 2019; Schmidt et al., 2022). Mobile learning can be defined as a method of delivering education via mobile devices such as Pocket PCs, cell phones, and similar handheld devices (Rietveld & Hout, 2020; Tan, 2020). Mobile learning is currently considered capable of supporting learning practices in both blended and independent contexts (Park & Ertmer, 2020; Polakova & Klimova, 2023).

The research problem raised in this study is the level of Preservice Counselor's problem solving abilities. Our teaching practices show that Preservice Counselors face challenges in problem identification, difficulty understanding the urgency of problems in the field of guidance and counseling, and difficulties in providing structured and systematic solutions. Based on these problems, this research aims to test the effectiveness of problem-based learning assisted by mobile learning applications in improving the skills of Preservice Counselors. The use of mobile learning applications in this research was carried out through a platform called Bikonesia. This application can be accessed on the bikonesia.com website. Bikonesia is a digitization of guidance and counseling education for students that we developed in 2021. PBL implementation is delivered through learning videos uploaded to Bikonesia. This video provides an explanation of the PBL steps that students must follow in each meeting. Video materials are available in the general psychology "course materials" section. Apart from uploading explanatory videos, Bikonesia is also used to assess students' problem solving abilities through pre-tests and post-tests. The instrument can be accessed via the "21st Century Skills Scale – Problem Solving Skills Scale" menu. Previous research has presented data on the effectiveness of the PBL model for various levels of education and fields of study. The application of PBL has also proven to be useful in improving various types of student skills. This research aims to show the relevance of problem solving skills as a research topic, especially in the context of higher education. The strength of this research lies in its focus on the application of problem-based learning assisted by mobile learning applications. The use of mobile learning for PBL is still an area that has not been explored in previous research.

2. METHOD

This research method is descriptive qualitative using a quasi-experimental nonequivalent pretest-posttest control group design. The subject of this research is students majoring in guidance and counseling in one academic year. Quasi-experimental research seeks to identify whether a treatment makes a difference in a particular outcome by comparing differences before and after treatment. Experiments can be clarified by selecting relevant theories, treatments, and outcome variables or by adding variable measures (Blumhof et al., 2023; Masak, 2021). Quasi-experiments are used because we cannot control external variables that might influence the dependent variable. A pre-test post-test control group design was used to compare the effects of PBL in improving students' problem solving skills. Before and after treatment, students were given a pre-test and post-test to assess their problem solving abilities. We used two classes, one as the experimental group and the other as the control group presented in Table 1.

Table 1. Experimental Group and Control Group

Group	Prates	Treatment	Post Test
Experimental (Class B)	P_1	X_1	P_2
Control (Class A)	Q_1	-	Q_2

Note: P_1: Experimental group pretest; Q_2: Experimental group posttest; X_1: Problem Based Learning (PBL) Assisted by Mobile Learning Applications (MLA)

This research was conducted at the Department of Guidance and Counseling, Faculty of Teacher Training and Education, Sebelas Maret University, Surakarta, Indonesia. The participants were guidance and counseling students aged 19-22 years who took General Psychology courses for half a semester, totaling 80 people. The research was conducted over eight meetings in the even semester of the 2023/2024 academic year. The experimental group consisted of 40 Class B students and the control group consisted of 40 Class A students. The instrument used in this research is the Problem Solving Skills Scale which was developed by researchers and has been validated and tested for reliability. The instrument was developed based on (Brodie et al., 2020; Evita et al., 2022), which concludes that problem solving skills are a process used to find the best answers to unknown things in order to solve life challenges or problems. Problem solving skills are measured based on three aspects, namely Problem Solving Confidence, Approach Style, Personal Control. Problem solving skills were assessed using a 4-point Likert scale response: Very Appropriate (VS), Appropriate (S), Not Appropriate (NS), Very Unsuitable (VUS). The student problem solving ability scale underwent content validity (expert judgment) and construct validity tests. This instrument is used as a pretest and posttest. The brief procedure of this research is guided by the concept of the PBL process which consists of 5 stages, namely PBL implementation Problem analysis and issue

learning meetings, Discovery and reporting, Solution presentation and reflection, Overview, integration and evaluation. These five stages were carried out over eight learning sessions. The PBL implementation stages are presented in Table 2.

Table 2. PBL Stages

Day	Experimental Group (Problem Based Learning Model)	Group Control (Conventional Learning Model)
1	Level 1 Troubleshoot; i. Course orientation, PSS Pre-test ii. Group allocation iii. Problem orientation (explanatory video via Bikonesia platform)	Orientation to the course Pretest problem solving skills Group allocation
2	Stage 2 Problem analysis and problem learning; i. Determine the subtopics of the test ii. Formulate steps for group activities (explanation via the Bikonesia platform)	Presentation of material Discussion and questions and answers
3	Discussion of the progress of case analysis in each group	Presentation of material Discussion and questions and answers
4	Stage 3 Discovery and reporting; Assist the group in finding solutions to the problems being researched	Presentation of material
5	Discussion of the progress of case analysis in each group	Discussion and questions and answers
6	Stage 4 Presentation and reflection of solutions; Presentation of group findings and discussion of results	Presentation of material
7	Stage 5 Overview, integration, and evaluation; Analysis and evaluation of the problem solving process, review of learning outcomes	Discussion and questions and answers
8	Post-Test (PSS) via the Bikonesia platform	Post-Test (PSS) via the Bikonesia platform

(Tan, 2020)

Analysis method the data in this study were analyzed using an independent t test to compare pretest and posttest data. The independent t-test is used to determine the significance of differences in the means of two independent samples. Another assumption for independent t-tests is homogeneity of variance, and this assumption is assessed using the "Levene test" statistic. Independent t-tests were used to compare mean differences between two unrelated groups for the same continuous dependent variable. The independent t-test is a parametric statistical test that has certain assumptions that must be met. These assumptions include normality and homogeneity of variance. Normality For each group, each dependent variable must represent normally distributed scores. Homogeneity of Variances: Independent sample t-tests can be significantly affected if the variances (standard deviation squared) of the groups to be compared differ substantially (Pilar et al., 2021; Schmidt et al., 2022). Normality was assessed using the Kolmogorov-Smirnov statistic (K-S test) in SPSS 24. Various tests are available to assess the assumption of normality, including the Kolmogorov-Smirnov test and its Lilliefors correction. The normality test is recommended for large samples (Oberlander & Talbert-Johnson, 2023; Polakova & Klimova, 2023). If the normality test produces Sig. A value greater than 0.05 indicates a normal distribution, and the next step is to test homogeneity to find out whether the groups come from the same variance. Levene's test was used to assess homogeneity. Decision making criteria are based on significance value (Sig). If Sig. The value is greater than 0.05, this indicates homogeneity in the data distribution. With the assumptions of normality and homogeneity fulfilled ($p > 0.05$), an independent t-test was carried out to compare the pretest and posttest scores between the experimental and control groups. Paired samples t-test was used to ascertain whether there were changes in pretest and posttest scores in each group.

3. RESULT AND DISCUSSION

Result

Based on the criteria for taking the normality test using the Kolmogorov-Smirnov test in Table 3, Sig. a value greater than 0.05 indicates normal data distribution, while Sig. a value less than 0.05 indicates a non-normal distribution. Sign it. The results in the table above for the 2023 Class A Pretest show a value of 0.20, which can be interpreted as normal distribution of pretest data. Likewise, in the 2023 Class A

posttest, a Sig score was obtained. a value of 0.20 means that the data distribution is also normal. The 2023 Class A Normality Criteria are presented in Table 3.

Table 3. Class A Normality Criteria 2023

	Class	Kolmogorov-Smirnov[A]			Shapiro-Wilk		
		Statistics	df	Sig	Statistics	df	Sig
Pretest and Posttest A 2023	Students A 2023	0.100	40	0.200*	0.975	40	0.502
	Post test A 2023	0.095	40	0.200*	0.985	40	0.862

*. This is the lower limit of the true meaning; A. Lilliefors Significance Correction

Based on the criteria for taking the normality test using the Kolmogorov-Smirnov test in Table 4, Sig. a value greater than 0.05 indicates normal data distribution, while Sig. a value less than 0.05 indicates a non-normal distribution. Sign it. The results in the table above for the 2023 Class B Pretest show a value of 0.51, which can be interpreted as normal distribution of pretest data. Likewise, in the 2023 Class B posttest, a Sig score was obtained. a value of 0.51 means that the data distribution is also normal. The 2023 Class B Normlity Criteria are presented in Table 4.

Table 4. Class B Normality Criteria 2023

	Class	Kolmogorov-Smirnov[A]			Shapiro-Wilk		
		Statistics	df	Sig	Statistics	df	Sig
Pretest and Posttest B 2023	Pretes B 2023	0.139	40	0.051	0.964	40	0.224
	Post test B 2023	0.110	40	0.200	0.968	40	0.316

*. This is the lower limit of the true meaning; A. Lilliefors Significance Correction

The homogeneity test was carried out to assess the level of homogeneity of the research sample data in table 5. Levene's test was used with the help of SPSS. If Sig. The "Based on Mean" value is greater than 0.05, this indicates that the data is homogeneous. In the Class of 2023 table, Sig. The value for "Based on Mean" is 0.299, which means that the pretest and posttest data for the Class of 2023 are homogeneous, and the samples in the study are relatively the same. The Homogeneity Test is presented in Table 5.

Table 5. Homogeneity Test

		Levene Statistics	df1	df2	Sig
Class of 2023	Based on Average	1.091	1	78	0.299
	Based on Median	0.895	1	78	0.347
	Based on Median and with adjusted df	0.895	1	77.172	0.347
	Based on trimmed mean	1.104	1	78	0.297

The basis for decision making in the Independent t-test is to test "Equal Variances Assumed" in Table 6, showing that Sig. (2-tailed) because the data distribution is normal and homogeneous, resulting in a value lower than 0.05. In the table above for the Class of 2023, Sig. (2-tailed) in the "Equal Variances Assumed" section is 0.000, lower than 0.05. Based on this, it can be concluded that Ha is accepted and H_0 is rejected. Independent sample tests are presented in Table 6.

Table 6. Independent Sample Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Say.	T	df	sig. (2-tail)	Meaningful Differences	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Above
Problem Solving Skills 2023	Equal variances are assumed	21.052	0.000	-7.389	78	0.000	-13.450	1.820	-17.074	-9.826

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Say.	T	df	sig. (2-tail)	Meaningful Differences	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Above
Equal variances are not assumed			-7.389	52.571	0.000	-13.450	1.820	-17.102	-9.798

Discussion

This model encourages students to focus on real problems and helps them understand real life situations. After identifying a problem, students learn independently, trying to find knowledge and strategies to solve their respective problems (NİSA et al., 2019; Obafemi, 2021). Through PBL, lecturers give students the freedom to find solutions according to their field of study. Students learn how to identify problems and find relevant solutions. They are given the opportunity to solve problems collaboratively, create effective learning models and foster independent learning habits through practice and reflection (Marra et al., 2019; Mourtos et al., 2020).

The PBL model is widely applied in the education sector because it offers benefits for both teachers and students. Some of the benefits of PBL, as emphasized, include giving students responsibility for their learning, allowing project groups to work together effectively, and allowing for individual assignments within each group to provide opportunities for students to do learning. each student to demonstrate his abilities. PBL is implemented because it is considered effective in improving students' skills. Current emphasis on college students includes student engagement, critical thinking, independent learning, authentic learning, team skills development, problem solving skills, and interdisciplinary studies. Problem solving skills need to be trained and possessed by students in the learning process. Problem solving skills refer to an individual's ability to use cognitive processes to overcome and resolve real life situations (Kilroy, 2020; Mustofa & Hidayah, 2019).

Based on the research results, it is known that students' problem solving abilities have increased after being treated with a problem-based learning model. Problem-based learning steps consisting of problem meetings, problem analysis and learning problems, discovery and reporting, presentation and reflection on solutions, overview, integration, and evaluation, can develop students' problem-solving abilities. Problem-based learning encourages students to develop concepts in solving or finding solutions to a problem. In PBL, the teacher acts as a facilitator who is tasked with providing assistance to students who face difficulties after the students try to understand the problem, plan the solution to be taken, and review the solution that has been prepared. Students are expected to be active both individually and in groups. In PBL, students form groups which are followed by presentation of the material carried out by the group, followed by discussion and questions and answers.

This was different from the control group who only received lectures from their respective instructors. In the current disruptive era, PBL is increasingly exciting and is facilitated using the Mobile Learning Application (MLA). The use of MLA in this case utilizes the Bikonesia application containing questions that must be answered by students and aims to improve or develop thinking abilities (Kadir et al., 2019; Klegeris & Hurren, 2020; Kourmousi et al., 2023). Mobile learning can be used by subject teachers to improve learning outcomes. However, in the implementation of learning using the PBL method, there are still several challenges. Some students may not be fully active during the learning process, and some may need to increase their involvement in asking questions (Kumar & Sharma, 2020; Magaji, 2020; Mehta, 2017). Additionally, some students may not be fully focused on the MLA opening, and there may be cases where the time allocation slightly exceeds the initial plan. However, the success of applying the PBL method in improving individual problem solving skills has been proven in previous research. Research that examines the effectiveness of several learning models compared to conventional learning models shows that currently conventional learning (lectures, discussions and questions and answers) is no longer effective for the learning process (Levin, 2023; Maciejewski, 2018).

Previous research on the effectiveness of problem-based learning (PBM) has shown that this method significantly improves students' problem-solving skills and critical thinking abilities. These studies are generally carried out in conventional learning contexts without the support of modern technology. Despite positive results, this research is often limited by limited resources and lack of flexibility in

implementing PBM. In contrast, recent research evaluating the effectiveness of mobile learning app-assisted PBM shows more significant improvements in preservice counselors' problem-solving skills. With the support of mobile technology, PBM becomes more interactive and accessible, allowing students to practice and develop their skills anytime and anywhere. Mobile learning apps also offer a variety of features such as interactive simulations, live feedback, and customized learning materials, all of which contribute to increased learning effectiveness. This comparison shows that the integration of mobile technology in PBM not only strengthens the results already achieved by conventional methods, but also overcomes some of their limitations. Recent research underscores the importance of technology in creating learning environments that are more dynamic and responsive to student needs, particularly in the context of preservice counselor training.

The implications of research regarding the effectiveness of problem-based learning assisted by mobile learning applications in improving preservice counselors' problem-solving skills show several important things for curriculum development and educational practice. First, the results of this research can encourage educational institutions to integrate mobile technology in the learning process, considering its effectiveness in improving problem-solving skills. Second, the development of learning applications specifically designed to support problem-based learning can be an effective tool in improving students' analytical and critical abilities, which are essential competencies for prospective counselors. Apart from that, this implication also emphasizes the importance of training and coaching for educators in using mobile technology as a learning tool so that its implementation can run optimally. This research also opens up opportunities for further study regarding various other innovative learning methods that can be integrated with technology to improve the quality of education. Overall, these findings support a shift in the educational paradigm towards a more interactive and technology-based model, which is not only relevant for prospective counselors but also for various other disciplines. This research is limited to students majoring in guidance and counseling in one academic year. The aim of this research is to test the effectiveness of the problem-based learning model assisted by mobile learning applications to improve problem-solving abilities in guidance and counseling students. Problem Based Learning is a learning method that promotes all learning through authentic problem solving, as well as to improve problem solving skills. The use of mobile learning applications is limited to the use of Bikonesia which was developed by researchers. Therefore, there are still many aspects that need to be further developed and strengthened beyond the limitations of this research.

Limitations of this research First, sample limitations may affect the generalization of the results of this research. If the sample used is not diverse or representative enough, the results may not be widely applicable to the larger population of preservice counselors. Second, this research may face technical barriers related to the use of mobile learning applications, such as limited technology access or digital skills gaps among participants. Third, the limited duration of the study may affect long-term understanding of the effectiveness of this method. In addition, external factors such as personal motivation and institutional support can also influence research results and are difficult to control completely. To overcome these limitations, several recommendations can be proposed. First, future research should include larger and more diverse samples to increase the external validity and generalizability of the results. Second, adequate training and technical support must be provided to participants to ensure effective use of mobile learning applications. Third, long-term research is needed to evaluate the ongoing impact of mobile app-assisted PBM on problem-solving skills. Additionally, it is important to consider motivational factors and institutional support in research design to understand their influence on learning outcomes. By considering these recommendations, future research can provide more comprehensive and in-depth insight into the effectiveness of mobile learning application-assisted PBM in preservice counselor education.

4. CONCLUSION

This research shows that the application of PBL assisted by MLA has a positive impact on the problem-solving abilities of students majoring in guidance and counseling. This research contributes to the literature regarding PBL assisted by website applications related to students' problem solving abilities. One of the most significant contributions to the literature on PBL and MLA is the realization that PBL can be implemented effectively with the help of technology, increase students' active engagement, and influence problem-solving skills, as supported by research findings. The results of this quasi-experiment show that there is a positive influence of MLA-assisted PBL in improving students' problem-solving abilities.

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