EFFECTIVENESS OF NETWORK LEARNING COMBINED WITH SYNCHRONOUS AND ASYNCHRONOUS SETTINGS AND SELF EFFICACY ON STUDENT MASTERY CONCEPT

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ABSTRACT

This study aimed to determine the difference in students' level of understanding before and after using synchronous and asynchronous network learning modes. This quantitative study employed a quasi-experimental research design. Data were obtained from 87 students who were divided into two experimental groups. The results show a higher level of mastery among students in Experimental Group 2 compared to Experimental Group 1. This implies that students with high self-efficacy had a different mastery of concepts from those who had moderate or low self-efficacy. This study concludes that the application of learning networks and self-efficacy influences and improves student science learning outcomes.

Keywords: *asynchronous learning, mastery concept, network learning, self-efficacy, synchronous learning*

INTRODUCTION

Since the turn of the century, most parts of the world have experienced global changes in technology as part of the Fourth Industrial Revolution. Computers once used in research institutes are now used at home. Network connectivity has progressed from slow and unreliable modems to high-speed broadband internet. Devices have evolved from stationary desktop computers to smartphones that are always present and always connected. These developments have been accompanied by new digital practices and changing user expectations, and education is no exception. Enthusiasm for digital technology in higher education is very high but there is a contrasting set of values at higher education institutions. With the rise of digital technology, the university has seen new opportunities to save money and grow income through online teaching. Many early attempts to combine technology and education had an instrumentalist understanding of the human relationship with technology, with a strong emphasis on practice and "what works" (Anders, 2018; Gourlay et al., 2021). In online education, the process of enhancing and strengthening learning binds people and data, which support each other in the field of education. The central term in this definition of online education is the bond between educators and students, while the bond between students is called network education. Network education is learning in which data and communication technologies are used to promote bonds between one student and another, between students and instructors, and between the learning community and its learning resources (Dirckinck-Holmfeld et al., 2009).

Online learning is intertwined either in relation to other people or in relation to learning resources that require relational behavior to use. Curriculum can be managed more strictly and centrally when online, or in terms of vocational education, network education can offer more functional efficiencies to learning institutions. Network education is divided into two types, namely synchronous and asynchronous. Synchronous network education is hands-on, real-time (i.e., it is scheduled), facilitated instruction and education-oriented interactions (Shahabadi & Uplane, 2015). In synchronous education, the learning experience is directly situated between the instructor and students and is performed in real time. Education that is rooted in synchronous electronic formats comes from three main influences, including classrooms, media, and conferences (Hagi, 2021; Nguyen, 2015; Sun & Chen, 2016). On the other hand, a well-known definition of asynchronous education holds that it is an interactive education that is not limited by the boundaries of a specific time or geographical place (Fahmi, 2020; Perrotta & Bohan, 2020). Asynchronous network education, similar to synchronous network education, is a learner-centered process that uses online learning resources to facilitate the sharing of data regardless of time and place among a network of people. It uses computer-mediated communication to fulfill the promise of an asynchronous, "anytime and anywhere" education, through the use of the online chat function (Khan, 2006).

A lot of research has been done on online learning, but there is not a separate discussion about the effect of network learning and self-efficacy on the learning outcomes of concept mastery by students that compares synchronous network learning and asynchronous network learning models. Therefore, further investigation is needed into this topic, which is why we undertook this study. The three research questions of this study are as follows:

1. What is the difference in the effectiveness of students' mastery of concepts in science subjects between using synchronous network learning and asynchronous network learning?

2. What is the difference in the effectiveness of students' mastery of concepts in science courses who have different self-efficacies?

3. What is the effectiveness of the interaction between network learning and self-efficacy on students' mastery of concept learning outcomes in a basic science course?

LITERATURE REVIEW

Mastery of the Concept of Network Learning

Self-concept is "the overall perception one has of oneself." (Burns, 1977) in his book says, "the self concept refers to the connection of attitudes and beliefs we hold about ourselves" (p. 42). According to the Bruner Model, concept formation and concept understanding are two different categorizing activities that demand different thought processes. All categorizing activities include identifying and placing examples (objects or events) into classes based on certain criteria. This means understanding the concepts that existed before, while in forming a concept is the act of forming new categories and is an act of discovery or formation. According to Bruner (1980), categorizing activities have two components, namely: (1) the act of forming the concept and (2) the act of understanding the concept. Furthermore, he argued that the first step is the formation of a concept, next is understanding the concept (Bruner, 1980).

Mastery of the Concept of Self-efficacy

In research conducted by Dian and Sungkono at the State University of Yogyakarta on improving educational interactivity through the use of asynchronous communication, their results showed that student learning interactivity before the application of asynchronous communication was low and only 35% successful. There was an increase in student learning interactivity after asynchronous communication was applied to 60% and further increase in the second cycle to 82.33% (Di Pietro et al., 2020; Reigeluth, 2013; Wahyuningsih & Sungkono, 2017). Critical thinking skills were not only emphasized in the classroom but also in social life so that social sensitivity and creative skills would emerge. To respond to these challenges, a person must have high self-efficacy (Ayu, 2020; Macchi et al., 2020). Self-efficacy for Canadian psychologist Albert Bandura (1997) is a person's belief in their ability to accomplish something successfully. That is, when a person has abundant self-efficacy, they believe they can do something better (Argyris & Xu, 2016; Shea & Bidjerano, 2010; Yu et al., 2015).

Interaction Between Network Learning and Self-efficacy

Network learning benefits self-efficacy by offering a peer-based mastery experience for learning communities' self-presentation that supports the recognition of one's own progress and mastery and promotes social networking and professional development by offering authentic challenges and providing external validation to learners. Peer-based, vicarious learning lets learners emulate peer role models while learning artifacts enhance learning and performance and, for social networking and professional development, peer role models and resources offer situated expertise and perspectives on real-world situations.

Peer-based social persuasion in learning communities allows peer-peer feedback that enables accurate self-assessment and supports improvement. Peer-peer feedback also enhances credibility and offers insights for social networking and professional development. Further, peer-based, affective state learning amplifies social interaction with peers to promote engagement and motivation. Network educational technology is very important for offering the ability to increase student interaction and improve their visual skills. Previous research has shown that network learning provides a self-presentation context in which self-efficacy is promoted when students identify themselves as role models who successfully imitate and observe peer education (Argyris & Xu, 2016; Leonard et al., 2016; Schiefele & Schaffner, 2015).

Conceptual ability is the ability of students to master concepts after educational activities. Conceptual ability can be referred to as the student's expertise in mastering the scientific meaning both in theory and in its daily implementation. On the other hand, a more comprehensive definition of conceptual ability is put forward by Bloom, namely, the ability to capture meaning, such as being able to say a module is presented in a form that is easier to understand, and to share interpretations, and to apply them (Straw et al., 2021; Tursinawati, 2016). Dahar defines conceptual ability as the ability of students to master scientific meaning, both in theory and in practice in everyday life. This study aims to analyze the effect of synchronous network learning and asynchronous network learning as well as self-efficacy on students' mastery of concepts in basic design learning. Thus, the purpose of this study is to determine the difference in the understanding of students after using synchronous network learning and asynchronous network learning at different levels of self-efficacy.

RESEARCH METHOD

This study used a quasi-experimental design using a pretest-posttest control group design because this type of experiment could control external variables that affected the course of the experiment. Thus, the quality of research design implementation (e.g., internal validity) was high (Mustami, 2016; Narbuko, 2013; Suryabrata, 2011). The hypothesis tested in this study was a comparison of the average value of the conceptual ability of students who used synchronous network education and those who used asynchronous network education at different levels of self-efficacy. In this study, the synchronous network education procedure used the Zoom application, while the asynchronous network education procedure used Unuja E-Learning LMS. The participants in this study were fourth-semester students at the Islamic Elementary School Teacher Education Program at Nurul Jadid University, Probolinggo, who were chosen through cluster random sampling. From a total population of 220 students,87 participants were chosen and divided into Experimental Group 1, consisting of 45 students, and Experimental Group 2, with 42 students.

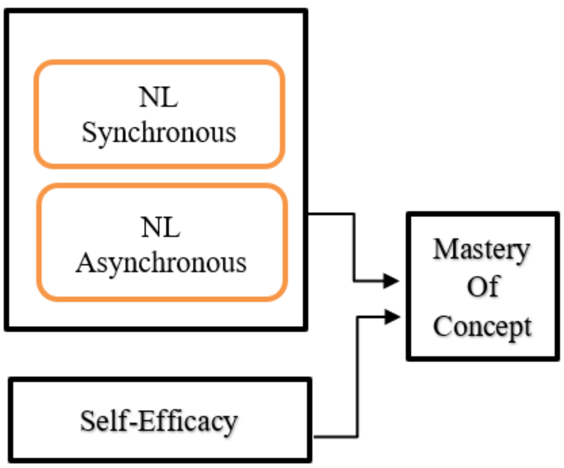
The instruments consisted of a science subject

Table 1.
Summary of Instrument Test Results

Instrument	Actual Score		Average	Category
	V1	V2		
Teaching material validation sheet for science courses	32	33	32.5	A
Assessment sheet for the validity of Assignments and Exercises	34	34	34	A
Assessment rubric validity sheet	32	33	32.5	A
Assessment sheet for the validity of the science subject concept mastery test consisting of a pretest and posttest	30	30	30	A
Bandura instrument validity sheet to measure self-efficacy	34	34	34	A

concept mastery test, which consisted of pre- and posttests, and a Bandura instrument to measure self-efficacy (Albert Bandura, 1997). Moreover, the tools needed in the study included (a) teaching materials for science courses, (b) assignments and exercises, and (c) assessment rubrics. The relationship between research variables, research instruments, instrument validation, and techniques was the focus of the study. Table 1 shows the results of the validation that had been carried out, and Figure 1 illustrates an overview of the research procedure.

Figure 1.
Research Procedure



This study used two types of research instruments consisting of (a) the concept ability test for science courses covering pre- and posttests and (b) the Bandura instrument to measure self-efficacy as developed by Casidy & Eachus (Straw et al., 2021). Next, we tested content validity to ensure that there were no unmeasured concepts. Based on information from educational technology experts and the test results, 40 out of 47 items were valid for measuring students' concepts.

This study analyzed the following information: (a) Concept ability between groups of students using network education, (b) Concept ability between groups of students with high-, moderate-, and low-level network education, and (c) Effects of interaction between education and self-regulation in learning on students' conceptual abilities. The aforementioned information was collected and analyzed using descriptive analysis and variance.

In this study, we measured the homogeneity values of the two groups to be tested and both groups are equally homogeneous as can be seen in Table 2.

Table 2.
Test of Homogeneity of Variances for Two Groups

Test of Homogeneity of Variances

Pretest

Levene Statistic	df1	df2	Sig.
1.386	1	85	.242

Based on Table 2, a significance value of 0.242 > 0.05 was obtained so that the data population group is homogeneous

FINDINGS

The results of the measurement of central tendency (e.g., mean, mode, and median), as well as the results of the measurement of the distribution of information (e.g., variance and standard deviation), were compared with prior knowledge covariables, including test scores, self-efficacy scores, and mean of self-efficacy in educational conceptual skills, obtained in Experimental Groups 1 and 2. This study aimed to identify the effect of the implementation of network education on increasing students' conceptual skills. Table 3 shows the comparison of the average conceptual skills scores of the pretest and posttest sessions in Experimental Group 1 (25% synchronous and 75% asynchronous). There was a significant comparison of students' conceptual skills in network education in Experimental Group 2 (75% synchronous and 25% asynchronous). The paired illustration test showed a significant increase in the ability of the pretest and posttest concepts (M= 11.44, SD = 6.09) with a significant increase in $t(44)$ of −12.61 with a significant value. Table 4 shows the results of the difference in the average concept skills scores on the pretest and posttest in Experimental Group 2 (75% synchronous and 25% asynchronous).

Table 3. Differences between Mean Scores of Concepts Understanding Pretest and Posttest Scores in Experimental Group 1

Test	Mean	N	Std. Deviation	Std, Error Mean
Pretest A	61.89	45	10.35	1.54
Postest A	73.33	45	6.22	.93
Pretest B	70.83	42	8.829	1.36
Postest B	78.69	42	6.25	.96

Table 4. Paired Difference in Average Concept Skills Scores on Pretest and Posttest Scores in Experimental Group 2

Test	Paired Difference						
	Mean	Std. Deviation	95% Confidence Interval of the Difference		t	df	Sig
			Low	Up			
Pretes A Postes A	−11.44	6.09	−13.27	−9.62	−12.61	44	.000
Pretes B Postes B	−7.86	4.44	−9.24	−6.48	−11.48	41	.000

The results showed that there was a significant difference in students' mastery of concepts in network learning in Experimental Group 1 (25% synchronous and 75% asynchronous). The paired sample *t*-test resulted in a significant increase in mastery of the pretest and posttest concepts ($M = 7.86$, $SD = 4.44$) with a significant increase in $t(41)$ of –11.48 with a significant value at .000. The influence of students' mastery of concepts between network learning and self-efficacy in the inter-subject effect test was interpreted as the interaction between learning with network learning and self-efficacy toward students' mastery of concepts (see Table 5).

Table 5.
Test of Between-subject Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1433.539[a]	3	477.846	15.910	.000	.365
Intercept	494143.727	1	494143.727	16452.309	.000	.995
NL	441.458	1	441.458	14.698	.000	.150
SE	578.066	1	578.066	19.246	.000	.188
NL * SE	208.553	1	208.553	6.944	.010	.077
Error	2492.898	83	30.035			
Total	505375.000	87				
Corrected Total	3926.437	86				

This study was strengthened by the *F* value generated by partial eta squared for Network Learning (NL) and Self Efficacy (SE) of 0.338. Therefore, it could be categorized as having a strong interaction, which showed that this study fit the actual conditions (Alakurt & Bardakci, 2017; Ingleby, 2012; Sari & Jusar, 2018.). On the other hand, the Adjusted R2 value generated by the model was .342, which meant that NL and SE could be used to explain the alteration of the dependent variable on concept ability. This meant that 34.2% of the alteration of concept ability could be explained by network learning and self-efficacy variables. Based on the table, the statistical *F* value of 6.944 was significant at .05 for interaction variables. This showed that the null hypothesis was rejected without any interaction effect between network learning and self-efficacy assisted by concept skills. On the other hand, the hypothesis that there was an interaction effect between network learning and self- efficacy assisted by conceptual skills was accepted.

DISCUSSION

The results of our analysis of the students' ability to master the concept showed a significant difference between the pretest and posttest scores. This could be seen from the comparison of the paired illustration test results that related to the concept skills scores between the students of Experimental Group 1 and Experimental Group 2. The students in Experimental Group 2 showed a higher concept description score with 75% synchronous network and 25% asynchronous network learning compared to Experiment Group 1, which used 25% synchronous network education and 75% asynchronous network education. This is in accordance with the theory about the use of technological assistance in learning systems to replace the old paradigm in education in which paper is replaced by technology in a shift from conventional education to digital education modules (Papadakis & Kalogiannakis, 2019). Network learning in education had removed the limitations of space and time, thereby increasing students' motivation and conceptual skills (Papadakis & Kalogiannakis, 2019).

Our results show that online education had a considerable influence in improving students' conceptual mastery skills during the learning process. These results are consistent with Sural's research

(Sun & Chen, 2016), which reported that synchronous network education needs to be integrated into certain educational strategies, with further research needed to identify the effectiveness of teaching materials designed with network education features.

From the research that we carried out, network learning in synchronous and asynchronous modes involves network technology and interactions between students and their educators by participating in dynamic, two-way interactions throughout the learning process to achieve learning goals. This was in line with earlier research (Li et al., 2021; Peng & RuiWei, 2021; Tompson et al., 2020), which reported that prospective educators were very enthusiastic about managing education using network education. Meanwhile, Zhang et al. (2018), Çelikkanat and Malliaros (2021), and Xie et al. (2021) reported that the use of network education in several modules and other subjects affected the positive position of education participants, though shifting learning from conventional to technology was a challenge for integrating educators and students (Gibson, 2010; Papastergiou et al., 2011). This was because the use of technology and network features required them to have a different perspective on learning and teaching (Anders, 2018). Our study showed that the aspect of technical ability was very important for efficient time management, which is in line with Veletsianos and Kimmons (2012), who reported that the use of software for the development of daily routines made a major contribution to accelerating learning time and understanding participants' learning concepts.

Another empirical result obtained in our study was that students with high self-efficacy could manage education independently while understanding online features. This is in line with research conducted by Veletsianos and Kimmons (2012), which measured the main factors that influenced students' self-efficacy education in the online modality. In our study, we used a questionnaire created by Casidy and Eachus as an instrument to measure the level of self-efficacy of students in learning. This was in agreement with the research of Zhang et al. (2014) and Rohatgi et al. (2016), who reported that the significant influence of self-efficacy was in the area of elearning. Our study showed that conceptual skills depended on students' level of self-efficacy, which necessitated the online implementation of an efficient online education strategy (Martínez-Martí & Ruch, 2017). We used the results of the paired comparison test to identify the comparison of the level of conceptual ability of students with high and low self-efficacy changes. Our results are in line with Dike's (2012) research, which reported that students with high self-efficacy could learn independently, and therefore, their skills for successful online learning were greater (Skaalvik & Skaalvik, 2014).

CONCLUSIONS, SUGGESTIONS, AND LIMITATIONS

We conclude that network learning with a combination of synchronous and asynchronous settings has a positive impact on student learning that is attached to the methods used. By using combinatorial methods, students will not get tired of using monotonous methods, and good methods will be developed because the right combination of methods can be more effective. This combination of methods results in good interaction between students and peers, between students and teachers, and between students and learning resources. Our study demonstrates that the baseline learning performance of students who were taught using network learning in a combined synchronous and asynchronous setting was higher in Experimental Group 2 (75% synchronous and 25% asynchronous) than in Experimental Group 1 (25% synchronous and 75% asynchronous). Network learning increases students' self-efficacy of concept understanding and learning success and through collaboration between synchronous and asynchronous arrangements between teachers, students, and other educational practices, it can be further integrated and developed as an alternative learning approach. The learning process of socialization and development networks that combine synchronous and asynchronous attitudes can be done in forums for teachers teaching the same subject or in classroom training.

Further research needs to be undertaken on network learning with synchronous combination and asynchronous placement using different materials and courses. In addition, there is also a need for research on work that is applicable to LMS platforms. Synchronous combinations of student attitudes are an integral part of mixed developmental learning for students, while other variables that do not require synchrony (e.g., intelligence, interests, motivation, and self-concept effects) influence learning success.

Based on our direct experience in the research process in this study, we found some limitations and a number of factors that can be given more attention to future researchers. One of the limitations in our study was that the number of respondents was only 87 people. The research object only focused on network learning using Zoom, which is just one of many other synchronous and asynchronous applications for elearning. In the data collection process, the information provided by the respondents through the questionnaire sometimes did not actually show the opinion of the respondent. This happens sometimes because there are differences in the thinking process of, assumptions made by, and the different understanding of each respondent, as well as other factors such as honesty, all of which factor into the respondents filling out the questionnaire.

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