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Qualitative and Quantitative Study on Students' Critical Thinking of Conceptual E-Scaffolding in Blended Learning Context

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Abstract

Critical thinking skills are one of the rational thinking skills that students really need in solving problems or conveying ideas. In fact, students' critical thinking abilities are still relatively low. A feasible alternative for developing students' critical thinking skills is by implementing electronic-based scaffolding.

This research uses mixed methods with an explanatory research design. The experimental group received conceptual treatment of e-scaffolding blended learning with the Problem-Based Learning model and the control group received no additional treatment. experimental group and control group, the research subjects were first semester students of IKIP Budi Utomo Malang. Because there were two research groups, 46 students were included in the control group. The instruments used in this research were pre-test and post-test. The pre-test consists of 18 multiple choice items with a reliability coefficient of 0.735 and the critical thinking post-test consists of 14 essay questions with a reliability coefficient of 0.762. In addition, semi-structured and think aloud interview guidelines were also used. Quantitative data was obtained from the distribution of pre-test and post-test questions. Meanwhile, qualitative data was obtained from semi-structured interviews and think aloud. Quantitative data was then analyzed using parametric ANACOVA analysis while qualitative data was analyzed using a path analysis model.

The results of the research show 1) the critical thinking abilities of students who learn with conceptual e-scaffolding in blended learning in Problem-Based Learning are higher than students who learn with conventional methods, 2) the application of conceptual e-scaffolding in Problem-Based Learning. The link map form in the Problem Based Learning model has a positive effect on students' critical thinking abilities. This is reflected in the behavior and way of thinking of experimental group students which shows the development of critical thinking skills during the learning process. Apart from that, conceptual e-scaffolding in the form of a link map helps students obtain information easily and use it in understanding concepts in geometric optics material.

. **Key words:** critical thinking, e-scaffolding, blended learning

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Introduction

Critical thinking ability is one of the rational thinking capabilities that is highly required by students in solving problems or delivering an idea. Critical thinking ability is one of the capabilities that must be acquired by students. One of the 21st century skills which can be developed by using student-centered approach is critical thinking (Hastuti Purwati Widi, n.d.). Critical thinking ability also contributes to an individual's success and professionalism. One research findings conducted by
(Wulandari et al., 2019) found that the ICT-assisted PBL model was able to improve critical thinking skills with moderate qualifications (Ngain = 0.69) with achievements in the ability to describe problems, provide arguments, carry out induction, carry out deductions, carry out evaluations and dimensions and implementation with moderate qualifications.

In general, critical thinking refers to an individual's ability to question information coming from external or internal sources (Naumkina, 2021). The ability to ask questions is what gives rise to doubt. Doubt can be considered as "a special state of awareness and self-awareness, when the subject experiences or shows distrust towards a certain statement, hesitates to accept it (recognition), because he considers the statement not convincing enough, needs to be justified, valid or well-founde (Zinkevych, 2021). This means that critical thinking must include reflective abilities, namely wrapping the subject matter around yourself. In this sense, critical thinking can be interpreted as an opinion about thinking about thinking, and is characterized by skills and a tendency towards reflective skepticism (Nieto & Saiz, 2010). A person is able to reflect as long as an active disciplined intellectual process is carried out, which includes collecting information received or produced through observation, experience, consideration or communication with other people, the ability to analyze, synthesize and evaluate it. These operations are characterized by consistency, relevance, search for evidence and good reasons, depth and breadth of the problem.

Therefore, critical thinking is reflective thinking with definite judgments and making the right decisions. Doubts arise because there is no strong basis for taking a firm stance. In this situation, individuals begin to look for various alternative options to obtain convincing arguments. Another assumption is that a person's field of study will become wider, obtaining additional information and opening up various possible answers to various basic principles and interpretations

Direct observation activity can increase students' critical thinking ability as long as it is equipped with particular aid, namely giving scaffolding. The effective scaffolding implementation can help students in studying. Scaffolding implementation influences on the increase of problem-solving capability, scaffolding also enhance high level thinking skill and the integration of knowledge (Brian R. Belland et al., 2015)

Basically, the implementation of scaffolding is only done individually. Scaffolding can facilitate the students in learning process with conceptual, procedural, strategic, and metacognitive assistances Hannafin in Brian R. Belland et al. (2015). In the learning process, however, teachers cannot give direct feedback to the entire students at the same time. Therefore, a learning strategy which can overcome the problem is required. One of the alternatives is the collaboration of online learning and face-to-face learning by using scaffolding which is designed into a website. Computer-based scaffolding can contribute to the students' success in solving problems (Brian R. Belland et al., 2015) The implementation of e-scaffolding in the form of website in teaching and learning process is expected to be able to ease teachers' burden in giving assistance to each student in the teaching and learning context.

One of the models collaborating face-to-face learning and online learning is blended learning. The effective combination from various delivery mode, teaching model, and learning style, and is based on the transparent communication among the involved parties is the definition of blended learning (Heinze A, 2008). The research conducted by (Alwan et al., 2017) show that the blended learning model using Edmodo can increase student learning outcomes from 55.29 to 88.65, one of which is sending and student responses generally respond positively.

Teaching basic skills is a course requiring the students to think critically. Problem solving, time management, effective communication, and learning environment understanding are required to achieve learning objectives in this course. According to the statement, conceptual e-scaffolding needs to be given to develop students' critical thinking ability. By referring to the background, the researchers conducted a study entitled "Qualitative and quantitative study on students' critical thinking of e-scaffolding in blended learning context

Method

This research is a mixed-method study with explanatory research design. The research subjects were first semester students at IKIP Budi Utomo Malang. There were two research groups which were acquired using cluster random sampling technique. The experimental group was given conceptual scaffolding treatment in blended learning on Problem-Based Learning model and the control group was not given any additional treatment. Meanwhile, the qualitative research subjects were selected using purposive sampling technique based on the gap between the scores of pre-test and post-test which can be shown in the following Figure 1.

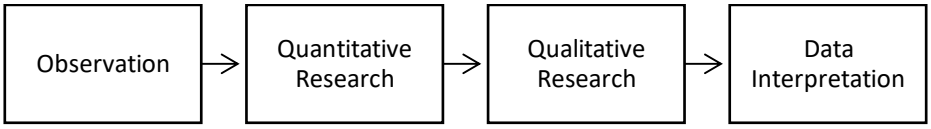

Figure 1. Mixed Methods Explanatory Design (Cresswell, 2007:73)

Quantitative data were used to find out the differences on students' critical thinking who were given conceptual e-scaffolding treatment in blended learning of Problem-Based Learning model and those who did not receive any additional treatment as the control group. The next step was collecting the qualitative data. The qualitative research design in this research employed case study research approach. This research was employed to discover in-depth explanation of the selected case. The case explained how conceptual e-scaffolding in blended learning on Problem-Based Learning model could enhance students' critical thinking ability. This research utilized two instruments, namely quantitative instrument and qualitative instrument. Qualitative data were collected through the results of semi-structured interview and think aloud on students in the experimental group influenced by the given intervention. Interview was done to find out the effect of intervention towards students' critical thinking ability. Think aloud was conducted to observe the students' thinking in solving problems. The problem given was the items of post-test. Case studies are more suitable for producing and revealing information than testing a situation or making assumptions (Aktepe et al., 2023).

After the research data were obtained, data analysis was then conducted. In this research, quantitative and qualitative data were analyzed sequentially. In the quantitative data analysis obtained from the result of post-test, statistical test was conducted to

observe the differences of students' critical thinking ability in experimental group and control group indicated from the students' initial knowledge. Next, qualitative data retrieved from the results of semi-structured interview were analyzed. Qualitative data were used to support the previously obtained quantitative data. There were two data analysis steps in this research, namely, quantitative data analysis and qualitative data analysis.

The difference of the critical thinking outcome for the two groups was tested using covariance analysis (ANACOVA) on the result of post-test examined from the students' initial knowledge. Analysis was conducted using SPSS v16.0 for windows software. If the two groups were different significantly, it was shown from the sig. < 0.05.

Conclusion formulating is the last step of the qualitative data analysis process. Conclusion making presents how the critical thinking of each student based on the indicators of critical thinking capability and how the conceptual e-scaffolding influences blended learning in problem-based learning model towards students' critical thinking ability.

Findings and Discussion

The findings of the quantitative research included the description of research data, prerequisite test, parametric analysis, and test on the difference of critical thinking abilities. Pre-test of the research groups showed that the experimental group obtained higher mean score compared to the control group with the score of 44.62. Meanwhile, the control group obtained the mean score of 37.15. Post-test was conducted after the teaching skills evaluation was done, both in experimental group which implemented conceptual e-scaffolding in blended learning in problem-based learning model and in control group which implemented conventional teaching and learning method. Post-test data were utilized to measure the students' critical thinking ability related to the learned evaluation materials. The mean scores of post-test score from the research groups indicated that the score of the experimental group was higher than the control group with the mean score of 39.26. Meanwhile, the control group obtained the mean score of 30.81.

The prerequisite test of parametric analysis in this research included tests of normality, homogeneity, and linearity. Normality test was utilized to find out whether the obtained data were distributed normally or not. Normality test was conducted towards the pre-test score of the students' initial knowledge and the post-test score of the students' critical thinking ability on both experimental group and control group as can be seen from the following table.

Normality Test

	Method	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	Df	Sig.
Post-test	Met_1	.086	46	.200*	.948	46	.058
	Met_2	.093	46	.200*	.957	46	.090

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

It was found that the significance value for pre-test score of the experimental group was 0.058 > 0.05. It indicated that the pre-test score of the experimental group was distributed normally. Meanwhile, the significance value for pre-test score of the control group was 0.090 > 0.05. It indicated that the pre-test score of the control group was distributed normally.

Levene's Test of Equality of Error Variances

Dependent Variable: Post-test score

F	df1	df2	Sig.
21.891	1	90	.210

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + X + A

It was known that the significance value of homogeneity of pre-test on the experimental group and control group was 0.210 > 0.05. It indicated that the pre-test scores of the two groups were homogeneous.

Test of Between-Subjects Effects

Dependent Variable: Post-test score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3173.795[a]	2	1586.897	2.785	.067
Intercept	48931.201	1	48931.201	85.872	.000
X	97.447	1	97.447	.017	.006
A	2564.861	1	2564.861	4.501	.037
Error	50713.814	89	569.818		
Total	364072.000	92			
Corrected Total	53887.609	91			

a. R Squared = .059 (Adjusted R Squared = .038)

The score of F_h (A)= 2.39; with the p-value = 0.037< 0.05; which means that there was difference of the average critical thinking ability between those who were taught using conceptual e-scaffolding in blended learning on problem-based learning model, which was higher compared to the students who were taught using conventional learning after controlling the treatment.

The result data of qualitative research were obtained from the semi-structured interview and think aloud implemented to the students influenced by the implementation of conceptual e-scaffolding in blended learning in problem-based learning model. Interview and think aloud were conducted to six students who showed improvement from the pre-test score to the post-test score and showed different behaviors during the teaching and learning process. The stated different behaviors were correlated to the action according to the indicators of critical thinking ability.

Conclusion

From the research findings, it can be concluded that the students' critical thinking ability who were taught using conceptual e-scaffolding in blended learning in problem-based learning model was higher compared to the students who were taught using conventional learning strategy. The mean score of the students' critical thinking ability who learned using conceptual e-scaffolding in blended learning in problem-based learning model was higher compared to the students who learned using conventional learning method where this research was conducted. Conceptual e-scaffolding in blended learning

in problem-based learning model helped students in learning to discover or build new knowledge and also to remember the previously obtained knowledge by the students. In this research, students who were influenced by the intervention giving were the students with good critical thinking ability, both in behavior and the thinking pattern. During the teaching and learning process, most of the students could be active and motivated in each step of teaching and learning such as the experimental step, individual and group examination, and even the analysis and evaluation of the problem-solving process. The findings indicated that, qualitatively, there was positive impact of the implementation of conceptual e-scaffolding in blended learning in problem-based learning model towards the students' critical thinking ability.

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