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Combining Flipped Classroom and Mind Mapping in Indonesian Vocational Schools: Their Influence to Students' Critical Thinking Ability

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Abstract:

The main problem of students in solving problems is the low ability to think. This study aims to improve students' critical thinking skills and measure the effectiveness of the combination of flipped classroom learning models and mind mapping. This research method used is a quantitative approach with a quasi-experimental design. The sample from this study was 31 students from the experiment class and 31 students from the control class. Data collection is done through critical thinking tests. Before using multiple-choice pre-tests and post-tests, instruments are tested first using validity tests and reliability tests. The results showed that the critical thinking abilities of students in the experiment class through the combined learning of flipped classroom models and mind mapping were higher than the control class, interpreted from the post-test score of the experiment class 77.6 while the control class got a score of 71.4. From the effectiveness of the experiment, class learning also got a score gain of 40.4947 with a fairly effective category, while the control class gained a score gain of 38.0115 with ineffective categories.

Keywords: Flipped Classroom; Mind Mapping; Critical Thinking.

Introduction

In the 21st century, quality improvement in various aspects of life is getting higher. The development of science and technology encourages every nation to exert its mind and all its resources. As an educator, teachers should prepare a resilient young generation and inspire students, not as learning objects (Mulyadi, 2016). To improve the quality of the Indonesian nation, strategic and systematic measures are needed in the planning, implementation, and continuous improvement of the education system in Indonesia (Hidayat & Patras, 2013). One of the problems that exist in education in Indonesia is the low critical thinking skills of students. Education at this time must be directed at increasing the nation's competitiveness to be able to compete in global competition. Globally, in 21st-century learning, the concept of critical thinking is the main target in education related to classroom learning and must be owned by all components in learning, both teachers as teachers and students as learners. Critical thinking is currently one of the important goals of education (Mite & Corebima, 2017). With critical thinking ability, students can think systematically and have the ability to distinguish truth from error (Rasiman, 2013). With critical thinking ability, students can think systematically and have the ability to distinguish a truth from a mistake. Critical thinking is also one of the few skills needed to prepare students at the level of education in the world of work (Salpeter, 2009). Critical thinking skills are also stated as one of the primary assets or intellectual assets that are important for everyone.

From the results of interviews with teachers of digital simulation subjects in 10th grade of software engineering Vocational High School 2 Surakarta, the critical thinking skills of students are still lacking. Students' learning patterns are always oriented to the assignment of theories, and teachers tend to emphasize students to memorize material in all fields of study. In class, the teacher uses a conventional learning model with the lecture method, which causes learning less effective, and students' critical thinking skills are less developed. Conventional learning causes learning to become less effective and students' critical thinking abilities are less developed (Pratiwi, 2015). Choosing the right method to build a learning atmosphere is very important so that students' critical thinking skills can be developed, so the teacher must be able to sort out which method is appropriate (Ramli, 2015). It is necessary to have a learning model that makes learning more effective while improving students' critical thinking skills, namely, by using a combination of flipped classroom and mind mapping learning models.

With the problem that requires students to think critically, teachers can use the Flipped Classroom learning model. The Flipped Classroom learning model itself is a learning model that can provide solutions to critical thinking problems. The flipped classroom learning model uses the class reversing method, basically changing the understanding of students who previously studied and understanding the material studied in class to be studied at home while learning in a class of students doing assignments and solving problems. That way, the ability of students will increase (Bergmann, 2017). In addition to using the Flipped Classroom learning model, educators can also collaborate with a mind mapping learning model. With so the potential to maximize the ability to think humans simultaneously (Dewi & Riandi, 2016). The mind mapping learning model makes it easier for students to train students to process information from various sources and turn it into a representation diagram (Liu, Tong, & Yang, 2018). Moreover, teachers adopting the mind mapping approach benefit from cognitive, affective, and psychomotor development while maintaining liveliness during the course (Saputra, Basori, Budiyanto, 2017). By combining the two learning models, learning will be more effective, and students' critical thinking skills is expectedly increasing. This research is an effort to improve students' critical thinking skills with a combination of flipped classroom learning models and mind mapping. This study is an effort to enhance students' critical thinking skills with a combination of flipped classroom learning models and mind mapping.

From the literature review above, this study adopts a theory about a combination of flipped classroom and mind mapping learning models that can improve critical thinking skills. So, the purpose of this research is to know the differences in critical thinking skills of students who use a combination of the application of Flipped Classroom and Mind Mapping with those who do not and Knowing the effectiveness of using a combination of flipped classroom learning models and mind mapping on students' critical thinking skills.

Research Method

This type of research uses a quantitative approach. A quantitative approach is a process of finding the knowledge by using numbers to find the information you want to know (Neolaka, 2016). The study used 2 groups of subjects divided into experiment classes and control classes using quasi-experimental research

methods. Quasi-experiments are defined as experiments with treatment, impact measurements, impact measurement, experimental units, but do not use random assignments to create comparisons to infer treatment-induced changes (Creswell, 2019). The design of the experiment used in this study is a pretest-posttest control group. Experiment classes will be given a combination of flipped classroom learning models and mind mapping, while control classes will use conventional learning models with lecture methods.

The population in this study was the 10th grade of software engineering. The number of students from the experiment class was 31. In the control class, there were also 31 students. For data collection, this study used to pre-test and post-test, which aim to measure students' critical thinking abilities. All pre-test and post-test questions have previously been tested using validity and reliability tests to determine the feasibility of these questions. After obtaining data from students, data processing, or data analysis is carried out to prove the truth of the hypothesis. The data analysis carried out in this research is the requirements analysis test in the form of data normality test and data homogeneity test; The balance test and hypothesis testing used the t-test, and the results of the post-test gain t-test were normalized. The research steps are described as follows.

Validity and Reliability Test

Before conducting pre-tests and post-tests to measure students' critical thinking ability, the instrument must be tested first. Tests are performed in different classes with experiment classes and control classes. After obtaining the data, to find out the validity of the test used, a validity test was carried out using the product-moment formula from Karl Pearson and for reliability test using an Alpha formula from Cornbarch.

Pre-test

Karl After the test is tested using validity and reliability test, and the instrument will be used for pre-test test of experimental class and control class. The purpose of the pre-test is to know the students' initial ability to think critically.

Treatment

Treatment is given for experimental classes using a combination of flipped classroom and mind mapping learning models to find out comparisons with control classes that are not treated.

Posttest

After being given different treatment between the experimental class and the control class, the final stage is to conduct a post-test to determine the student's final abilities.

Results and Discussion

Description of Data Research

This study took data from the pre-test and post-test scores of the experimental class and the control class. The pre-test value is used to determine the initial state of students' critical thinking skills in the experimental class and control class before being given treatment. To determine the increase in students' critical thinking skills, the researcher performed calculations using the normalized gain formula. The results of the statistical calculations of research data are shown in the following table

Table 1. Summary of the Statistical Data

Calculation Result	Mean	
	Experiment Class	Control Class
Pre-Test	71,4	52,6
Post-Test	77,6	53,2

Based on Table 1, the initial state of the students' critical thinking ability in the experimental class and the control class before being given treatment was the same because the pre-test results of the two classes obtained almost the same average score. For the average post-test score, the experiment class looks higher than the control class, but both classes show an increase. The increase in critical thinking skills of both classes is also proven by the known average value of normalized gain in the experimental class is 40.4947 which is quite effective in the category, and in the control class is 38.0115 which is categorized as less effective. It can be concluded that the increase in critical thinking skills in the experimental class is higher than in the control class.

Requirements Analysis Test Results

Normality Test

The normality test is carried out before testing the hypothesis tests to find out which data to be analyzed is a normal distribution or not. In this study, the normality test used the Kolmogorov-Smirnov test at a significance level of 5% with SPSS 25 with a Kolmogorov-Smirnov significance > α (0.05). The following are the results of the normality test for the experimental class and control class.

Table 2. Results of Research Data Normality Test

Test of Normality		
Data	P(Sig.)	Conclusion
Experiment Class Pre-Test	0,145	Normal
Experiment Class Post-Test	0,146	Normal
Control Class Pre-Test	0,126	Normal
Control Class Post-Test	0,146	Normal

Based on Table 2, the pre-test, post-test, and gain index values in the experimental class and control class each have a value of P> α (0.05). It can be concluded that the data is normally distributed

Homogeneity test

To find out whether the data from each sample group have the same or different variants, a homogeneity test will be carried out using the SPSS 25-assisted Levene test. The results of the homogeneity test can be said to be homogeneous if the significance of the test results is more than α (0.05). The results of the homogeneity test can be seen in Table 3

Table 3. Data Result Homogeneity Test Results

Data	Lavene Statistic	P (Sig.)	Conclusion
Pre – Test	1,024	0,316	Homogeneous
Post-Test	0,350	0,557	Homogeneous

Based on Table 3, the results of the pre-test, post-test, and index homogeneity test results in the experimental class and control class each have a significance of more than 0.05. It can be concluded that the data come from populations that have the same variant

Hypothesis Test Results

Testing the hypothesis in this study using the Independent Sample T-Test using SPSS 25 from the test results of students' critical thinking skills in the experimental class and the control class. If the probability value (Sig. 2 tailed)> 0.05 then Ho is accepted and Ha is rejected, and if the probability value (Sig. 2 tailed)

<0.05 then Ho is rejected, and Ha is accepted. The results of the Independent Sample t-Test can be seen in Table 4

Table 4. Results of First Hypothesis Data

Group	Sig. (2-tailed)
Pretest-Posttest Eksperimen	0,004
Pretest-Posttest Kontrol	0,004

Based on Table 4, the sig (2-tailed) value on the assumed line is 0.004 which is smaller than the significant level, which means that the two classes have a different level, so H0 is rejected and Ha is accepted. In the results of Dehghanzadeh's research, the results of the t sample test also showed that groups of students who used the flipped classroom learning model experienced a significant increase in scores (Dehghanzadeh & Jafaraghaee, 2018). This means that there are differences in students' critical thinking abilities in the application of a combination of flipped classroom and mind mapping learning models in digital simulation subjects for class 10th grade of software engineering Vocational High School 2 Surakarta. The results of this study are also supported by research by Shi-Chun (2014), which states that flipped classroom learning activities can improve higher-order thinking or critical thinking skills.

Tabel 5. Results of First Hypothesis Data

Group	Gain Score
Pretest-Posttest Eksperimen	40,4947
Pretest-Posttest Kontrol	38,0115

Based on table 5, the data from the gain test results in the experimental class obtained a value of 40.4947 which is categorized as quite effective. Meanwhile, the control class was 38.0115 in the ineffective category. From these results, the effect of implementing a combination of flipped classroom and mind mapping learning models on students' critical thinking skills is higher than using conventional learning. The results of this study are also supported by Rini Nurhayati (2017), the application of learning with the flipped classroom strategy is effective in improving students' critical thinking skills. This is also relevant to research conducted by Siu Cheung Kong (2015) who researched for 3 years using the flipped classroom learning model. The results revealed that critical thinking skills can be developed through the application of the flipped classroom learning model.

Discussion

This research aims to find out the improvement and effectiveness of critical thinking using a combination of flipped classroom and mind mapping learning models in digital citizenship. The study also took samples in class 10th grade software engineering. Testing is carried out in advance to determine the validity and reliability of the instrument. Tests using pre-test tests were conducted to determine the initial capabilities of the experiment class and control class and found that the initial critical thinking abilities of the two classes did not differ significantly. Treatment is applied to experimental classes using a combination of flipped classroom learning models and mind mapping.

Based on the data analysis that has been carried out, the results of this study indicate that the combination of flipped classroom and mind mapping learning models is better in improving students' critical thinking skills. From the results of the cognitive performance of the experimental class, the pre-test results got a value of 69.17 and for the post-test with a value of 80.08, while the cognitive performance of the control class pre-test results got a value of 64.19 and a post-test score of 71.25. It can be concluded that the experimental class that uses a combination of flipped classroom and mind mapping learning models is higher than the control class that uses conventional learning models with the lecture method.

The use of flipped classroom learning models indirectly familiarizes students to think critically, as students are required to search and analyze the materials studied. In dehghanzadeh's study, the t sample

test also showed that the group of students using the flipped classroom learning model experienced a significant increase in scores (Dehghanzadeh & Jafaraghaee, 2018). Flipped classrooms provide new methodologies and modalities for teaching and learning (Tan, Yue, & Fu, 2017), which means it involves changing roles for instructors as a way of minimizing the number of direct instructions in students' teaching practices. While the mind mapping learning model according to Buzan (Kiong et al., 2012) notes that mind mapping is the easiest step to capture and retrieve information from the human brain so that a person's critical thinking ability will improve. following the research conducted by Rijal Darrusman (2014), with the learning model mind mapping students can produce many ideas about a concept given by teachers poured in a mind map, training students to have critical thinking skills.

The application of flipped classroom learning models helps students to practice critical thinking skills because by applying reverse classes where learning that was previously done in the classroom and should be guided by teachers becomes done at home. Students are required to dig deeper into the learning materials studied. As Xiaona Dong (2016) said, students should have the awareness to improve their skills, to lay a solid foundation for the development of critical thinking skills in the flipped classroom learning model. After implementing the flipped classroom learning model, in the classroom students apply mind mapping learning models to help improve students' critical thinking skills by reanalyzing the material that has been studied at home and then summarizing it into a thinking map.

The use of a combination of flipped classroom and mind mapping learning models also shows the effectiveness of students' critical thinking skills which is higher than using conventional learning models with the lecture method. proven by the known that the average value of normalized gain in the experimental class is 40.4947 in the quite effective category, and the control class is 38.0115 in the less effective category. In a study conducted by Smith (2018), it was explained that in several years of learning using the flipped classroom and mixed model, it has increased attractiveness as an effective alternative for learning. In research conducted by Yizhen Liu (2018) explained that mind mapping learning models foster innovative skills, and improve students' critical thinking skills. It can be concluded that the increase in critical thinking skills in the experimental class is higher than in the control class. Such classroom active setting also suggested to be the rationale behind constructivism that developed during active engagement one another that help students better understand the subject being delivered (Siahaan, 2017).

Conclusions and Suggestions

Conclusion

In this research, there are differences in the use of a combination of flipped classroom and mind mapping learning models with conventional learning models using the lecture method to increase students' critical thinking skills. The increase in students' critical thinking skills in the experimental class using a combination of flipped classroom and mind mapping learning models is higher than the control class using conventional learning models. There are differences in the effectiveness of critical thinking skills. The experimental class that uses a combination of flipped classroom and mind mapping learning models are higher in the effectiveness of critical thinking abilities than control classes that use conventional learning models using lecture methods

Suggestions

1. The use of a combination of flipped classroom and mind mapping learning models can improve students' critical thinking skills and have a higher effectiveness than conventional learning models and it is hoped that teachers can utilize the combination of these learning models according to learning needs

2. Need for more research with wider coverage and using more variables.

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