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Effect of Cooperative e-Learning Model by eLMA on its Level of Students Understanding and Self-Regulated Learning at Basic Chemistry Course

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Abstract. This study sought to investigate the effect of Cooperative e-Learning by eLMA as an online learning platform in their student's understanding and self-regulated learning. With an implementational of Cooperative e-Learning at a university, this study was performed with a Pre-experimental One Group Pretest-Posttest Design which implemented in two selective sections in The Basic Chemistry course, especially in stoichiometry and reaction rate topics. The sample research was 40 students who participated in the Basic Chemistry course at Universitas PGRI Madiun. The research instrument that was used as a measurement of student understanding was 49 multiple choices test questions and 28 questions questionnaires which were analyzed as a self-regulated learning parameter. Research data were analyzed by descriptive analysis, paired sample t-test, and N-gain score. The results of the pretest and posttest showed that cooperative e-learning had a significant effect on student understanding ($p = 0.000$) and student self-regulated learning ($p = 0.003$). Students' understanding showed enhancement which was indicated by an increase of pretest average score from 40 being to 58 in the posttest. So as students' self-regulated learning scores showed enhancement which was indicated by the increase of average pretest score from 77 being to 84 in the posttest. The N-gain score shows that the level of effectiveness of cooperative e-learning on student understanding and student self-regulated learning is medium. So it can be concluded that the application of cooperative e-learning has an effect on improving student's understanding and self regulated learning.

INTRODUCTION

When the COVID-19 pandemic hits the world, it has led to the largest interruption in education. It makes the government concerned to solve this problem, classroom education activities in formal schools being stopped and replaced by online learning. Online learning is supported by technology such as internet technology and is well known as e-learning. The use of this type of e-learning is a solution that can be applied and the learning process can be continued. E-learning in Indonesia initially encountered many obstacles, such as a difficult internet network and inadequate equipment. However, in line with current development, the learning process by utilizing e-learning also continues to grow and can be applied at each level of education in Indonesia, one of which is at the university level.

Universitas PGRI Madiun is one of the universities in Indonesia that has developed an e-learning platform called eLMA to improve the quality of the lecturing process. The development of eLMA is equipped with complex and relevant features for current lectures, especially to help the teaching and learning process during a pandemic.

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Learning through eLMA is expected to increase social interaction between teachers and students which is more open and flexible. So that students can study anytime, anywhere, and with anyone.

The application of learning strategies in e-Learning classroom management can be done with group settings or with simple settings (no complicated settings required). Setting up a learning environment where students work in small groups to solve questions or problems given by the teacher is an effective effort to support learning [1].

Students with different levels of understanding will interact with each other so that their confidence in their ability to solve complex problems will increase as long as they have support from group members [2]. The learning model that can support learning activities in groups is cooperative learning. There are basic elements in cooperative learning that distinguish it from simply learning in groups. The five main elements of cooperative learning are: (1) Positive interdependence, (2) Individual responsibility, (3) Face-to-face, (4) Member communication, and (5) Group process evaluation [3]. By paying attention to these elements, it is hoped that in cooperative learning between students, social interaction and cognitive interaction can be established, so that students can understand the material being studied, can interact, and develop social attitudes.

Cooperative learning that is applied to UNIPMA's e-learning using eLMA media has been used by teachers, one of which is applied to basic chemistry courses. Web-based cooperative learning is effectively applied as a foundation in chemistry classes [4]. The application of cooperative learning in online classes is designed to provide opportunities for students to jointly build their knowledge [5]. Learning activities such as giving assignments, collecting assignments, providing feedback, and lots of interactions can be provided via the internet which makes cooperative learning more meaningful [6]. In addition, the use of web-based media in cooperative learning can improve learning outcomes, communication skills, creativity, and critical thinking [4].

The success in implementing cooperative e-learning is supported by many factors including the attractiveness of the material content provided, the creation of sustainable interactions both in the classroom and online environments, and strong support within students. Such support is motivation and self-regulated learning ability. Several studies have stated that self-regulated learning is a predictor of academic achievement in learning environments such as technology-based learning [7] [8]. This study sought to investigate the effect of cooperative e-learning by eLMA as an online learning platform on its student understanding and self-regulated learning at Basic Chemistry course.

METHODS

This study used a pre-experimental one-group pretest and posttest design and the research sample was first semester students taking Basic Chemistry courses at Universitas PGRI Madiun, totaling 40 students. Sampling was done by convenience sampling technique. The pre-experimental design in this study was used because of the treatment to find out its effect on others in one group of subjects [9].

The instruments used in this study consisted of treatment instruments and measurement instruments. The treatment instrument is the learning implementation plan and the teaching materials contained in the eLMA media. Teaching materials consist of links or websites that are relevant to teaching materials, images, and supporting videos. Before being used as research instruments, all of these instruments have been verified and validated by the validator. The measurement instrument is a student understanding test to determine cognitive understanding of stoichiometric and reaction rate topics and a questionnaire to measure student self-regulated learning. This measurement instrument is given before and after cooperative e-learning takes place. The final test of the material before it is used is validated first to find out the validity and good reliability. The self-regulated learning questionnaire instrument used was adapted from the Online Self-regulated Learning Questionnaire (OSLQ) developed by Barnard et al [10] where this questionnaire was adapted from the instrument developed by Zimmerman in 1998. The questionnaire used four alternative answers, including highly not appropriate, not appropriate, appropriate, very appropriate, while the types of questions or statements consist of two types, namely positive and negative. The aspects used in the student self-regulated learning scale are (1) Goal setting, (2) Task strategy, (3) Time management, (4) Self-evaluation, (5) Environmental structuring, (6) Help-seeking, (7) Critical Thinking, and (8) Elaboration.

This research was carried out for six meetings and in one learning activity there were five stages in cooperative e-learning activities, namely: (1) Preliminary assignments, (2) Class presentation, (3) Team or group and class discussions, (4) Quizzes, and (5) Self-reflection and peer-assessment. At the first and last meetings, measurement instruments were given in the form of student understanding tests and student self-regulated learning questionnaires. The data analysis used in this research is descriptive, statistical analysis of paired sample t-test and N-gain score.

The descriptive analysis technique used is to describe the results of student understanding and student self-regulated learning. The statistical analysis technique of paired sample t-test was used to determine the effect of e-learning cooperative learning on student understanding and self-regulated learning. N-gain score analysis is used when there is a significant difference between mean pretest and posttest scores through the paired sample t-test. The gain score is used to determine whether the implementation of cooperative e-learning assisted by eLMA can be said to be effective or not. The gain score is interpreted using Hake's classification [11].

TABLE 1. Gain Score Classification

Standard Gain Score (g)	Criteria
0,70 < (g)	High
0,30 ≤ (g) ≤ 0,70	Medium
(g) < 0,30	Low

RESULT AND DISCUSSION

Research on the effect of cooperative e-learning on student understanding and student self-regulated learning use e-learning facilities at Universitas PGRI Madiun under the name eLMA.

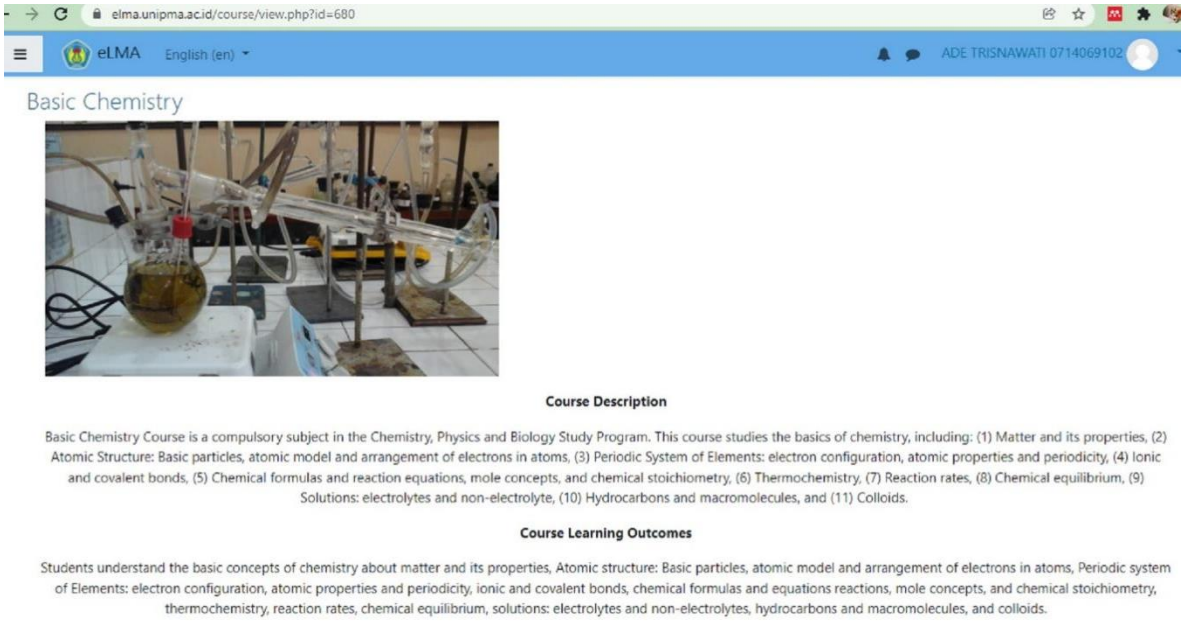

FIGURE 1. Homepage Platform e-learning UNIPMA (eLMA) in Basic Chemistry Course

TABLE 2. Results of Paired Sample T-Test and Gain Score

Data	Students Understanding		Self Regulated Learning	
	Pretest	Posttest	Pretest	Postest
Mean	40	58	77	84
Standard Deviation	11,460	11,385	9,481	9,306
Correlation	0,809		0,094	
p (Correlation)	0,000		0,566	
Df	39		39	
P	0,000		0,003	
N-gain score	0,32		0,36	

The paired sample t-test analysis test was used to determine the effect of cooperative e-learning on student understanding and self-regulated learning. Based on the results of the paired sample t-test analysis, which is summarized in Table 2, it shows that in the student understanding data there are differences in the mean value of

student understanding before and after cooperative e-Learning, where the results of students' understanding scores after learning have increased compared to mean value student understanding before learning. However, the results of student understanding score are still low and when viewed from the gain score it shows that the level of effectiveness of cooperative e-learning on student understanding is medium.

Based on the results of student answers and analysis on the eLMA discussion forum, it can be seen that there are still many students who have difficulty with the reaction rate topic rather than the stoichiometry topic. For example, in the concept of reaction rate, students assume that in the reaction $P + Q \rightarrow R + S$, the rate of this reaction is increasing the concentration of reactants (P or Q) or increasing the concentration of products (R or S) per unit time. Whereas the correct concept reaction rate of this reaction can be determined decreasing the concentration of reactants (P or Q) or increasing the concentration of products (R or S) per unit time. Then on the concept of reaction order, although students can understand zero-order reactions correctly, students are not necessarily able to understand first- and second-order reactions correctly. This is because the first and second-order reactions are more difficult to understand, so a higher level of understanding is needed. In addition, students assume that the rate of a reaction is determined by the concentration of the reactants in the last stage of the reaction. Whereas the correct concept is that the rate equation for the reaction is determined by the concentration of the reactants at the slow stage. While in the concept of stoichiometry, students have difficulty regarding the concept of molar mass and types of ionic compound particles related to the types of molecular compound particles.

Generally, the difficulties experienced by students in studying reaction rate and stoichiometry topics are in understanding the basic concepts and microscopic representation. One of the successes of e-learning is the attractiveness and completeness of the learning content provided. In this case, it is necessary to have learning content that discusses in-depth microscopic understanding and must be supported by images in the form of videos or animations related to microscopic concepts as basic concepts in reaction rate and stoichiometry topics. In addition, the presence of teachers is very important in online learning to prevent and avoid misconceptions that students may experience. A teacher must become more aware of student's difficulties and can involve students more in planning and evaluating the learning that has been done [12].

Cooperative learning can be effective learning to improve students' understanding and achievement, especially if the following two conditions can be met [13], namely: (1) Provided rewards to groups, giving awards to groups aims to make the group understand that helping others is in their interests as well. (2) Individuals are held accountable. It is necessary to use a method of evaluating the contribution of each individual, such as an individual quiz. Without responsibility, students may be lazy or let other students do group assignments and some may be ignored because they feel that they do not contribute much.

Although the teachers used some strategies in this learning such as giving feedback after discussion, submission of assignments by each student individually, fostering social interaction between students, and building a learning community, it seems that the method was still not enough to support the students when working in a team. Results confirmed the need for new strategies to support and encourage them to work and share their ideas with the team in cooperative e-learning. Jacob & Ivone suggest some suggestions for fostering individual accountability in cooperative learning in distance education including before doing synchronous communication, allowing everyone time to write, think about, or rehearse what they will say, using turn-taking, and having a regular discussion about how well the groups [14].

TABLE 3. Results of Student Self Regulated Learning Aspect

No	Self Regulated Learning Aspect	Mean value at the beginning	Mean value at the end
1	Goal Setting	2,73	2,73
2	Environment Structuring	2,80	3,00
3	Task Strategies	2,63	3,00
4	Time Management	2,78	3,20
5	Help Seeking	2,80	2,93
6	Self Evaluation	2,68	3,00
7	Critical Thinking	2,82	2,86
8	Elaboration	2,74	3,20

The results of the paired sample t-test analysis on student self-regulated learning contained in Table 2 show that there is a difference mean value of self-regulated learning before and after cooperative e-learning, where the results of mean self-regulated learning scores after learning are increase compared to the mean value of self-regulated

learning before learning. When viewed from the gain score, it shows that the level of effectiveness of cooperative e-learning on students' self-regulated learning is medium.

Self-regulated learning is one of the important factors in students who are needed in e-learning. In blended learning, Jonassen et al [15] asserted that the possibility of student self-regulated learning in an online environment may be more important than a face-to-face environment because of the lack of student activity. Online learning requires more proactive peer interaction and collaboration and self-regulation in the learner's personality. Self-regulated learning is an important factor in the success of online learning.

Based on the analysis of the results of student questionnaire answers from aspects on a self-regulated scale in Table 3 that experienced a significant increase, including task strategies, time management, help-seeking, self-evaluation, and elaboration. Based on research by Brak et al [16], strategic ability in completing tasks, time management, initiative to seek help, and self-evaluation are descriptions of attitudes that are often associated with performance control and self-reflection phases in developing strategies and independent learning skills. Students who have these characteristics are ideal descriptions of being part of a performance control or self-regulation profile that supports self-reflection.

Technology that uses planned instructional strategies with sustainable support for self-regulation [17]. Cooperative e-learning provides freedom for students to how the strategy is carried out in doing the task. Students in groups use turn-taking in doing assignments so group members can do a fair share in the group. In time management, students who can manage study time efficiently will have better achievements than students who cannot manage their study time. Students with high self-regulated learning will submit assignments well in advance of the submission deadline so that they have extra time to study the material being studied. This is done to avoid interference with the internet or interference with the computer used. Self-evaluation efforts are also shown when students are having conversations in online discussions or doing online quizzes, if there are words that are not appropriate they will edit or correct the words that have been uploaded. The elaboration efforts used by students in this study include being able to make a summary of the results of the discussion or make a summary of the material using their sentences, making an analogy or idea, and making general notes of all the information obtained either on references from the internet or books.

CONCLUSION

This study sought to investigate the effect of cooperative e-learning by eLMA as an online learning platform on its student understanding and self-regulated learning at Basic Chemistry course, especially in the topic of stoichiometry and reaction rate. The results of the pretest and posttest confirmed that there are significant differences between student understanding and self-regulated learning before and after experiencing the cooperative e-learning by eLMA at basic chemistry course. The Effectiveness of cooperative e-learning on student understanding and self-regulated learning is medium. Cooperative e-learning provides opportunities for the student to establish social interaction and cognitive interaction. The study found that cooperative e-learning can be implemented to develop student's performance control or self-regulation profile such as task strategies, time management, help-seeking, self-evaluation, and elaboration.

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