Application of the Socratic Method-Based e-Learning Media in Linear Algebra Lectures

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Abstract: This study aims to determine the application of the Socratic method in the LMS model platform at Tanjungpura University e-learning. The use of e-learning from UNTAN has been applied by researchers for 4 semesters and the Socratic method is the reference for research in this semester. The Socratic method is a learning method with a discussion process led by educators to make students think about the truth of the validity of their reasoning or to reach a correct conclusion. The whole conversation is a constructive conversation and uses Socratic questions in building learning. The data in this study were given before and after the Socratic method was applied. The quantitative method in a comparative form is the type of this research. The research population is second semester students who take elementary linear algebra courses which are divided into 4 classes, namely class IIA1, II A2, IIA3, and B. The research sample was taken with consideration because the researcher was in charge of the class, namely class IIA2. The data obtained were analyzed descriptively by using the t test. The results of data analysis showed that there was a significant increase in learning outcomes after the implementation of the Socratic method in learning in the Tanjungpura University model e-learning platform.

Keywords: e-learning moodle, learning outcomes, socratic method.

Abstrak: *Penelitian ini bertujuan untuk mengetahui penerapan metode socrates dalam platform LMS modle di e-learning Universitas Tanjungpura. Penggunaan e-learning untan telah diterapkan oleh peneliti selama 4 semester dan metode socrates menjadi acuan penelitian pada semester ini. Metode Socrates adalah suatu metode pembelajaran dengan proses diskusi yang dipimpin oleh pendidik untuk membuat peserta didik berpikir tentang kebenaran validitas penalarannya atau untuk mencapai sebuah kesimpulan yang benar. Seluruh percakapan merupakan percakapan yang bersifat konstruktif dan menggunakan pertanyaan-pertanyaan Socrates dalam membnagaun pembelajaran. Data dalam penelitian ini diberikan sebelum dan sesudah diterapkan metode socrates tersebut. Metode kuantitatif dalm bentuk komparataif menjadi jenis penelitian ini. Populasi penelitian adalah mahasiswa semester II yang mengambil mata kuliah aljabar linier elementer yang terbagi menajdi 4 kelas yakni kelas IIA1, II A2, IIA3, dan B. Sampel penelitian diambil secara pertimbangan karena peneliti mengampu di kelas tersebut yakni kelas IIA2. Data yang diperoleh dianalisis secara deskriptif dengan menggunakan uji t. Hasil analasis data menunjukkan bahwa terjadi peningkatan hasil belajar yang signifikan setelah diterapkannya metode socrates dalam pembelajaran di dalam platform e-learning model Universitas Tanjungpura.*

Kata kunci: *e-learning moodle, hasil belajar, metode sokrates.*

▪ **INTRODUCTION**

Talking about education in the Society 5.0 era is certainly related to changes in the learning system that existed in that era. The era of society is closely related to 21st century skills which are closely related to rapid developments in technology. In line

with this, it brings a relationship with various advanced and developing technological concepts that are applied in complex learning. These technological skills are used as guidelines in learning the era of society 5.0 so that the learning system is in line with the concept of the industrial revolution that will soon take place, namely the 5.0 revolution era (Fukuyama, 2018; Berawi, 2019; Ellitan, 2020; Rahayu, 2021; Perwiranegara, 2022; Husniati et al., 2022).

In line with what learning skills conceptualized in the 21st century refers to four types of skills, namely: (1) critical thinking and problem solving skills; (2) communication skills; (3) creativity and innovation; (4) collaboration. The concept of revolution that was initiated in Japan is more encouraging to the role of humans in obtaining ideas to overcome the positive paradigm of the progress of the industrial revolution 4.0. In the sense that the learning period of society 5.0 requires humans to be more able to have the ability to solve complex problems, think critically, and be creative (Ghazivakili et al., 2014; Changwong et al., 2018; Basith et al., 2020; Kamal et al., 2020; Rahayu, 2021). In response to this, the ministry is currently formulating the Merdeka Learning Campus Merdeka (MBKM) program which is an independent and versatile higher education learning program designed to create a creative learning community that does not limit its creativity to meet the various needs of students (Nurhasanah & Nopianti, 2021; Endrawan et al., 2021; Prakoso et al., 2021; Denny et al., 2022). In following independent learning, the Socratic method was chosen as a learning method that was considered appropriate in directing students to think critically in accordance with the development of their mindset when they were independent in learning (Peterson, 2009; Rahmawati & Suwarjo, 2021; Boa et al., 2018; Grace & Maigue, 2020; Endrawan et al., 2021).

When we get to know the Socratic method, we are faced with a method that emphasizes dialogue or discussion led by educators. Educators are very important in leading discussions or dialogues because only educators know the learning objectives to be achieved. The stages of simple to complex questions become the plot in this Socratic method, which is used to test the validity of students' beliefs about a problem object. The Socratic method is a very constructive method or builds knowledge for students (Stoddard & O'Dell, 2016; Burns et al., 2016; Astuti S. et al., 2019; Ismah & Muthmainnah, 2021; et al., 2022).

Facilitated by the Moodle e-learning platform which has been used and developed for 3 years at the University of Tanjungpura, the Socratic method is very well applied to the learning of the system. This Moodle platform is very suitable for use in learning, especially for assignments and exams. The learning management system, in this case the Moodle LMS, is the most widely used platform in universities because it is very systematic and detailed (Jebari et al., 2017; Ismail et al., 2020; Sari & Exacta, 2021; Makruf et al., 2022; Makruf et al., 2022; Gamage et al., 2022). With these considerations, it encourages the author to examine the Socratic method based on e-learning with the formulation of the problem: (1) find out whether there is a significant difference between before and after the application of the Socratic method in learning; (2) how much improvement the method is when it is used in linear algebra courses.

▪ **METHOD**

This research is comparative research which is used by data researchers before

and after the application of the Socratic method in the Moodle e-learning basis. The dependent variable is the test of learning outcomes before and after the learning is carried out. All students who teach linear algebra are used as the research population with details of classes A1, A2, A3, and B. The sample is class A2, which consists of 20 students. The data collection technique is measurement technique and direct observation. The research instruments are tests and observations. The research sample was taken in consideration because the researcher was in charge of the class, namely class IIA2. Essay tests were conducted to obtain research data by testing hypotheses using the t-test, so the sample and population must be homogeneous and normally distributed. Meanwhile, direct observation is used during the process of learning activities that take place during the A2 class linear algebra lectures at the Mathematics Education Study Program, FKIP Tanjungpura University. The instruments used in this study were observation and test instruments. What is observed is the learning process from the previous action and the application of the Socratic method based on e-learning moodle is applied. The data obtained were analyzed descriptively by using the t test.

Hypothesis test
Two-Party Test
　　The sample test was carried out on samples originating from populations that were normally distributed and homogeneous with several stages in accordance with the formulation of the hypothesis:
$H_0 : \mu_1 = \mu_2$ (There is no difference in learning achievement before and after the application of the Socratic method based on e-learning moodle).
$H_1 : \mu_1 \neq \mu_2$ (There is a difference in the average learning achievement before and after the application of the Socratic method based on e-learning Moodle).

Two-Mean Difference Test
　　The sample test was carried out on samples originating from populations that were not normally distributed or not homogeneous with several stages in accordance with the formulation of the hypothesis:
$H_0 : \mu_1 \leq \mu_2$ (mean learning achievement after applying the Socrates method based on Moodle e-learning is lower or the same as before it was used).
$H_1 : \mu_1 > \mu_2$ (the average learning achievement after applying the Socrates method based on Moodle e-learning was higher than before it was used).

Research Procedure
　　The steps in this research are: a) conducting pre-research research for initial data collection; b) conduct preliminary tests for students; c) applying the Socratic method based on e-learning moodle in learning; d) observing the learning process; e) conduct a final test of student learning outcomes; f) assessing student learning responses with a questionnaire.

▪ **RESULT AND DISSCUSSION**
　　The average student learning achievement derived from essay tests conducted on students of A2 class linear algebra before and after the application of the Socrates method based on e-learning moodle were 75.71% and 86.82%, respectively. Before

being applied, their highest score was 95 and the lowest was 60 and after the method was applied, the highest score was 100 and the lowest was 65.

Then the normality test was carried out by conducting the t test, the results obtained: (1) by calculating the similarity test of two parties, it was found that $t_{hit} = 3,67$ greater than $t_{daf} = 2,00$ (through the 5% significance level) then the criteria for the rejection test are obtained H_0 and received H_1; 2) By calculating the mean difference test, it is found that $t_{hit} = 3,67$ greater than $t_{daf} = 1,67$ (at the 5% significance level) then the criteria obtained are reject and accept. Looking back at the problem formulation, in other words, after applying the Socrates method based on Moodle e-learning, the average learning achievement was better than before it was applied.

The results of the effectiveness test using the independent sample test t test were obtained greater than the significant value which indicated that there was a difference in average learning achievement before and after the application of the Socrates method based on Moodle e-learning. The results of the normality gain test also showed a significant increase after the implementation of the Socrates method based on Moodle e-learning, which was 0.45 in the medium category. Theoretically, the difference in learning achievement before and after being applied occurs as a result of the large amount of discussion time on the Socratic method and the many questions that cause critical thinking, for example: (1) how do you solve it; (2) if yes, why do you think it is appropriate; (3) if not, why; (4) are you sure that the answer is correct; (5) if not, what made you change your mind.

From the observations, the implementation of this activity went well and smoothly. By implementing all learning activities using the Socratic method and detected in the Moodle e-learning platform. The assessment process was obtained from the results of the pretest and posttest in accordance with the questions of creative thinking and mathematical disposition. Examples of e-learning moodle used in this study are:
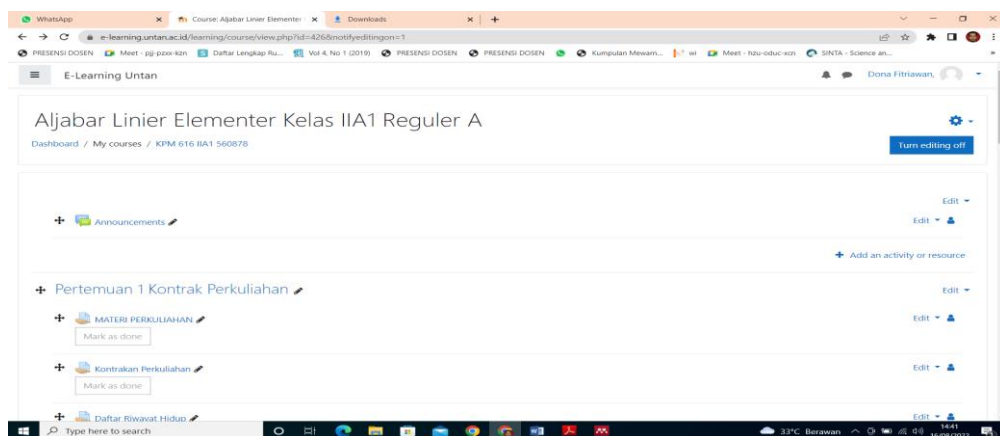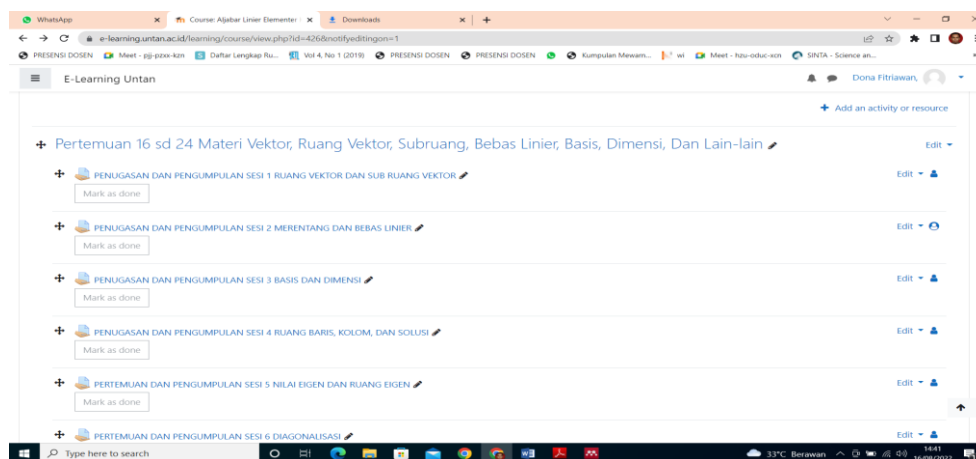
Figure 1. Moodle e-learning for linear algebra lecture platform

The learning process that occurred while using the Socratic method was observed with an observation sheet with good results. With e-learning moodle, it appears that the Socratic method is able to be applied properly and produces satisfactory results. This is also reflected in their learning responses through the response questionnaires that were distributed resulting in a positive response for students. This response questionnaire is an illustration of the implementation of the Socratic method which received a satisfactory response from all parties related to this research.

Some research results that are in line with this research are: (1) (Grace & Maigue, 2020), specifically, this study focuses on the importance of incorporating Socratic questioning in teaching Social Studies. The primary resources of this paper were taken from international journals. Related studies reveal that when teachers use Socratic questioning, students examine and probe their thoughts by making them explicit thus allowing them to develop and evaluate their thinking while overtly expressing their ideas. This in turn, is the paramount objective targeted by the Socratic Method, a student with an enriched critical mind; (2) (Ismah & Muthmainnah, 2021) conducting research on the application of the Socratic method contextually obtained the results that during the learning process, most of the students gave a positive response and more than 75% of them responded actively. The test results of students' critical thinking skills are dominated by medium and high criteria with an average of 66.28%. So it can be concluded that the application of the Socratic method with a contextual approach is going quite well; 3) (Pangestuti et al., 2019) conducted a study on the influence of the Socratic method with the results of the study that the average result of the Socratic method of learning was 82.70% and the conventional learning average was 72.90%. Which shows that the Socratic method provides better learning; (4) (Rizal & Walidain, 2019) conducted a study that aims to determine the use of e-learning moodle learning media to support student learning activities with research results showing that the use of e-learning moodle can significantly improve the results of student learning activities.

▪ **CONCLUSION**

Based on the results of the research and discussion, the conclusions are: (1) there is a difference in the average learning achievement before and after the application of the Socratic method based on e-learning moodle; (2) the average learning achievement

after the application of the Socrates method based on Moodle e-learning is more than before it was applied. The impact of this research is the use of the Socratic method which is very suitable for use in the Moodle e-learning platform in learning and learning activities. The impact of this research is the use of the Socratic method which is very suitable for use in the Moodle e-learning platform in learning and learning activities. In order to contribute constructive ideas and insights, the researchers provide several suggestions, namely: (1) the e-learning platform is very suitable for use in various higher education institutions, especially for ranking these universities; (2) the Socratic method is very appropriate to educate students in critical and creative thinking.

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