

The Effectiveness of Online Problem-Based Learning in Improving Critical Thinking Skills and Digital Literacy of Elementary School Students

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Abstract

Online learning is a learning process that is far from the center of education and is independent. Critical thinking skills and digital literacy are considered as 21st century skills. This study aims to test and analyze the effectiveness of online problem-based learning in improving students' critical thinking skills and digital literacy skills. The design of this study was a *quasi-experimental design* in the form of a *nonequivalent control group design*. The subjects in this study were fifth grade students of Gugus Muhammad Syafei. The data from the expert validation were analyzed using a quantitative descriptive method. The thinking ability of the experimental class students at the pretest was 59.83 and increased at the posttest by obtaining an average score of 75.67. While the critical thinking skills of the control class on the pretest obtained an average of 52.96 and increased at the posttest of 64.07. The result of the value of Sig.(2-tailed) is 0.000. The digital literacy skills of experimental class students at the pretest of 40.53 got an increase in the posttest by reach an average score of 50.77. While the digital literacy skills of the control class in the pretest reached an average of 33.33 and increased at the posttest by 40.00. The result of the Sig. (2-tailed) is 0.001. Based on these results, it can be concluded that there is a significant effect in the application of the online problem-based learning model on improving students' digital literacy skills.

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INTRODUCTION

The paradigm shift in education in Indonesia is growing very rapidly as a result of the Corona Virus Diseases-19 pandemic (Schröder-Turk & Kane, 2020). The old paradigm that requires the learning process to always be carried out by face-to-face learning has turned into a new paradigm, that is the learning process can be carried out by online method (Benson, 2015). This is one proof that there is a digital transformation in the world of education in Indonesia. This policy was implemented to carry out social distancing and physical distancing policies which have the aim to break the chain of transmission of Covid-19 by changing the learning process from face to face to an online learning process (Noor et al., 2020). Therefore, it is necessary to involve all parties, especially the school in preparing students to have 21st-century skills so that students can follow technological developments (Suci et al., 2019).

These 21st century skills arise from an assumption that currently students live in an environment surrounded by technology, students are able to get many information, the acceleration of very fast technological progress and new patterns of communication and collaboration patterns. Success in this digital world very relies on the skills that are important to have in the digital era, including skills in processing digital information that students receive from various information sources. Technology is inseparable from today's online education world (Benson & Kolsaker, 2015). However, the current learning system in Indonesia still emphasizes lesson material that is related to memory knowledge (Marambe et al., 2012).

Critical thinking skills are essential skills and function effectively in all aspects of life (Herdini et al., 2019). The purpose of critical thinking is to evaluate the best or believed actions (Anisa, 2017). In every subject and at every level of education, the learning and instruction process needs to integrate content knowledge learning, with activities that require

critical thinking and problem-solving skills (Khiyarusoleh, 2016). Zahroh & Yuliani (2021) stated that besides being targeted to be able to master critical thinking skills, students are also targeted to master scientific literacy to support their skills in dealing with future problems.

Literacy is an influential and supportive skill in the learning process (Adiarsi et al., 2015). Poor media literacy skills will have a bad impact on the information obtained related to the truth of the information (Fatmawati & Sholikin, 2019). Digital literacy is the ability of students to make assessments of information found online, which can be based on student's ability to think critically, and the key is to form a balanced assessment by distinguishing between content and presentation of information that students get from the internet (Sutisna, 2020).

Based on the results of observations of critical thinking skills in fifth-grade students in the Dabin Muhamad Syafei Cluster, Klego District, Boyolali Regency, it shows that the online learning process implemented by the school is not optimal because teachers still use expository learning methods when online learning takes place. The teacher conveys learning materials related to memory knowledge and has not integrated contextual aspects. The learning process makes students unable to be actively involved. The low critical thinking skills of students result in low student learning outcomes so that learning objectives cannot be achieved optimally (Prasasti et al., 2019).

Increasing human resources in the field of education can be done through the use of digital media as a welcome and supporter in the world of education (Ahsani et al., 2021). The results of the observation of the digital literacy skills of fifth graders in the Dabin Muhamad Syafei Cluster, Klego District, Boyolali Regency indicate that the online learning process implemented by the school is not fully in accordance with the online learning plan made by the teacher. There are students who still have difficulty operating the learning applications planned by the teacher, students have not mastered the processing of information obtained from the internet, students are also constrained

by internet signals which are the main supporters of the implementation of online learning. The low critical thinking skills and digital literacy skills of students affect the low learning outcomes obtained by students

(Anggraini, 2018). This can be seen in Table 1 which shows that the average PAS score is still below the minimum completeness criteria (KKM).

Table 1. Value of PAS Class V Muhammad Syafei Cluster for the Academic Year 2021/2022

No	School name	Min. score (KKM)	Average score
1	SDN 1 Kalangan	70	61
2	SDN 2 Kalangan	65	63
3	SDN 1 Sangge	70	63
4	SDN 1 Banyuurip	70	62
5	SDN 2 Banyuurip	60	65
6	SDN 1 Sendangrejo	70	60
7	SDN 2 Sendangrejo	70	62
8	SDN 1 Bade	60	65

Those low average value indicates the need for innovative learning models that can encourage and stimulate students to be skilled in critical thinking and improve their digital literacy skills. The online learning model that is assumed to be able to overcome these problems is a problem-based learning model (Fauzi et al., 2018). Problem-based learning is learning that places students in various authentic and meaningful problem situations, these problems can serve as a stimulus for students to conduct investigations (Hakim, 2015). Problem Based Learning (PBL) is a learning model whose presentation of problem-oriented material is developed based on learning objectives so that students gain knowledge that makes them able to overcome a problem and have the ability to work in teams (Aminah et al., 2021). The main purpose of problem-based learning is to investigate important problems and become independent learning (Sujiono., & Widiyatmoko, 2014).

Online learning is an independent learning model that can connect student learning with the current state of development and technological progress so that it can facilitate students to learn anywhere and anytime (Amarila et al., 2014). Online learning is learning that is carried out through the internet network (Ahsani et al., 2021). Therefore, in Indonesian online learning is translated as

online learning or online learning (Fatchurrohman, 2017). In online learning, interactions between students and teachers, and other students certainly occur online as well. The technology used for synchronous interactions is for example video-conferencing and online chat, while for asynchronous interactions such as e-mail and discussion boards (Zimmerman, 2021).

In accordance with the researcher's assumption that the application of an online-problem-based learning model can overcome the problems found in the field, it is strengthened by several previous studies that have implemented online-problem-based learning to overcome the research problems. Nugraha (2017) in his research found that after learning using the Problem-based learning model, it showed an increase with an average of 30.70 while for the results of the concept mastery test increased with an average of 32.17. Both critical thinking skills and mastery of concepts experienced a significant increase.

Based on this background, researchers want to innovate learning models using online-based problem-based learning in improving critical thinking skills and digital literacy of elementary school students.

This study aims to test and analyze the effectiveness of online -problem-based learning in improving students' critical thinking skills and

digital literacy skills. The benefit of this research is to contribute to educators in implementing learning using online- problem-based learning.

METHODS

This research is an experimental study using a quasi-experimental design in the form of a nonequivalent control group design where there are two groups, namely the experimental and control groups. Before being treated, each group was analyzed for similarity by being given a pretest, the results from the pretest were analyzed to determine the initial state, homogeneity and normality of the sample, then the experimental group was treated using online-based problem-based learning, while the control group was treated using expository learning. Then both groups will be given a posttest. In this study, the effect of online-based problem-based learning was analyzed with a different test using a t-test consisting of a Paired Sample test and an Independent Sample Test. The treatment is considered to have a significant effect if there is a significant difference between the experimental group and the control group.

The independent variable in this study is online-based problem-based learning. The dependent variable in this study is students' critical thinking skills and digital literacy skills. The instruments in this study consisted of learning tools (syllabus, lesson plans, teaching materials, and student worksheet), description questions, observation sheets for the Implementation of Problem-based learning based online, and questionnaires for students' digital literacy skills.

The hypothesis for the Paired Sample t-test is as follows.

$H_0: \mu_1 \leq \mu_2$ (There is no significant effect in the application of online-based Problem-based learning on improving students' critical thinking skills)

$H_a: \mu_1 > \mu_2$ (There is a significant effect in the application of online-based Problem-based learning on improving students' critical

thinking skills)

The test criteria are if the value of Sig. (2-tailed) < 0.05 with a significance level of 5%, then H_0 is rejected or the average critical thinking skills and digital literacy skills of students using online-based problem-based learning is more than the average of students' critical thinking skills using the expository model. On the other hand, if the value of Sig. (2-tailed) > 0.05 then H_0 is accepted. The N-Gain test was conducted to determine the magnitude of the increase in students' critical thinking skills and digital literacy skills by applying online-based Problem-based learning.

RESULTS AND DISCUSSION

This research was conducted from February to March 2022. It was conducted in the fifth grade of SD Negeri 1 Kalangan which consisted of 30 students as the experimental class and the fifth grade of SD Negeri 1 Sendangrejo which consisted of 27 students as the control class. This school is located in Klego District, Boyolali Regency. In addition, Class V of SD Negeri 1 Bade which consisted of 20 students was also selected as a trial class. The following is an analysis of critical thinking skills and digital literacy skills for fifth-grade students using an online-based problem-based learning model in the experimental class, and online learning using the expository method in the control class.

The test carried out in this hypothesis is the effectiveness test. The effectiveness test was conducted to know the effectiveness of online-based problem-based learning in improving students' critical thinking skills. The online-based problem-based learning model is said to be effective if there is an average difference between the pretest and posttest scores of critical thinking skills in the experimental class and the significance value of Sig. (2-tailed) is smaller than 0.05 with a significance level of 5%. Processing and analysis of the effectiveness of online-based problem-based learning models on students' critical thinking skills were analyzed using the SPSS version 25 program with Paired

Sample t-test. The results of the average test and the improvement of students' critical thinking skills are presented in Table 2 below.

Table 2. Average Improvement of Critical Thinking Skills

Class	Average	
	Pretest	Posttest
Experiment	59.83	75.67
Control	52.96	64.07

The average value of critical thinking skills of experimental class students in the pretest was 59.83 and increased on the posttest by obtaining an average score of 75.67. While the critical thinking skills of the control class on the pretest obtained an average of 52.96 and increased at the post-test to 64.07. The results of the significance test using the Paired Sample T-test test on the average pretest and post-test values obtained tcount of -14.045 with a significance value of 0.000. The significance value obtained is less than 0.05 with a significance level of 5%. Refers to the test criteria if the value of Sig. (2-tailed) < 0.05 then H0 is rejected, in other words $0.00 < 0.05$ then H0 is rejected, so it can be concluded that there is a significant influence in the application of online-based problem-based learning models to increase students' critical thinking skills.

In addition to knowing the increase in critical thinking skills from the average pretest and posttest, the researcher also explained the amount of increase or N-Gain of each student in the experimental and control classes. N-Gain

critical thinking skills of each student in the experimental class, 5 students or about 17% of students get an increase in the low category, 23 students or about 76% of students get an increase in the medium category, and 2 students or about 7% students get the amount of increase in the high category. The average N-Gain of critical thinking skills in the experimental class obtained an average of 0.40 with moderate criteria. N-Gain critical thinking skills of each student in the control class, 17 students or 63% of students get an increase in the low category, 10 students or 37% students get an increase in the medium category. The average N-Gain of critical thinking skills in the control class obtained an average of 0.24 with low criteria.

The difference in the N-Gain of students' critical thinking between the experimental class and the control class was analyzed using the Independent Sample t-test to determine the significance of the increase. Analysis of the significance of the increase is presented in Table 3.

Table 3. Significance of N-Gain Critical thinking skills

Independent Samples Test

		Levene's Test for Equality of Variances				
		f	Sig.	t	df	Sig. (2-tailed)
Critical thinking	Equal variances assumed	.264	.609	5.132	55	.000
	Equal variances not assumed			5.171	54.923	.000

Based on Table 3 above, it is known that the value of Sig. (2-tailed) is 0.00. These results indicate that the significance value obtained is

less than 0.05 with a significance level of 5%. Refers to the test criteria if the value of Sig. (2-tailed) < 0.05 then H0 is rejected, in other words

$0.00 < 0.05$ then H_0 is rejected, so it can be concluded that there is a significant increase in students' critical thinking skills using an online-based problem-based learning model.

The effectiveness of the online-based problem-based learning model on students' critical thinking skills can be seen in the difference in the average score of critical thinking skills on the pretest and posttest in the experimental and control classes. The average acquisition of critical thinking skills in the experimental and control classes has increased in the posttest results. In the experimental class 76% of students experienced an increase in the medium category, and in the control class only 37% of students increased in the medium category. This shows that there is a significant

effect on the application of the online-based problem-based learning model to the improvement of students' critical thinking skills as indicated by the acquisition of Sig scores, which is smaller than the significance level of $0.00 < 0.05$.

In addition to knowing the differences in critical thinking skills between the experimental class that applies the online-based problem-based learning model and the control class that applies the expository learning model, the researcher also describes the percentage of students' critical thinking skills achievement on each indicator. The results of the percentage of achievement of each indicator of students' critical thinking skills are presented in Table 4.

Table 4. Percentage of Achievement indicators Critical thinking skills

o	Indicators Critical Thinking Skills	Class	
		Experiments (%)	Control (%)
	Focusing questions	78	68
	Analyzing arguments	76	68
	Asking and answering questions	69	62
	Considering sources	68	64
	Observing and considering the results of observations	74	69
	Inducing and considering induction results	74	55
	Creating and determining the results of consideration	74	66
	Defining terms and considering a definition	74	68
	Determining an action	72	60
	Identifying assumptions	69	55
0	Average	73	69

Based on Table 4, it is known that the experimental class that applies the online-based problem-based learning model gets an average percentage of each indicator of 73%, while the control class that applies the Expository learning model gets an average of 69%.

The application of an online-based problem-based learning model that is able to provide new experiences to students in learning activities. In accordance with the results of research by Aliyah (2021) which states that the

learning outcomes of spreadsheet subjects using online-based PBL learning models with the support of video media there are significant differences with learning outcomes without video media, classes using video media have higher learning outcomes than in classes without learning media. In the implementation of online-based problem-based learning models, students are first directed to problems related to online, then students are divided into several groups and assigned to analyze, discuss and solve problems.

Giving learning materials to students through zoom meetings in Figure 1.



Figure 1. Providing learning materials to students through Zoom meetings

During the student discussion, the teacher guides the discussion of the group that has difficulties, after the completion of the discussion the teacher invites the group or representatives of the group to present the results of their work, and the other group is assigned to compare the results of their work, this is done to find out the accuracy of the student's work results. In the experimental class, judging from

the results of the answers to the questions given by the teacher, students can give ideas well. Students are also able to provide a variety of answers according to the given problem. Meanwhile, in the control class, students' critical thinking skills are low due to the absence of the application of supportive models. Students make a group presentation via zoom meeting in Figure 2.



Figure 2. Students make group presentations through Zoom meetings

By implementing an online-based problem-based learning model, students' critical thinking skills are improved. This is under the results of research conducted by Khikmiyah (2021) which states that through this problem-solving process, students can think critically and systematically to draw conclusions based on their understanding.

Furthermore, research conducted by Fauzi et al. (2018) states that problem-based learning has very significant benefits in improving students' ability to understand the subject matter and at the same time be able to solve problems. In line with this opinion, Hendryawan et al. (2017) also stated that students' critical thinking skills become better after obtaining problem-based learning with the help of green's motivational strategies. The results of observations and interviews show that students feel comfortable, confident, and easier to understand problems after learning with the model. Problems related to the surrounding environment displayed in the question can be answered properly. The answer given is the idea of student originality, this idea arises because it is presented interestingly through the Problem Based Learning model. So that through the application of the model students can generate

new ideas that are rational and full of consideration to solve the problems presented. Students' positive response to the application of the online-based problem-based learning model is seen when students are more excited, and more enthusiastic when discussing and directly involved in learning. The application of this model makes students consider answers that they feel are appropriate enough to answer problems that they often encounter in everyday life.

The effectiveness test was conducted to know the effectiveness of the online problem-based learning model in improving students' digital literacy skills. The online problem-based learning model is effective if there is an average difference between the pretest and posttest scores of digital literacy skills in the experimental class and the significance value of Sig. (2-tailed) is smaller than 0.05 with a significance level of 5%. Processing and analysis of the effectiveness of the online problem-based learning model on students' digital literacy skills were analyzed using the SPSS version 25 program with the Paired Sample T-test. The results of the average test and improvement of students' critical thinking skills are presented in Table 5.

Table 5. Average Improvement of Digital Literacy Skills

Class	Average	
	Pretest	Posttest
Experiment	40.53	50.77
Control	33.33	40.00

Based on table 6 above, the average value of digital literacy skills of experimental class students in the pretest was 40.53, an increase in the posttest by reaching an average score of 50.77. While the digital literacy skills of the control class in the pretest obtained an average of 33.33 and increased at the posttest by 40.00. The results of the significance test using the Paired Sample t-test at the average pretest and posttest values obtained a calculated value of 3.882 with a significance value of 0.001. These results showed that the significance value obtained was smaller than 0.05 with a

significance level of 5%. Refers to the test criteria if the value of Sig. (2-tailed) < 0.05 then H₀ rejected, in other words 0.00 < 0.05 then H₀ rejected, so it can be concluded that there is a significant influence in the application of online-based problem-based learning models on improving students' digital literacy skills.

The average pretest and posttest scores were also used to determine the score for increasing each student's digital literacy skills using N-Gain. In the experimental class, 6 students, or 18% of students got the amount increase in the low category, and 21 students or

76% of students got the amount increase in the medium category. The average N-Gain of digital literacy skills in the experimental class obtained an average of 0.36 with moderate criteria. N-Gain digital literacy skills of each student in the control class, 21 students or 77% of students get an increase in the low category, and 6 students or 23% of students get an increase in the medium category. The average N-Gain of

critical thinking skills in the control class obtained an average of 0.25 with low criteria. The value of the N-Gain acquisition of students' digital literacy skills between the experimental class and the control class was analyzed using the Independent Sample t-test to determine the significance of the increase. The results of the data analysis of the significance of the increase are presented in Table 6.

Table 6. Significance of N-Gain Digital Literacy Ability

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality		
		f	Sig.	t	df	Sig. (2-tailed)
Critical thinking	Equal variances assumed	.497	.484	4.318	55	.000
	Equal variances not assumed			4.392	52.581	.000

Based on Table 6 above, it is known that the Sig.(2-tailed) values are 0.000 and 0.00. These results showed that the significance value obtained was smaller than 0.05 with a significance level of 5%. Refers to the test criteria if the value of Sig. (2-tailed) < 0.05 then H₀ rejected, in other words 0.01 < 0.05 and 0.00 < 0.05, then H₀ Rejected, so it can be concluded that there is a significant improvement in students' digital literacy skills using an online-based problem-based learning model.

The effectiveness of the online problem-based learning model on students' digital literacy skills can be seen in the difference in the average student skill scores on the pretest and posttest in the experimental and control classes. The average result of digital literacy skills in the experimental and control classes has increased in the posttest results. In the experimental class, 76% of students experienced an increase in the medium category, and in the control class, only

56% of students increased in the medium category. This shows that there is a significant effect on the application of the online problem-based learning model to the improvement of students' digital literacy skills as indicated by the result of Sig scores. which is smaller than the significance level of 0.00 < 0.05. The application of an online problem-based learning model begins with orienting students to problems in the real environment.

In the next phase, namely orienting students to learn to identify problems given in groups, at this stage students learn to dare to express their opinions and argue to defend their opinions. Students also learn about acknowledging the shortcomings of their opinions, and respecting differences of opinion between group members, especially students learning to accept if their opinions are not used in the group. The teacher as scaffolding guides if there are groups experiencing problems.



Figure 3. The division of student discussion groups through zoom meetings

In line with the implementation of the online problem-based learning model, research results state that the PBL model can improve students' digital literacy skills. In its application, this model emphasizes the formation of

relationships between students and other students. This can also be seen when students are enthusiastic about participating in quiz activities during learning. As seen in Figure 4.



Figure 4. Student results during quizzes through the *quizizz* application

Figure 4 shows that digital literacy skills can support an individual's success to work with others effectively. This is in accordance with Piaget's theory of cognitive development which states how children adapt by interpreting objects and events around them. In theory, the learning process is not only related to the problem of maturation, because although children move from one stage to the next as they get older, child development also depends on environmental interactions.

After the second phase is complete, students are then directed to develop and present

their work. At this stage, students learn to be confident, dare to present the results of their group work in front of the class. Continued at the last stage in the application of the problem-based learning model is to analyze and evaluate the problem-solving process, at this stage all students together with the teacher reflect and straighten the answers of each group that are less precise.

By implementing an online problem-based learning model, students' digital literacy skills improved from before treatment was carried out in the experimental class, seen from the increase

in the acquisition of the final questionnaire given. While in the control class the improvement of students' digital literacy skills is low because there is no innovation model used in learning, in other words, learning in the control class only uses conventional models and relies on lectures as a learning method. This is in accordance with the results of Pusparini et al. (2018) research which states that digital literacy skills can not only be developed through materials, but also variations of models, methods, and media. Teachers as curriculum developers should prepare learning that is thematic and problem solving in accordance with the students' immediate environment. This opinion is supported by Dewi et al. (2018) in their research which explains that the implementation of the problem-based learning model improves students' digital literacy skills, through the problem-based learning model students can have digital literacy skills, such as working with friends, interacting well, exchange ideas, and experiences and control themselves. Furthermore, research conducted by Khoimatun & Hadiansah (2019) showed a positive and significant influence on the application of the problem-based learning model to digital literacy skills.

CONCLUSION

The conclusion of this study is that the online problem-based learning model is effective in improving students' critical thinking skills and students' digital literacy skills. There is a significant difference in critical thinking skills and digital literacy skills of students who take learning using an online problem-based learning model and students who take online learning using an expository model.

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