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The influence of e-scaffolding in blended learning on prospective teacher's scientific explanation

The influence of e-scaffolding in blended learning on prospective teacher's scientific explanation

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Abstract. Science is not only about facts and concepts, but also involves a scientific way of thinking and reasoning. The ability of scientific reasoning in science consists of explaining the facts in a problem (claim), connecting these facts with related concepts (evidence), and explaining the problem scientifically (reasoning). Scientific reasoning ability is a crucial ability in a prospective teacher. The results of observations at Islamic Primary School Teacher Education UIN Maulana Malik Ibrahim Malang found that the scientific reasoning abilities of prospective Islamic Primary School Teacher Education were still not developed. One of the strategies that can optimize students' linking between concepts is scaffolding in blended learning. This study aims to examine the influence of e-scaffolding in blended learning on prospective teacher's scientific explanation. This research was a quasi-experimental research with a pre-test - post-test control group design. The research sample was taken using purposive sampling technique. The sample of this study consisted of 30 prospective Islamic Primary School Teacher with science concentration. The instrument for measuring scientific reasoning ability was description questions. The data analysis of this research used a t-test. The result of this study found out that e-scaffolding in blended learning influences the prospective teacher's scientific explanation.
Keywords: Blended Learning, E-Scaffolding, Scientific Explanation.

1. Introduction

Science is not only about facts and concepts but also involves scientific thinking and reasoning. The ability to reason scientifically (scientific explanation) in science is different from the reasoning ability used in everyday life. The ability of scientific reasoning in science consists of explaining the facts that exist in a problem (claim), connecting these facts with related concepts (evidence), and explaining the problem scientifically (reasoning) [1]. When a scientist explains a phenomenon, the first step is to build a claim and then provide evidence and reasons to justify their statement [1,2].

Scientific reasoning ability is a crucial ability of a prospective teacher. Scientific reasoning skills are expected to be taught in the classroom as a provision for students to face globalization's challenges. Students' scientific reasoning abilities depend heavily on teachers' ability to develop learning that can train students' reasoning abilities [3–6]. Thus, a prospective teacher's scientific reasoning ability must be good to practice scientific reasoning abilities in students.

The results of observations at Islamic Primary School Teacher Education Universitas Islam Negeri (UIN) Maulana Malik Ibrahim Malang found that the scientific reasoning abilities of prospective Islamic primary school teacher were still not developed. Prospective teacher still did not fully understand science concepts. Most of prospective Islamic Primary school teachers are correct in explaining the facts in a problem, but they were often confused when asked about their reasons for answering certain matter. Prospective Islamic primary school teacher can generally explain claims and evidence well but own difficulty in making reasoning[7].

One of the strategies that can optimize students' linking between concepts is scaffolding. Scaffolding can help students explain the relationship between concepts[8], compiling claims, evidence, and reasoning so that their scientific reasoning abilities develop [9]. Through scaffolding, students also find it easier to explain a problem, starting from compiling a problem, linking between concepts, and compiling a reason to answer why a problem can occur[9]. Scaffolding helps students build arguments based on existing evidence[10,11]. Therefore, scaffolding can develop scientific reasoning abilities.

Currently, technology is increasingly developing and influencing human life. This technological development also has an impact on various fields, one of which is education. Along with the rapid development of technology, technology and media in learning have also begun to develop. One of them is blended learning, which is a combination of offline and online learning[12–14].

Blended learning is very suitable to be combined with scaffolding. Students who learn in blended learning with scaffolding owning better sciences' competence than students who do not use scaffolding[11,15,16]. This is because the environment formed in blended learning can help students connect concepts and improve their understanding on the concepts[17–19]. Thus, it is necessary to know more deeply about students' scientific reasoning abilities (scientific explanation) in blended learning with e-scaffolding. This study aims to determine the influence of blended learning with e-scaffolding on students' scientific reasoning abilities (scientific explanation).

Research on scaffolding has been done before. Research by Kim & Lim [20] investigated the effect of scaffolding on students' achievement and metacognition, but this study was only limited on the reflective type of scaffolding. Amelia's Research [21] has also investigated procedural scaffolding, but dependent variable is only limited on learning achievement. Zhou and Lams' research [22] has also investigated the effect of scaffolding on information seeking, but the scaffolding provided is still in written form. In addition, Gobert [23] has also investigated the effect of online scaffolding on students' ability to interpret data. The difference between this study and previous research is that this study uses the form of e-scaffolding and scientific explanation as variable. E-scaffolding is an online form of scaffolding directly integrated into the e-learning Model. Scientific explanation is the students' ability to explain event scientifically. The scientific explanation indicator consists of claim, evidence, and reasoning.

2. Methods

The method used in this research was the quasi-experimental method. The research design used a pre-test - post-test control group design. This design used one class as the research subject. Before being given treatment in the form of e-scaffolding in blended learning, students in that class were given a pre-test. Then, after being given e-scaffolding in blended learning treatment, students were given a post-test. The research procedure can be seen in Figure 1 below.

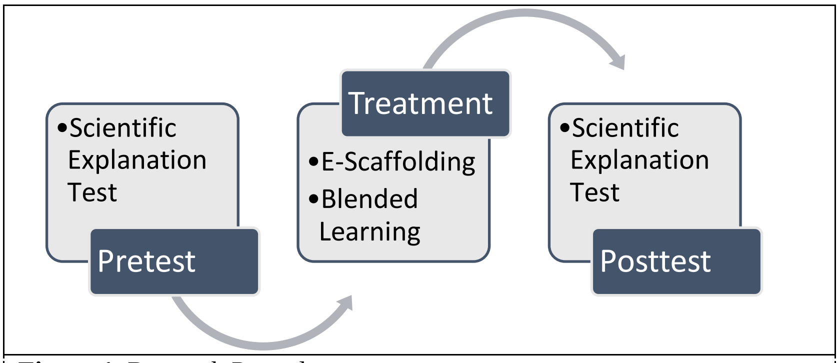

Figure 1. Research Procedure

This study population was students majoring in Islamic Primary School Teacher Education UIN Maulana Malik Ibrahim Malang. The sample of this research was taken using a purposive sampling technique with the consideration of students who took the science concentration as the sample. The sample of this research consisted of 30 students of Islamic Primary School Teacher Education Department.

The research instrument consisted of treatment instruments and measurement instruments. The research treatment instrument consisted of a semester learning plan and students' worksheets with e-scaffolding. The measurement instrument is in the form of description questions to measure students' scientific explanation. Before being used, the treatment instruments and measurement instruments were validated by two expert lecturers.

The data analysis of this study consisted of a prerequisite test and hypothesis testing. The prerequisite test or normality test was carried out using the SPSS-assisted Kolmogorov-Smirnov test. At the same time, hypothesis testing was done by using the paired sample t-test method. The pre-test and post-test data were analysed using the paired sample t-test. The pre-test and post-test results were analysed to determine the significance of the increase in scientific explanation after learning using blended learning with scaffolding.

3. Result and Discussion

3.1 Description of Research Data

Description of research data in this study includes descriptions of learning before being given treatment, descriptions of learning when given treatment, and scientific explanation test data consisting of pre-test and post-test.

3.1.1 Description of learning before treatment.

Learning at the time before being given treatment was carried out by the learning that is usually done. The learning before the treatment took place by way of students' presentations. Then the lecturer gave a reflection at the end of the lesson. The difference in learning before giving treatment is that students before giving treatment are learning with material explanations from the lecturer (direct instruction).

3.1.2 Description of learning after treatment.

Learning when giving treatment begins with the provision of initial problems that include the material to be studied. Then, students group according to the groups that have been divided. This is the grouping stage.

After each group has gathered, each group plans an experiment to be carried out. At this stage, each group reads a guide in the form of students' worksheets on e-learning integrated with procedural scaffolding. Students pay attention to the problem orientation section in e-Learning then formulate problems and hypotheses. This is the phase of providing an orientation about problems to students.

After formulating problems and hypotheses, students begin to solve these problems with the Students' Worksheet guidelines, which are integrated with procedural scaffolding. After solving the problem, students are asked to analyse the data and take conclusion. After that, several groups were asked to present the results of the discussions that had been carried out.

After the presentation ended, the lecturer gave an evaluation of students' learning activities. During the problem-solving process, almost all students were active in solving problems. They discussed with each other in each group in problem-solving and data analysis. Besides, during the presentation, each group was also ready to present the results of the discussion.

After all, the problem solving and presentation activities ended, at the 5th meeting, students were given a scientific explanation test to measure the students' scientific explanation ability. The test lasts 90 minutes and takes place in an orderly manner, and no students are discussing to each other. Description of learning after treatment can be seen in Table 1.

Table 1. Description of learning after treatment

Learning Process	**Indicator of Scientific Explanation**
1. Provision of Initial Problems The teacher explains about initial problems included material should be studied.	
2. Grouping Students make group. Each group plans an experiment to be carried out. At this stage, each group reads a guide in the form of students' worksheets on e-learning integrated with procedural scaffolding.	
3. Problem orientation & Hypotheses Formulation According to students' worksheets on e-learning which integrated with procedural scaffolding, student state the problem and formulate hypotheses.	Claim
4. Solve Problems Students begin to solve the problems with the Students' Worksheet guidelines, which are integrated with procedural scaffolding. Then they analyse the data and take a conclusion.	Evidence & Reasoning
5. Presentation & Discussion	
6. Reflection	

3.1.3 Data on Students' Scientific Explanation.

Indicators of scientific explanation are claim, evidence, and reasoning. Claim means temporary statement or conclusion that answers the question of the problems. Evidence means scientific data that supports claim. Reasoning means justification linking evidence and claims. This matter explains why data considered as evidence by the use of scientific principles. The scientific explanation test was carried out before and after giving the treatment. The scientific explanation test data are used to measure students' scientific explanation abilities related to movement, force, and energy material that has been studied. The example of pre-test and post-test of scientific explanation is described in Figure 2 and Figure 3.

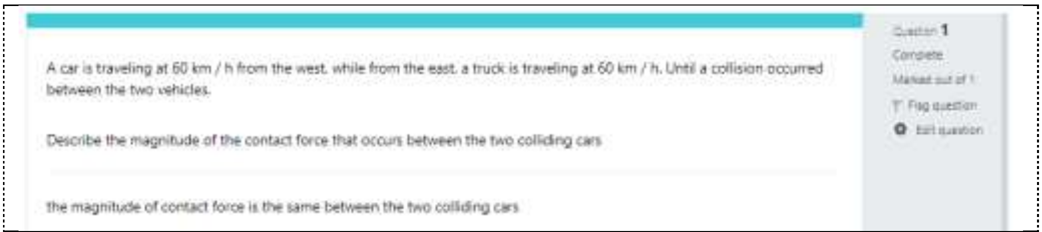

Figure 2. Pre-test of Scientific Explanation

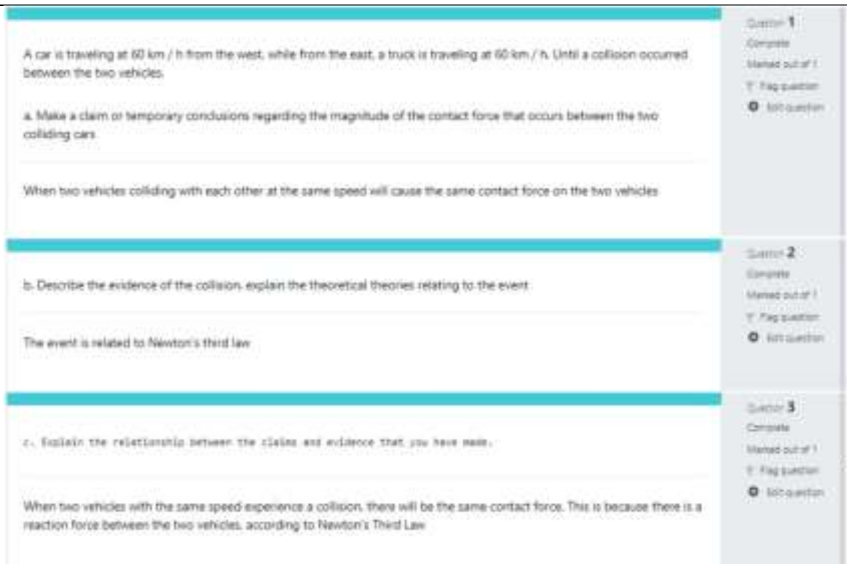

Figure 3. Post-test of Scientific Explanation

A summary of the students' scientific explanation test scores on the pre-test and post-test can be seen in Table 2

Table 2. The Summary of Scientific Explanation Test Values

Variable	***Pre-test***	***Post-test***
Total students	30	30
Average	19.8	42.07
Standard Deviation	12.45	15.97

Table 2 shows the mean value of the students' pre-test scientific explanation of 19.8, with a standard deviation of 12.45. Meanwhile, the mean value of students' post-test scientific explanation is 42.07, with a standard deviation of 15.97. This shows that the average students' scientific explanation is higher after being given treatment than before being given treatment. The results of the scientific explanation test for each scientific explanation indicator are shown in Figure 4 below.

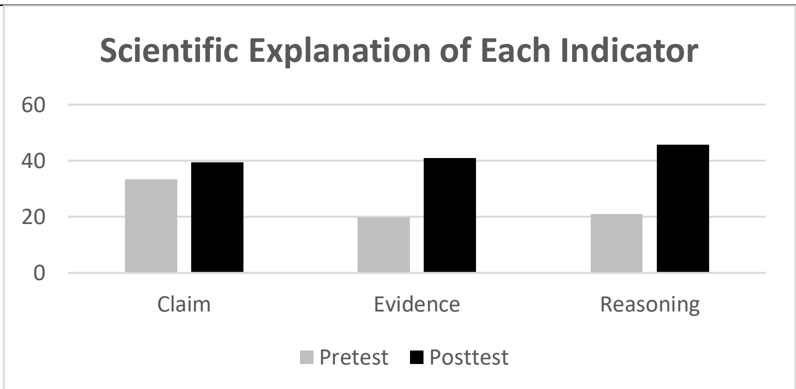

Figure 4. Data Scientific Explanation on Each Indicator

Figure 4 shows the students' scientific explanation value for each indicator, namely claims, evidence, and reasoning. On the claim indicator, the students' pre-test score is 33.42, and the post-test score is 39.49. On the evidence indicator, the students' pre-test score is 19.87, and the post-test score is 40.97. On the reasoning indicator, the students' pre-test score is 21.00, and the post-test score is 45.75.

3.2 Hyphotesis Testing

3.2.1 Normality Test.
The prerequisite test consists of normality tests. Because this study only uses one class, the prerequisite test required is only the normality test. The normality test was analysed using the Kolmogorov-Smirnov analysis with SPSS. The following is a summary table of the results of the Kolmogorov-Smirnov normality test with SPSS. The complete normality test results can be seen in Table 3.

Table 3. The Summary of Normality Test Results

N	Mean	Kolmogorov-Smirnov	Sig.
30	19.8	0.939	0.341

Based on the results of the normality test using the Kolmogorov Smirnov method with the assistance of SPSS, it can be seen that the sig value is 0.341> 0.05, so it can be concluded that the data is normally distributed. Because the data is normally distributed, the hypothesis test can use parametric statistics, namely using the paired sample t-test.

3.2.2 Hyphotesis Testing.
The research hypothesis test was analysed using a paired sample t-test. This is because this study uses the same class as the pre-test and post-test tests. The following is a summary table of the paired sample t-test can be seen in Table 4.

Table 4. The Summary of Paired Sample T-Test Results

N	Mean difference	T	Sig.
30	22.27	8.28	0.000

Based on Table 4, it is known that the t-test results are 8.28, with a significance value of 0.00 <0.05. This shows that there is a difference between the pre-test and post-test results, with the average post-test score is higher than the pre-test value.

The results of the analysis showed that based on the students' pre-test and post-test scientific explanation scores, it is known that the post-test scores are higher than the students' pre-test scores. This shows that students' scientific explanation after learning using e-scaffolding in blended learning is more optimal than students' scientific explanations before studying using e-scaffolding. This is in line with several previous studies [16,21,24], which state that the scientific reasoning abilities of students who learn with e-scaffolding are better than students who learn using conventional methods. [1,2,16,21] state that students' scientific reasoning skills significantly improve in claim, evidence, or reasoning. However, students who are given scaffolding have better reasoning than students who are given written instructions.

Based on the scientific explanation test results for each indicator, it can be seen that at the time of the pre-test, the evidence indicator has the lowest value after reasoning and claiming. Meanwhile, the post-test results show that the indicator with the highest value is reasoning. When viewed from the difference between the pre-test and post-test on each indicator, the claim indicator has a difference of 6.08, evidence has a difference of 21.09, and reasoning has a difference of 24.74. This shows that changes in students' scientific explanation after learning with e-scaffolding in blended learning are very significant in the aspect of reasoning.

In the process of building or finding knowledge, students are not free of mistakes. Therefore, giving e-scaffolding as an aid assist students to be more focused on finding the knowledge. This is what was done in this study, namely using e-scaffolding to help direct students in building or finding knowledge. If students have good knowledge, their inner abilities will develop better, one of which is the scientific explanation ability. Students who have good scientific explanations can develop a strong understanding on the content knowledge [25–27]. Previous studies [28–31] also support that, when students construct explanations, they actively use scientific principles to explain different phenomena, developing a deeper understanding of the content. Constructing explanations may also have helped change how students' view science [28,30].

As explained earlier, e-scaffolding in this study is integrated into students' worksheets on the web. In online worksheets, some links are a form of procedural e-scaffolding that helps students solve problems. This is in line with previous studies [32], which states that the scaffolding used in the learning process refers to the assistance provided so that students complete assignments that may not be completed by students. These results are in line with some previous research [28,33], which state that scaffolding improves students' understanding and problem-solving abilities. If a link is not provided, students will feel confused in solving the problems given.

Therefore, e-scaffolding in blended learning can affect students' scientific explanation abilities. The scaffolding in the form of links in blended learning can help students gather information about material concepts so that students can solve the problems given by reviewing the concept of the material that underlies the problem. It also provides a good scientific explanation. This result is supported by Cagiltay [34], who found that procedural scaffolding supports the design and development of independent learning activities. Yu, et. al. [35] found that the use of procedural scaffolding supports students in learning activities. The results of students who use procedural scaffolding are better than students without using procedural scaffolding [35]. Hsu, et. al. [36] also reveal that scaffolding helps the process of investigating and developing an understanding of the concept, likewise with activities in learning that help hone students' scientific explanations.

The strength of this study compared to previous studies [20–23] lies in the type of scaffolding used and variable scientific explanation used. This study uses procedural scaffolding which is integrated in e-learning. In addition, this study also investigates the scientific explanation for prospective Islamic Primary school teachers. The result of this study can be used as an evaluation on the ability of prospective Islamic Primary school teacher's scientific explanation, also determine the solution steps to overcome this problem. This research is limited to one class of prospective Islamic Primary school with science concentration and limited to the scope of UIN Maulana Malik Ibrahim Malang. Thus, it is expected that this research will later cover another prospective Islamic Primary school teacher in another college.

4. Conclusion

Scientific explanation is a crucial ability of a prospective teacher. The scientific explanation of a prospective teacher must be good to practice scientific reasoning skills in students. The ability of students' scientific explanation for learning with e-scaffolding in blended learning is different from students who learn with the usual learning. The results of data analysis show that students who learn using e-scaffolding in blended learning are better than students who learn using normal learning. Teachers can also use e-scaffolding learning in blended learning for other learning materials in general and science material in particular so that they can help students practice their scientific explanation skills.This study is also limited to quantitative data only, for further research it is necessary to develop research that investigates the qualitative profile of scientific explanation with e-scaffolding in blended learning.

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