The Role of Learning Interest and Prior Knowledge on Critical Thinking Skills in E-Worksheet Supported Learning

Budi Widyaningsih, Dwi Sulisworo

Universitas Ahmad Dahlan Yogyakarta, Indonesia

widiyaningsih2007050019@webmail.uad.ac.id,
dwi.sulisworo@uad.ac.id

Abstract. Applying specific learning strategies is widely claimed to improve critical thinking skills, but this success sometimes does not consider covariates in the research design. This study aims to explain the role of learning interest and prior knowledge as covariates in improving critical thinking skills. The method used is quantitative research with quasi-experimental. Students participate in problem-based learning and measure learning interest, prior knowledge, and critical thinking skills. Learning interest is calculated using a questionnaire. Prior knowledge and critical thinking skills were measured using essay test questions. The analysis using Paired Sample T-tests in both groups showed an increase in critical thinking skills in the experimental and control groups individually. However, the research with ANCOVA indicates that there is no difference in critical thinking skills in the two groups by considering learning interests and prior knowledge. Results also suggest that learning interest can be a predictor in a model with a high effective contribution and vice versa for PKP. The findings of this study explain that the increase in critical thinking skills is not due to the applied learning strategy but because of learning interest. Similar research must pay attention to the level of learning implementation to ensure a clear difference in the learning received by students between the two groups.

Keywords: learning strategies, critical thinking skills, learning interest, prior knowledge

1 Introduction

Changes, improvements and developments in education include the competence of teachers and the quality of teaching staff, the quality of education, the curriculum, educational facilities and infrastructure, and the quality of education management. In addition, in education, there are changes in models, methods and learning strategies that are more innovative [1]. Understanding the logical, rational, mathematical way of thinking is essential in today's era. Mathematics learning is expected to equip students in reasoning, critical thinking and solving problems experienced daily [2]. The purpose

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of learning mathematics is to understand mathematical concepts flexibly and accurately, to reason and solve problems experienced. Students are more passive, hesitant, afraid, or embarrassed about expressing thoughts. Specific individuals consider mathematics difficult, scary and even disliked, thus hindering learning [3]. Students can recognize a limited number of basic facts but cannot communicate, integrate several themes, or apply complex and abstract mathematical concepts [4]. Critical thinking is reasoned, and reflective thinking emphasizes deciding what to believe or do. E-worksheet is an alternative and innovative mathematics learning, especially in online learning. It is expected that students, especially 7th-grade students can learn mathematics independently and be able to think critically in dealing with problems in online learning. The relationship between critical thinking and problem-solving is symbiotic in mathematics [5]. One of the learning models that can provide opportunities to develop critical thinking skills is the problem based learning model. In the problem based learning, students copy and investigate alternative approaches or solutions to mathematical problems [6]. During problem-solving, students build knowledge and develop problem-solving skills and self-regulated learner skills [1]. E-worksheet can facilitate this learning so that students actively find information and organize information independently and develop critical thinking skills by solving problems [7]. In online learning situations that encourage independent learning, digital learning media in e-worksheet are an alternative to foster critical thinking skills. From many research findings, several factors affect critical thinking skills, including prior knowledge and learning interest. These two factors become predictors for learning success using a specific learning model [8]. So to see the influence of e-worksheet, these two factors are essential to be included as considerations in studying the effectiveness of e-worksheets. This study reveals the impact of using e-worksheet based on problem-solving to encourage critical thinking skills considering the learning interest and prior knowledge.

2 Literature Review

Problem based learning presents problems to students to focus on learning. Still, a rigorous and structured approach is based on experience and all of their knowledge and skills from various sources that they have obtained [9]. Several other researchers argue that problem based learning is a learning model that copies and investigates alternative approaches or solutions to mathematical problems [6]. Problem based learning is learning that presents contextual issues to stimulate students to learn [10]. Problem based learning changes the learning paradigm from teacher-centred to student-centred learning. In mathematics, problem based learning involves students in active activities by investigating problems through finding solutions to mathematical problems in groups. The characteristics of this model are that it focuses on students, the issues presented are authentic, possible solutions are unknown, implemented in groups, and the teacher acts as a facilitator [9].

Problem-based learning relates to real-life problems. It promotes students' skills in solving problems and developing thinking skills [11]. Problem based learning has its

strategy for solving problems faced by students [2,12]. Problem based learning improves the learning process by incorporating various kinds of cognitive problem solving and assisting teachers in imparting as much knowledge as possible to students through challenges [13]. This learning model involves students going through the stages of the scientific method [14].

The application of problem based learning is closely related to developing critical thinking skills. The learning process is inefficient of teaching materials that do not involve students thinking critically. Critical thinking is an intellectual process of conceptualizing, applying, synthesizing or evaluating information obtained from observation, experience, reflection, thinking, or communication as a basis for believing and taking action [14]. Critical thinking skills are essential because critical thinking can be used to solve problems and as a consideration in making correct decisions [15]. Critical thinking stages include problem interpretation, problem analysis, evaluation of completion, and inference.

One of the opportunities to use technology in learning with the application of the problem based learning is to use E-worksheet. Teachers use it in implementing learning activities in electronic form accessed by android, computer, notebook, or laptop to encourage student involvement in the learning process. E-worksheet functions as a compliment or a mean to assist the implementation of lesson plan in general. The use of e-worksheet has various advantages, including the ability to streamline the learning process, assisting teachers in directing students to find concepts through their activities or in groups, improving abilities/cultivating a scientific mindset and assisting educators in tracking student progress towards their learning goals [16].

3 Methods

3.1 Research design

This research is a quantitative study with a pretest-posttest control group design. The independent variable of this research is Learning Strategy which Problem Based Learning using an e-worksheet and Conventional one. Critical thinking skills as the dependent variable were measured before and after learning. The covariate were Learning Interest and Prior-Knowlegde. The data analysis technique used ANCOVA.

3.2 Population

The population used was 7th-grade junior high school students (SMPN Nurul Muttaqin, Purworejo, Indonesia) which consisted of five classes. The classes used as the control and treatment groups were selected randomly. From the selection results, the control group consisted of 30 students (12 boys, 18 girls), and the treatment group consisted of 30 students (14 boys, 16 girls). The researcher ensured that all students participated in the learning fully from the start.

3.3 Instrument

Critical thinking skills were measured using essay questions adapted from Ref. [17]. Five test questions were assessed using a rubric, as shown in Table 1.

Table 1. Critical Thinking Skills Test Instrument Rubric

Critical Thinking Indicators	Critical Thinking sub-Indicators
Elementary clarification	Answering questions "why" and "how."
Basic support	Considering the use of the right procedure in a question.
Inference	Making inference based on facts.
Advance clarification	Identifying arguments
Strategy and tactics	Using logic strategies

3.4 Learning Activities

Learning activities follow the stages that have been outlined in the e-worksheet using problem based learning. In each learning activity, the sets carried out by students include problem interpretation, problem analysis, evaluation of completion, and inference. See Table 2 for symbols and activities. Students used these symbols to guide their learning. It is as a reminder what activity did by student currently.

4 Results

The e-worksheet was built using the online application ie. http://www.flipbuilder.com. This application supports to manage text, animation, link, video and other content format and convert the product as an e-book in EXE file type. Figure 1 and Figure 2 show some of the strategy in the e-worksheet to enhance the critical tinking skills. There are many strategy in this worksheet to promote the critical thinking skills.

Table 2. Symbols and Activities in the e-wokrsheet

Symbols	Activities	Symbols	Activities
	Problem interpretation		Evaluation of completion
	Problem analysis		Inference

Figure 1 shows the problem solving activity on how to make a specific shape using difference smaller shapes. This strategy fostered the student to think creatively to match the other ones.

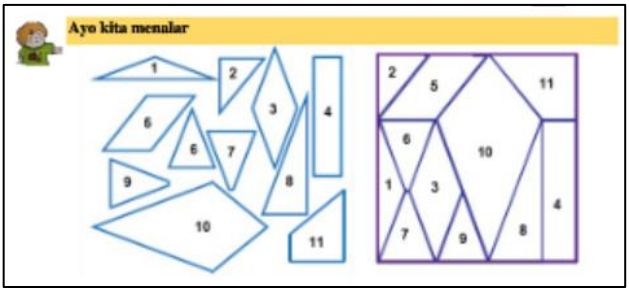

Fig. 1. Solving the problem on make a specific shape from smaller shapes

Figure 2 shows the example of practicing formulae to solve a certain problem. Therefore student can copy this strategy to other situation. This strategy fostered the student to think criticallt on choosing the formulae.

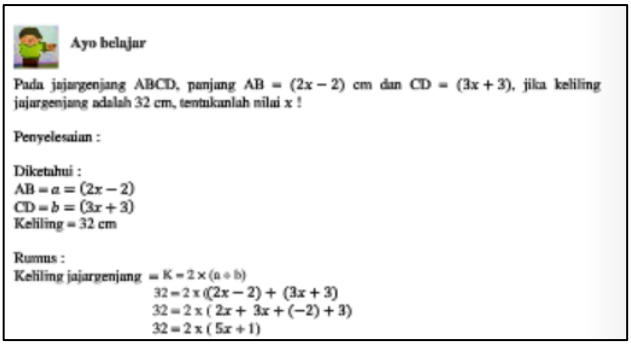

Fig. 2. Practicing the formulae to solve the problem

As stated in the method that the participants was 60 students; 30 students for each group. Table 3 shows the descriptive statistics calculation.

Table 3. Descriptive Statistics

Dependent Variable: Critical Thinking Skills

GROUP	Mean	Std. Deviation	N
Treatment Group	83.0000	12.90549	30
Control Group	78.6667	13.82984	30
Total	80.8333	13.44060	60

This data shows that the treatment group has an average Critical Thinking Skills (83.00) which is higher than the control group (78.67). It does not mean that the learning strategy in the treatment group was better than the control group. The other analysis is needed.

The next analysis, we add the learning interest and prior knowlegde as the predictors. Therefore, the influence of these predictor were eliminated in the comparing both group number of critical thinking skills. We use ANCOVA to analyse this step.

Table 4. Tests of Between-Subjects Effects

Dependent Variable: Critical Thinking Skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6813.434a	3	2271.145	33.079	.000	.639
Intercept	914.747	1	914.747	13.323	.001	.192
Learning Interest	5980.393	1	5980.393	87.103	.000	.609
Prior Knowledge	174.754	1	174.754	2.545	.116	.043
GROUP	12.379	1	12.379	.180	.673	.003
Error	3844.900	56	68.659			
Total	402700.000	60				
Corrected Total	10658.333	59				

a. R Squared = .639 (Adjusted R Squared = .620)

From the ancova analysis, it is known that the R squared model is quite good (0.639) which means that the model of the relationship between Critical Thinking Skills can be explained by including Learning Interest and Prior Knowledge as predictors. It's just that the Prior Knowledge does not have a significant effect on the Critical Thinking Skills.

5 Discussion

The learning model uses e-worksheets by including problem based learning as a strategy to show the impact on students' interest in learning so that they are more active in the learning process. Several studies related to e-worksheets and PBL together or separately support this result. This approach can be used to explain concepts and, at the same time, encourage critical thinking skills [18]. Some of the attractive features and appearance of the e-worksheet provide opportunities for students to learn better, which is easier and more time efficient.

This good interest in learning impacted critical thinking skills indicated in the increase of critical thinking skills in both groups. Students who experience learning using e-worksheets have an average rise in critical thinking skills higher than other groups. This improvement cannot automatically be used to claim that learning by using this e-worksheet is effective. There are several factors in learning that may affect the increase in critical thinking skills [19,20]. These factors are used as covariates to see if the rise in critical thinking skills is due to the learning strategy.

Many studies explain that prior knowledge is essential for successful learning [21]. Prior knowledge is the knowledge that students have before taking lessons. As a predictor, if students have good prior knowledge, it can be assumed that their learning outcomes will also be good. And vice versa. It is evident in this situation that knowledge has an essential role in critical thinking skills, However, in this study, prior knowledge did not affect critical thinking skills when it was included as a predictor in ANCOVA to see differences in critical thinking skills after learning. This result means high prior knowledge does not necessarily have higher learning outcomes.

On the other hand, interest in learning as a predictor influences critical thinking skills. Students' interest in learning has the power to encourage students to maximize the potential that exists outside and within themselves. Students interested in learning will show their sincerity in learning and vice versa [22,23]. Students' interest in learning affects the improvement of learning outcomes marked by the seriousness in thinking to solve a problem in the e-worksheet. Students who lack interest are less able to last longer in learning. Low interest is also a critical problem in education. Because of the importance of students' interest in learning, teachers must design learning, so students do not feel bored while following the learning process.

The results of ANCOVA showed that the average posttest scores of the experimental class and the control class were not significantly different when they included prior knowledge and students' interest in learning as covariates. This finding shows that the learning strategy using e-worksheet cannot be claimed to be a good one. The exciting factor becomes the determinant of critical thinking skills after learning. The normalized gain score can be used as a basis for analysis to find out the learning effectiveness [24]. The normalized gain score for the experimental class is 75.791% which is in the high category. This results imply that this learning media and learning strategy have potential effect to promote the critical thinking skills in mathematics learning.

6 Conclusion

There is an increase in critical thinking skills when students experience learning using e-worksheets that problem based learning implements. This increase was higher than for students who did not participate in learning with this strategy. However, when interest in learning and prior knowledge were used as covariates, the difference in the increase was not significant. Interest in learning can be used as a predictor in this model, and vice versa; prior knowledge cannot be used. This model can explain the phenomenon of learning with e-worksheet can be a pretty high category. Similar research needs to pay attention to the implementation of learning to ensure that learning is the same design. These findings imply that using e-worksheets increases the effectiveness of mathematics learning. With teacher competence in information technology literacy, it is necessary to support education management policies with related training.

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