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The Impact of Problem-Based Learning Model Assisted by Mentimeter Media in Science Learning on Students' Critical Thinking and Collaboration Skills

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ABSTRAK

Penelitian ini dilatarbelakangi oleh kemampuan mahasiswa yang masih kurang dalam mengidentifikasi, memahami, menyatakan, mencari solusi, dan menarik kesimpulan terhadap masalah yang diberikan. Selain itu mahasiswa juga cenderung pasif dalam pembelajaran. Penelitian ini bertujuan menganalisis pengaruh model pembelajaran problem-based learning (PBL) berbantuan media mentimeter terhadap kemampuan berpikir kritis dan kemampuan kolaborasi mahasiswa Pendidikan guru sekolah dasar. Metode yang digunakan dalam penelitian ini adalah eksperimen kuasi dengan desain non-equivalent control group. Kemampuan berpikir kritis dikumpulkan dengan tes kemampuan berpikir kritis berbentuk tes essay dan lembar observasi untuk mengetahui keterampilan kolaborasi. Hasil penelitian menunjukkan bahwa terdapat perbedaan yang signifikan kemampuan berpikir kritis dan keterampilan kolaborasi antara mahasiswa yang belajar dengan menggunakan problem based learning berbantuan media mentimeter dengan mahasiswa yang belajar tanpa menggunakan problem based learning berbantuan media mentimeter sehingga dapat disimpulkan bahwa model pembelajaran problem based learning berbantuan media mentimeter memberikan pengaruh pada kemampuan berpikir kritis dan keterampilan kolaborasi mahasiswa pendidikan guru sekolah dasar.

ABSTRACT

This research is motivated by the ability of students who are still lacking to identify, understand, state, find solutions, and draw conclusions to the problems. In addition, students also tend to be passive in learning. This study aims to analyze the effect of the problem-based learning model with the aid of the mentometer on elementary school teacher education students' critical thinking and collaboration skills. The method used in this study is a quasi-experimental design with a non-equivalent control group. Critical thinking skills were collected with critical thinking skills tests in the form of essay tests and observation sheets to determine collaboration skills. The results show significant differences in critical thinking and collaboration skills between students who study using problem-based learning with the aid of a mentimeter and students who learn without using problem-based learning with the aid of a mentimeter. So, it can be concluded that the problem-based learning model assisted by a mentimeter influences elementary school teacher education students' critical thinking and collaboration skills.

1. INTRODUCTION

The main aspect that makes a country developed or not can be seen in the quality of education in that country. Education is the nation's backbone (Rahayu et al., 2018; Utomo et al., 2020). Education is the key to all quality progress and development because with education; humans can realize all their potential both as themselves and as a community (Kurniawan, 2013; Sotero et al., 2020). Education is a guiding effort consciously by educators (including parents) towards students to develop students potential to form a perfect personality (Kuswari et al., 2019). Education functions to develop capabilities and shape the character and civilization of a dignified nation to educate the nation's life (Asyari et al., 2016; Utomo et al., 2020). The learning process at school is one of the educational processes. The learning process is not only limited to conveying knowledge from educators to students (teacher-centered), but students are required to be active in seeking, processing, and constructing knowledge so that learning can be centered on students (Aufa et al., 2020) through various learning experiences and interactions in multiple contexts (de Jong et al., 2021).

Student-centered learning is focused on students' needs, abilities, interests, and learning styles, with the teacher as a learning facilitator (Ariani, 2020; Ariyani & Prasetyo, 2021; Larasati, 2018). One of the teacher's roles is to guide learning practices to develop students' critical thinking skills (Cai, 2021; Reichert

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et al., 2021). Critical thinking skills are one of the life skills that students must have; having critical thinking skills will help students to solve simple or complex problems because considering the importance of critical thinking in educational discourse (Dewi et al., 2019; Giacomazzi et al., 2022). Critical thinking is a process in which a person elaborates on evidence-based statements and focuses on argumentation and reasoning (Landa-Blanco & Cortés-Ramos, 2021; Meirbekov et al., 2022; Sinaga et al., 2022). Critical thinking skills reflect a tendency to be open to new ideas, evaluate them critically, and be prepared to change one's point of view based on evidence (Alvarez-Huerta et al., 2022; Ellerton, 2022). The purpose of teaching critical thinking is so that students can apply it in various contexts, not only in the context in which they are taught but also in everyday life (Rombout et al., 2022). With the ability to think critically, students can consider the opinions of others and can express their own opinions. In addition to critical thinking, collaboration is also needed by students to be able to participate and compete in the 21st century. Collaboration skills unite views by discussing and exchanging opinions (Kereluik et al., 2013). Students' collaboration skills must be developed during science learning because students are also required to be able to collaborate with team members in solving problems (Ashraf et al., 2017).

However, in reality, science learning in schools tends to emphasize cognitive rather than affective and psychomotor abilities, so students only focus on developing cognitive abilities (Mardiana, 2018). Many think that science lessons are difficult to understand. The critical thinking ability of students is still low. Learning is still teacher-centered (Cahyono, 2017; Farisi et al., 2017). The teacher only uses a monotonous learning method. It causes a lack of student participation in learning (Ögren et al., 2017). Based on the results of observations and interviews with lecturers in the science concept 1 course, it is known that most of the second-semester student learning outcomes of the elementary school teacher education program at PGRI Yogyakarta University are still low. It can be proven from the results of assignments, mid-semester exams, and end-semester exams that they have not reached the achievement standards set by the university. Science 1 course is one of the courses that contains many concepts that students must master, so this course is still considered a collection of images that most students must memorize. As a result, they feel bored and pay less attention to the lecturer's explanations. Students' attention to lecture material only occurs at the beginning of learning. Students tend to be silent and do not ask questions even though they have been allowed to ask. In addition, information was obtained that the ability of students to identify, understand, state problems in a simple form, find solutions to given problems, and draw conclusions is still very low. Furthermore, the level of collaboration possessed by students is still relatively low, as in group discussions, some students rely on students who are active and more silent. As a result, learning is more dominated by active students. These problems, if not addressed, will negatively impact student learning outcomes.

One way that can be applied to overcome these problems is by using a problem-based learning model. The problem-based learning model can be applied in the learning process to develop students' cognitive, affective and psychomotor abilities (Asyari et al., 2016; Marzuki, 2017; Netriwati, 2018). Motivation, emotions, environment, and learning models influence critical thinking skills, communication, creativity, and collaboration (Huang et al., 2017). Using learning models is one of the critical success factors of a learning process. Learning models that meet good criteria will make an effective and efficient learning process (Mahjaty, 2017; Rubiah, 2016; Tang et al., 2021). Problem-based learning (PBL) model is a model characterized by the use of problems that exist in the real world. Problems are set as the starting point of the learning process, which motivates students to continue to investigate so that they can better understand the mechanics of the problem and its solution (Aslan, 2021; H. Li et al., 2021; Phungsuk et al., 2017) (Phungsuk et al., 2017). The problem-based learning (PBL) model is student-centered learning (Andersen & Rosio, 2021). Problem-based learning (PBL) is a non-traditional pedagogical model that focuses on students and collaborates in small groups (A.Montepara et al., 2021). According to (X. Li et al., 2020), learning in small groups can provide opportunities for students to construct ideas through social interaction. This small group of students will be guided by a tutor like a teacher (Virginie & Miklos, 2019).

The problem-based learning (PBL) model can train students to think critically and improve cooperative student attitudes (Seibert, 2020). This form of learning helps students learn about the material and forms the character of cooperation with other students, where they communicate and help each other solve problems (Suparno et al., 2019). In addition to using problem-based learning (PBL) models, educators must also involve learning media as learning aids, stimulating students' thoughts, attention, and abilities or skills to encourage an optimal learning process. One of the media that educators can use is a mentimeter. Media Mentimeter is an interactive presentation application. Mentimeter is an online application that offers significant advantages (Andriani et al., 2019; Sari, 2021). This application allows users to create presentations and receive audience input through polls, charts, quizzes, Q&A, and other interactive features. A mentimeter is used as a medium in learning when holding apperception or prompting questions during learning to activate students in learning (Gokbulut, 2020; Hasyyati & Zulherman, 2021). Mentimeters in

class improve learning quality by encouraging students to interact and discuss specific topics, even the most introverted students (Mahmashony, 2018; Wong & Yunus, 2020). Mentimeter offers collaborative learning as it allows students to share their thoughts as they post their ideas on the same page (Wong & Yunus, 2020). This media meter can use a problem-based learning (PBL) model.

Several previous findings related to the problem-based learning model have been carried out. There are differences in cognitive learning outcomes between students taught using a problem-based learning model (PBM) and those taught using conventional learning models (Damopolii et al., 2018). Students are learning to use PBM, become more active, and can solve problems given by the teacher very well. Applying problem-based learning (PBM) in thermodynamics course learning can improve students' cognitive and creative abilities compared to using powerpoint-assisted conventional knowledge (Rusydi, 2017; Sa'dulloh, 2021; Umbara et al., 2020). Problem-based learning models can improve student learning outcomes (Ariyani & Prasetyo, 2021; Lidyawati et al., 2017; Suana et al., 2017). Although research on problem-based learning models has been widely carried out, this research differs from previous research. This study uses a problem-based learning model with the aid of a mentimeter. This study aimed to analyze the effect of the problem-based learning (PBL) model with a mentometer on elementary school teacher education students' critical thinking and collaboration skills. Applying the problem-based learning model with the mentometer is expected to influence elementary school teacher education students' critical thinking and collaboration skills.

2. METHOD

The research used in this study was quasi-experimental (Sudarsana, 2018). The research design is a Pretest-Posttest Control Group Design using experimental and control classes (Fitriyyah & Wulandari, 2019). The research population was all 4th-grade 2nd-grade students. The research sample consisted of two classes, namely classes A7-21 and A8-21, which were taken by purposive sampling and simple random sampling. Class A7-21 was the experimental class treated using the Problem Based Learning (PBL) Model with the aid of a mentometer. Class A8-21 treated the control class treated using the Direct Instruction Model. The data collection technique uses the test method to obtain data on cognitive learning outcomes and the observation sheet method to obtain psychomotor learning outcomes (Santoso et al., 2013).

The technique used to analyze the data to test the research hypothesis is Multivariate Analysis of Variance (Manova). Before testing the hypothesis, several requirements must be met and need to be proven. The requirements in question are that the analyzed data must be normally distributed and know that the analyzed data is homogeneous. Both of these prerequisites must be proven first, so to fulfill this, a prerequisite analysis test is carried out by conducting a normality test and a homogeneity test. Normality test using SPSS 28.00 for windows Shapiro Wilk statistical test at a significance of 0.05. While the homogeneity of variance testing in this study was carried out using Levene's Test of Equality of Error Variance test with the help of SPSS through the Box's M test. The three hypotheses were tested using Multivariate Analysis of Variance (Manova). Hypotheses 1 and 2 were carried out with the F test of variance through Manova analysis using the Test of Between Subject Effects with the test criteria for a significance level of F = 5%, assisted by SPSS 28.00 for windows. While hypothesis 3 is carried out by F test through decisions taken by analysis of Pillae Trace, Wilk Lambda, Hotelling's Trace, and Roy's Largest Root, with test criteria for significance level F = 5%. If the F arithmetic significance number is less than 0.05, then the null hypothesis is rejected, and Ha is accepted.

3. RESULT AND DISCUSSION

Result

The data in this study are grouped into critical thinking skills taught using the PBL learning model assisted by the mentometer. Collaborative skills are learned using the PBL learning model assisted by the mentimeter media. Critical thinking skills are taught with educator-centered learning, and collaboration skills are taught with educator-centered learning. The results of the data analysis can be seen in Table 1.

Table 1. The results of calculating critical thinking skills and collaboration skills

Statistic	A1		A2	
	Y1	Y2	Y1	Y2
Number of Respondents	25	25	25	25
mean	87.36	80.72	65.32	75.68
Standard Deviation	6.3763	3.7807	6.9145	4.9642

variance	40.66	14.29	47.81	24.64
Minimum Score	78	74	50	66
Maximum Score	100	88	80	86

Table 1 shows that the experimental class's average value of critical thinking ability is 87.36, which is greater than the average value of the control class, which is 65.32. Likewise, the average value of collaboration skills in the experimental class is 80.72, which is higher than the average value of collaboration skills in the control class, which is 75.68. Before testing the hypothesis, the data on students' critical thinking and collaboration skills were tested with prerequisites, namely the normality and homogeneity tests. After all the data is obtained, the next step is to analyze the data. The first step is to perform a data normality test to measure whether the analyzed data is normally distributed so that it can be used in parametric statistics. The normality test was performed using Shapiro Wilk by looking at the value of Shapiro Wilk and its Asymp.Sig. The criteria for acceptance of normality are if the significance value of the calculation results is greater than α = 0.05, then the distribution is normal. Otherwise, the distribution is declared abnormal if it is smaller than α = 0.05. The summary of the data normality test can be seen in Table 2.

Table 2. Normality test results

Tests of Normality							
	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Critical thinking skills	IPA A7	0.116	25	0.200	0.942	25	0.162
	IPA A8	0.116	25	0.200	0.980	25	0.886
Collaboration skills	IPA A7	0.127	25	0.200	0.970	25	0.644
	IPA A8	0.128	25	0.200	0.964	25	0.509

Based on Table 2, it is found that the significance value of this normality test is greater than = 0.05. Thus, it can be concluded that the overall data in the control and experimental groups are normally distributed. In this study, the homogeneity of variance test was carried out on the variance between the experimental and control groups. The homogeneity of variance test in this study was carried out using Levene's Test of Equality of Error Variance test with the help of SPSS through the Box's M test. The complete calculation of the homogeneity test for the distribution of data is presented in Table 3.

Table 3. The results of the homogeneity of variance

Box's Test of Equality of Covariance Matrices[a]	
Box's M	3.561
F	1.133
df1	3
df2	414720.000
Sig.	.334

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
a. Design: Intercept + Kelas

Table 3 shows that the Box's M value produced is 3.561 (p = 0.334), where the value is 0.334 > 0.05, so it can be concluded that the covariance matrix between groups is assumed to be the same or homogeneous. Based on the prerequisite test of data analysis, it was found that the post-test results of the experimental and control groups were normal and homogeneous. After obtaining the results of the prerequisite test of data analysis, it is continued with testing the research hypothesis. From the results of data processing on hypotheses 1 and 2, the variance F test was carried out through Manova analysis using the Test of Between Subject Effects with the test criteria for a significance level of F = 5%, if the F arithmetic significance number was less than 0.05 then the null hypothesis was rejected, and Ha received. The test calculations are presented in Table 4.

Table 4. The results of the f variant test using the test of between subject effects

Tests of Between-Subjects Effects							
Source	**Dependent Variable**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected	Critical thinking skills	6072.020	1	6072.020	137.272	<0.001	0.741
Model	Collaboration skills	317.520	1	317.520	16.310	<0.001	0.254
Intercept	Critical thinking skills	291389.780	1	291389.780	6587.561	<0.001	0.993
	Collaboration skills	305762.000	1	305762.000	15705.607	<0.001	0.997
Kelas	Critical thinking skills	6072.020	**1**	6072.020	**137.272**	**<0.001**	0.741
	Collaboration skills	317.520	**1**	317.520	**16.310**	**<0.001**	0.254
Error	Critical thinking skills	2123.200	48	44.233			
	Collaboration skills	934.480	48	19.468			
Total	Critical thinking skills	299585.000	50				
	Collaboration skills	307014.000	50				
Corrected	Critical thinking skills	8195.220	49				
Total	Collaboration skills	1252.000	49				

From the results of data processing shown in table 4, it can be described that in the first hypothesis, the calculated F value is 137.272 df = 1, and sig = <0.05. It means significance < 0.05. Thus the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha) is accepted. So based on the results of the analysis of the first hypothesis, there is a significant difference in critical thinking skills between experimental class students (IPA A7) who were taught by the problem-based learning (PBL) learning model with the aid of a metered media and control class students (IPA A8) who were taught by learning direct. Furthermore, in the second hypothesis, the study results show that the calculated F value is 16.310 df = 1, and sig = <0.05. It means significance < 0.05. Thus the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha) is accepted. So, based on the results of the analysis of the second hypothesis, the collaboration skills between experimental class students (IPA A7) who were taught using a problem-based learning (PBL) learning model assisted by a mentometer and control class students (IPA A8) who were taught by direct learning. The third hypothesis, carried out by the F test through the decisions taken by the analysis of Pillae Trace, Wilk Lambda, Hotelling's Trace, and Roy's Largest Root, with the test criteria of significance level F = 5%. If the F arithmetic significance number is less than 0.05, then the null hypothesis is rejected, and Ha is accepted. The test calculations are presented in Table 5.

Table 5. Multivariate Test Results

Multivariate Tests						
	Value	**F**	**Hypothesis df**	**Error df**	**Sig.**	**Partial Eta Squared**
Pillai's trace	0.747	69.426	2.000	47.000	<0.001	0.747
Wilks' lambda	0.253	69.426	2.000	47.000	<0.001	0.747
Hotelling's trace	2.954	69.426	2.000	47.000	<0.001	0.747
Roy's largest root	2.954	69.426	2.000	47.000	<0.001	0.747

Based on table 5, the results show that the F count of Pillae Trace (F count = 69.426), Wilk Lambda (F count = 69.426), Hotelling's Trace (F count = 69.426), Roy's Largest Root (F count = 69.426), all have significance <0.05, so the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. Thus, based on the analysis of the third hypothesis, there is a significant difference in critical thinking skills and collaboration skills jointly between experimental class students (IPA A7) who were taught using the problem-based learning (PBL) learning model with the aid of a metered media and control class students (IPA A8) which is taught by direct learning.

Discussion

Based on the research results obtained, several results. First, there is a significant difference in critical thinking skills between experimental class students (IPA A7) who were taught using a problem-based learning (PBL) model with the aid of a mentometer and control class students (IPA A8) who were taught by direct learning. Looking at the data from the research, theoretically, it can be said that the PBL model with the aid of the metered media is better and more effective in improving critical thinking skills in the learning process. The PBL model assisted by the mentometer is a model and learning media that can

improve students' critical thinking skills. Students not only have to understand relevant concepts but are required to have critical thinking skills and adapt to new knowledge to cultivate higher-order thinking patterns (Ariyani & Prasetyo, 2021; Mutakinati et al., 2018; Silberman et al., 2021). Students who use problem-based learning models show better thinking skills than expository learning models (Elizabeth & Sigahitong, 2018). The higher the thinking process, the higher the thinking skills needed (Afriansyah et al., 2020; Ariani, 2020). Therefore, the PBL model, with the aid of a mentimeter, is better and more effective in improving critical thinking skills in the learning process.

Second, the PBL learning model assisted by the media meter is better and more effective in improving student collaboration skills in the learning process. Applying the PBL learning model with the aid of a mentometer can make students able to express ideas or ideas based on problems, exchange information, receive the results of ideas or ideas between group members and present the results of group discussions. Students also have good initiative and responsibility in completing individual or group tasks that have been divided to achieve common goals. All group members are responsible for seeking information, data, and supporting facts through various sources to solve problems. After obtaining data and information related to the problem, students make compromises in making decisions from the facts, information, and data obtained. It is under the statement that collaborative learning requires students to learn together or in groups (teamwork) (Fahmi et al., 2020). The attitude of collaboration is very important to be accustomed to students so that students have skills in group collaboration effectively, adapt to various roles and responsibilities, work productively with others, have empathy and respect for different perspectives, can compromise with members in the group to achieve the goals that have been set (Anggelita et al., 2020; Fahmi et al., 2020; Hidayanti et al., 2020). Collaborative skills of students in groups cause each member to work together in solving problems so that they can achieve certain goals (Sunbanu et al., 2019).

Third, there are significant differences in critical thinking skills and collaborative skills between experimental class students (IPA A7) who were taught the problem-based learning (PBL) model with the aid of a metered media and control class students (IPA A8) who were taught using direct learning. Looking at the data from the research, theoretically, it can be said that the PBL learning model assisted by the media meter is better and more effective in improving critical thinking and collaboration skills in the learning process. It can be realized because the PBL learning model emphasizes the importance of social interaction between students and collaboration to solve problems so that learning is fun and meaningful (Asyari et al., 2016; Nurhayati et al., 2015; Yazar Soyadı, 2015). Each student is prepared for collaborative activities, working in pairs, gathering ideas, and sharing their thoughts or solutions with all colleagues (Anjelina Putri et al., 2018; Handayani & Koeswanti, 2021; Jayadiningrat & Ati, 2018). Students are learning to use PBM, become more active, and can solve problems given by the teacher very well (Aufa et al., 2020; Mulyani, 2020).

This finding is reinforced by previous findings, which state that there are differences in students' cognitive learning outcomes who are taught using a problem-based learning model (PBM) and a conventional learning model (Damopolii et al., 2018). Problem-based learning (PBM) can improve students' cognitive and creative abilities with the help of PowerPoint (Rusydi, 2017; Sa'dulloh, 2021; Umbara et al., 2020). Problem-based learning models can improve student learning outcomes (Ariyani & Prasetyo, 2021; Lidyawati et al., 2017; Suana et al., 2017). Based on the data analysis and relevant research results, it is evident that there is an effect of Problem Based Learning (PBL) assisted by a mentometer on students' critical thinking and collaboration skills. From the discussion description, the Problem Based Learning (PBL) learning model assisted by the media meter implemented by the lecturer will greatly affect students' critical thinking and collaboration skills and can improve students' critical thinking skills and collaboration skills. This research implies that it is expected to improve critical thinking and collaboration skills through applying a problem-based learning model with the aid of a mentimeter.

4. CONCLUSION

The problem-based learning (PBL) model assisted by the mentometer influences the critical thinking and collaboration skills of UPY PGSD students in science learning. Furthermore, it is expected that science and other learning educators can use problem-based learning models and measure media as an alternative model and learning media in schools and universities. So educators must pay attention to the presentation of teaching materials in the form of something new and attract the attention and interest of students, embrace students in learning and link learning with students themselves, involve students in the learning process, and invite students to solve learning problems with the knowledge they have as efforts to improve the quality of education, especially science courses related to critical thinking skills and collaboration skills.

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