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The Effect of Blended Learning with Edmodo-Assisted Scientific Approach on Independence and Science Learning Outcomes

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Independence and science learning outcomes were observed to be lower due to the coronavirus disease (covid-19) outbreak. Therefore, this research aims to determine the effect of blended learning with an Edmodo-assisted scientific approach on students' independence and learning outcomes. The method used was quasi-experimental with a two-group pretest-posttest design. The population consisted of two different state junior high schools grade VIII in Medan City with 19 classes and a total of 590 students. The sample consisted of four classes with 121 students selected through simple random sampling from two schools. The experiment class was taught using blended learning with an Edmodo-assisted scientific approach, while the control class was taught using the conventional learning model. The learning independence was measured through a non-test in the form of a questionnaire with a likert scale consisting of 30 statements. Meanwhile, the learning outcomes in the cognitive domain were measured using a multiple-choice test with four options consisting of 20 valid questions. The Manova test and correlation analysis showed a significant effect of applying blended learning with the Edmodo-assisted scientific approach on independence and learning outcomes. It was also discovered that there is a positive relationship between students' independence and learning outcomes. This means a better learning independence has the ability to produce greater learning outcomes in studying substance pressure and its application in daily life material.

Keywords: blended learning, scientific approach, learning independence, learning outcomes, learning

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INTRODUCTION

Coronavirus disease-19 (covid-19) is a new disease that has hit the world and spreads out rapidly. The World Health Organization (WHO) has named the coronavirus as one of the world's pandemics because it spreads quickly and has killed a lot of people. To stop the spread of the virus, many countries, including Indonesia, have temporarily closed schools. Since the covid-19 outbreak at the beginning of 2020, face-to-face learning has been replaced by online learning (Eva et al., 2023; Setyowati et al., 2023; Adedoyin & Soykan, 2020; Ahied et al., 2020; Littenberg-Tobias & Reich, 2020; Rasmitadila et al., 2020; Setiati & Azwar, 2020).

During covid-19, learning that was carried out completely online had certain problems (Ariyani et al., 2023; Boonroungrut et al., 2022; Pribadi & Chung, 2022). Based on the observations and interviews at several junior high schools, problems found in science learning that students must face include: 1) the material being studied is limited; 2) many assignments given by the teacher make students stressed and lazy; 3) the scientific approach activities are not explored even though they are needed in science learning in accordance with the requirements of the 2013 curriculum and the nature and objectives of science itself; 4) lack of facilities, such as students not having cell phones and a limited internet quota; and 5) students are required to learn independently, but in fact students are getting lazy and bored because they have not interacted directly with teachers and peers for a long time. On the other hand, teachers also have several issues, such as; 1) the limitation of teaching materials studied due to limited time, the limitations in controlling and assessing students because some of the student's assignments are done by their parents, making difficulty for the teacher to assess; and 2) the use of technology in online learning, which commonly uses WhatsApp groups, which is limited in displaying features and file capacity sizes. The problem for parents of students is that they admit to having difficulty accompanying their children in learning. With the various issues mentioned above, online learning reduces independence and student learning outcomes.

The cases of low science learning outcomes are not only in Medan but also in other cities, as reported by Schneiderhan-Opel & Bogner (2020) in Germany, Costa & Araujo (2018) in the European Union, Chen et al. (2017) in Taiwan, Kadbey et al. (2015) in Abu Dhabi, and Omorogbe & Ewansiha (2013) in Nigeria. The trend was observed to be higher during the covid-19 pandemic (Rapanta et al., 2020; Rasmitadila et al., 2020; Martin et al., 2019) due to the limited ability of teachers to use technology-based media (Anthony, 2019; Fayanto et al., 2019). Teaching science to students is a challenging and complicated process (Fleischner et al., 2017; Kadbey et al., 2015; Omorogbe & Ewansiha, 2013). It was reported that the learning process has not been mastered effectively, with students not having a better understanding of science concepts (Gathong & Chamrat, 2019), thereby reducing their motivation to learn (Pratama et al., 2020; Reimers et al., 2020). Another reason for the low outcome is the limited ability of teachers to use varied learning models (Le et al., 2018). Besides, teachers must be aware that science learning often involves the fundamental knowledge that has been brought by students (Arends, 2009).

Based on the various problems found, since the beginning of October 2021, there has been a decrease in the spread of the covid-19 virus and supported by increasing public interest in resuming face-to-face learning, it is necessary to do blended learning (BL). Blended learning (BL) is the use of technology to combine online and offline learning (Horn & Staker, 2015; Thorne, 2003). Combining offline learning with online learning results in a unity of learning that can overcome time constraints (Suprihatin et al., 2022; Humaira & Hurriyah, 2018). Offline learning will cover the shortcomings of online learning in the form of a lack of direct interaction between teachers and students, and students and other students (Suprihatin et al., 2022). Integrating offline and online learning helps students to improve their experience, especially learning using ICT, and is more likely to explore the scientific approach (Suprihatin et al., 2022).

We believe that those issues can be overcome by applying BL due to several reasons below: (1) it fosters and optimizes learning interactions; 2) it assists teachers in explaining science material, which is a lot and complex because it is equipped with teaching materials, experiment-based worksheets, and media in the form of videos, pictures, animations, simulations, and quizzes; (3) it is possible to apply a scientific approach because students are allowed to carry out scientific investigations; (5) it is flexible and more economical; and (6) it trains students to learn independently, which can affect their learning outcomes.

Independent learning is an active and constructive process in which students set learning goals and try to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by the goals as well as the contextual features of their environment (Jansson & Ene, 2016; Schunk, 2012). Moreover, the existence of encouragement and desire from within leads students to be successful in their learning (Pribadi & Chung, 2022).

One of the applications used to improve the quality of BL is Edmodo, which is an example of a learning management system (LMS) designed for teaching and education activities. It is in the form of an application or web-based social network that is free and safe to assist teachers in designing virtual classrooms (Danver, 2016; Al-Kathiri, 2015). Edmodo has a lot of features (Sayfouri, 2016). LMS-Edmodo was chosen in this study because it is a social networking-based application or web, free and safe, can display simpler features, provide broader information, and can involve parents in monitoring their children's learning progress compared to the other LMS. Kasani and co-workers (Kasani et al., 2020) found that there are several issues with using LMS including the internet network system not good, making teachers and students unable join the LMS class, teachers not having enough time to control students during the learning process, and some students not taking part in learning. Meanwhile, according to the research done by Rawashdeh et al, (2021), there are difficulties for students who are using the LMS for the first time and a lack of time availability, so it requires more time.

Based on the explanation above, the aims of this study are: 1) to determine the effect of applying BL with a scientific approach assisted by LMS-Edmodo on student independence and learning outcomes; 2) to determine the relationship between

independence and science learning outcomes; and 3) to find out the increase in learning independence and science learning outcomes by using LMS-Edmodo.

METHOD

Research Design

This research employed a quasi-experiment to examine the impact of BL with a scientific approach utilizing LMS-Edmodo on student autonomy and science learning results. The research was conducted in two Medan junior high schools. This study was conducted at the eighth grade during the even semester of the academic year 2021-2022. The study was conducted in six meetings on the subject of the pressure of matter substances and their application in daily life, which consists of six sub-topics (solid pressure; liquid pressure; Archimedes' law; Pascal's law; gas pressure; and the application of the pressure of substances in daily life.

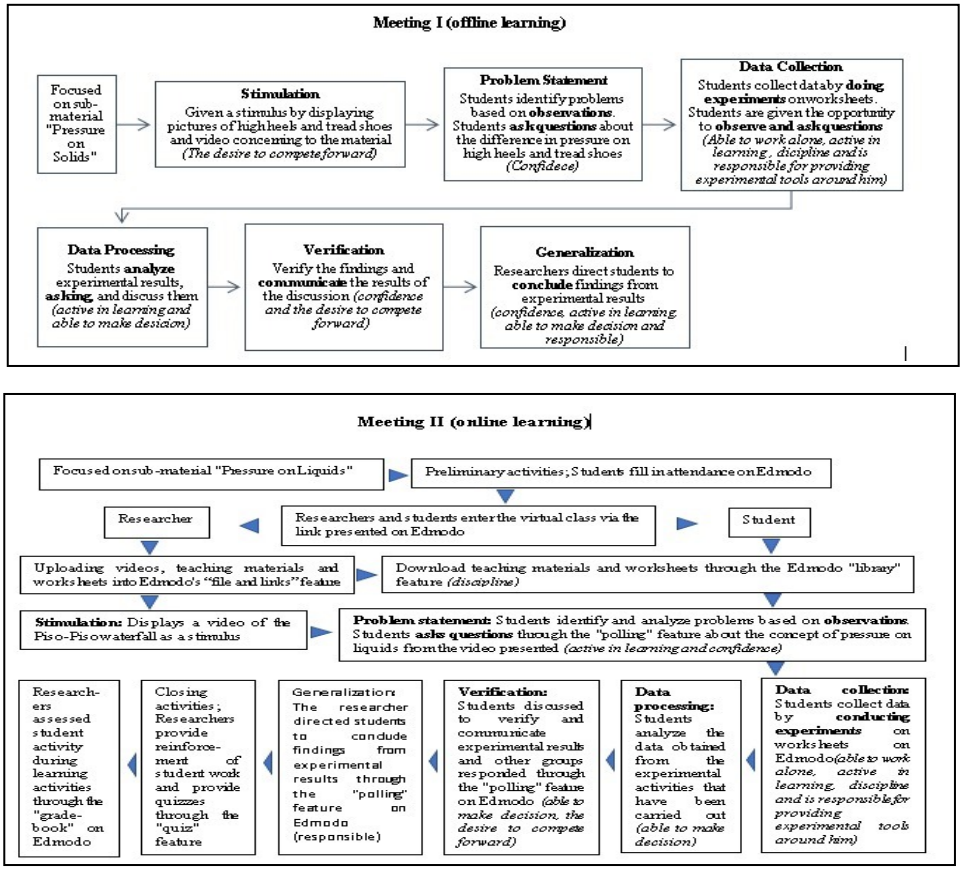


Figure 1
Blended learning (Offline and Online)

These are the features of LMS-Edmodo: 1) Group to construct a class with the code "hidcfp"; 2) A location for student attendance for homebound students. 3) Gradebook, used by teachers to oversee assessment of student learning outcomes 4) Award badges, using this function to recognise students or groups; 5) Assignment, utilised by teachers to assign work (may take the form of brief description questions or essays, animations, simulations, and facts; 7) Quiz, used to administer daily examinations; 8) Polls, a discussion room used by teachers to gather student opinions on material and non-material topics; and 9) Parental code, which allows parents to participate in monitoring their children's actions and accomplishments.

The experimental class combines the use of BL with an Edmodo-assisted scientific method using discovery learning syntax, whereas the control class uses conventional learning. During each meeting, students were instructed to undertake experiments employing a scientific method. Lesson plans, experiment-based student worksheets, instructional materials, media (videos, photos, animations, and simulations), quizzes, and assessments are the learning resources developed for BL. The first, fourth, and sixth meetings involve offline learning, while the second, third, and sixth meetings are conducted online. Figure 1 depicts the offline and online implementations.

Sample/Participants/Group

The research population consisted of 590 students in 19 class VIII of two different Junior High Schools in Medan City. Samples were selected from each school with the same representative characteristics using a simple random sampling technique. It is important to note that two classes were formed in each school which includes the experimental and the control with a total of 121 students. The experimental class was taught through blended learning with a scientific approach assisted by Edmodo while the control class was taught using the conventional method. The two-group pretest-posttest research design is presented in Figure 1

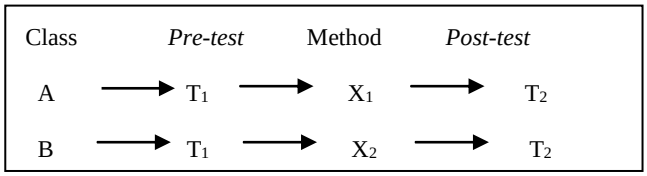


Figure 2
Two group pretest-posttest design

Description:
T_1 : *Pretest*
T_2 : *Posttest*
X_1 : Application of blended learning with an Edmodo scientific approach
X_2 : Conventional learning

Instrument and Procedures

The instruments used are non-test and test. The non-test instrument is a questionnaire to measure learning independence using a Likert scale with choices of strongly agree, agree, disagree, and strongly disagree. Moreover, the learning independence variable has 30 statements guided by seven indicators which include confidence, ability to work alone, ability to make decisions, responsible, desire to compete forward, discipline, and active in learning (Arista & Kuswanto, 2018; Jansson & Ene, 2016). Learning independence questionnaires were given to students before and after applying LMS-Edmodo in experiment classes and conventional learning in control classes. The grids of the self-study questionnaire instruments used are shown in Table 1.

Table 1
Independence questionnaire instrument grid

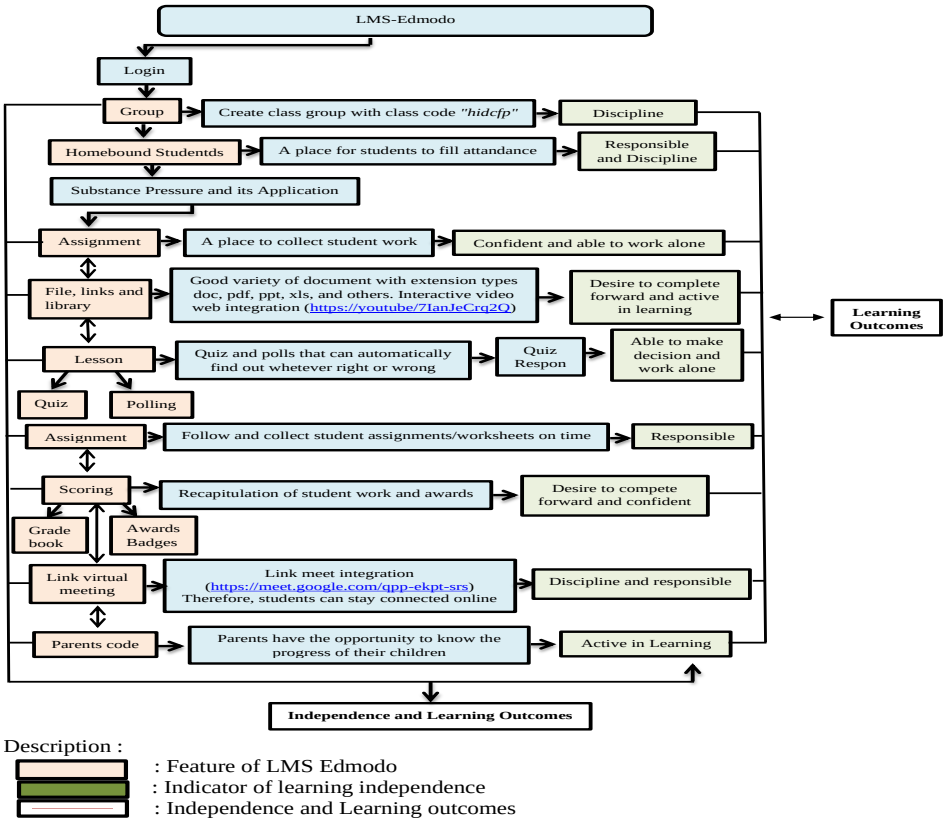
Variable	Indicator	Observed Aspects	Total
Learning independence	Confidence	Dare to express opinions during the learning process Confident in personal abilities Dare to interact with friends in discussion activities and solve problems	6
	Able to work alone	Doing tasks without being ordered by others Complete tasks without asking for help from others Satisfied with the results obtained	6
	Able to make decisions	Able to solve personal problems Be careful in making decisions	3
	Responsible	Dare to admit mistakes and accept risks Complete the assigned tasks on time	4
	The desire to compete forward	Have curiosity Have high creativity	4
	Discipline	Follow lessons on time Do not procrastinate work	4
	Active in learning	Providing personalized textbooks Dare to make conclusions based on the explanation of the material	3
Total			30

The test instrument used to determine the student learning outcomes in the cognitive domain is a multiple-choice test consisting of 20 questions with cognitive domains of C1 (remember), C2 (understanding), C3 (apply), C4 (analyze), C5 (evaluate), and C6 (create) (Anderson & Krathwohl, 2001). The tests used are valid (content validation (which is validated by experts) and predictive validity). Reliability test learning outcomes of 0.92 (very high category). The grid of learning outcomes test instruments is presented in Table 2. Learning outcomes tests were given to students before and after the application of LMS-Edmodo in experiment and conventional classes in control classes.

Table 2
Learning outcome test instrument grid

No	Sub Subject	Cognitive Realm						Total
		C1	C2	C3	C4	C5	C6	
1.	Solid Pressure	1	9	6	2	-	5	5
2.	Liquid Pressure	3	11	-	7	4	-	4
3.	Archimedes' law	-	15	-	-	8	10	3
4.	Pascal's Law	-	-	12	13	-	-	2
5.	Gas Pressure	-	16	17		14	-	3
6.	Application of Substance Pressure in Daily Life	-	19	-	18	-	20	3
Total		2	5	3	4	3	3	20

The flowchart of the application of BL with an Edmodo-assisted scientific approach to independence and learning outcomes is presented in Figure 3.



Description :
: Feature of LMS Edmodo
: Indicator of learning independence
: Independence and Learning outcomes

Figure 3
Flowchart to apply BL with the LMS-Edmodo scientific approach to independence and learning outcomes

FINDINGS

The sample consists of four classes from two junior high school grade VIII (School A and School B). Students in experiment and control classes were first given pretests to measure independence and learning outcomes before treatment. Pretest data for both schools is presented in Table 3.

Table 3
Initial data on students' independence and learning outcomes

Variable	School A				School B			
	Class	N	Mean	Standard Deviation	Class	N	Mean	Standard Deviation
Independent Learning	Control	31	38.7	6.2	Control	29	39.0	6.1
	Experiment		35.2	4.8	Experiment	30	35.6	4.5
Learning outcomes	Control		43.4	8.7	Control	29	40.7	10.7
	Experiment		41.3	10.0	Experiment	30	40.0	10.5

N = number of students who participated in the initial test

Based on the data presented in Table 3, the average results of the pretest independence and learning outcomes in schools A and B of the experiment and control classes are similar which have been analyzed using the Manova test with the help of SPSS version 20 are presented in Table 4.

Table 4
Summary of MANCOVA data pretest results on independence and learning outcomes

Effect	School A				School B			
	value	Hypothesis df	Eror df	Sig.	value	Hypothesis df	Eror df	Sig.
Pillai's Trace	.093	2.000	59.000	.056	.084	2.000	56.000	.084
Wilks' lambda	.907	2.000	59.000	.056	.916	2.000	56.000	.084
Hoteling's Trace	.103	2.000	59.000	.056	.092	2.000	56.000	.084
Roy's largest Root	.103	2.000	59.000	.056	.092	2.000	56.000	.084

The Manova test was used to examine the similarity between the effects of experiment and control classes on students' independence and learning outcomes by comparing the values of Sig. from Pillai's Trace, Wilks' Lambda, Hoteling's Trace, and Roy's Largest Root to the level of significance. It was discovered that the class effect value obtained is greater than the significance level (α=0.05). This means the students in the experiment and control classes of the two schools had the same initial independence and learning outcomes. Moreover, a post-test was conducted after the treatments were applied, and the results are presented in the following Table 5.

Table 5
Posttest data on independence and learning outcomes

Variable	School A			School B			
	Class	Mean	Standard Deviation	Class	N	Mean	Standard Deviation
Independent Learning	Control	70.8	9.4	Control	29	71.7	7.1
	Experiment	80.9	6.3	Experiment	30	81.1	5.5
Learning outcomes	Control	68.2	7.8	Control	29	72.7	7.1
	Experiment	83.5	7.3	Experiment	30	86.3	6.8

The post-test data were analyzed using the MANCOVA test to examine the effect of applying the blended learning approach on students' independence and learning outcomes using IBM SPSS version 22.0. The results presented in Table 6 showed a class effect of 0.000 or less than 0.05 as indicated by four p-values < 0.05. It can be concluded that there is a significant effect of the application of BL on the independence and learning outcomes of students in school A and school B. In other words, the application of BL with an Edmodo-assisted scientific approach is better for the independence and learning outcomes of students compared to the conventional learning.

Table 6
Summary of Manova data posttest results on independence and learning outcomes

Effect	School A				School B			
	value	Hypothesis df	Error df	Sig.	Value	Hypothesis df	Error df	Sig.
Pillai's Trace	.533	2.000	59.000	.000	.530	2.000	56.000	.000
Wilks' lambda	.467	2.000	59.000	.000	.470	2.000	56.000	.000
Hotelling's Trace	1.139	2.000	59.000	.000	1.127	2.000	56.000	.000
Roy's largest Root	1.139	2.000	59.000	.000	1.127	2.000	56.000	.000

Table 7
Percentage of increase in N-gain independence and learning outcomes

Variable	Class	School A				School B			
		Initial Test Average	Final Test Average	N-gain (%)	Category	Initial Test Average	Final Test Average	N-gain (%)	Category
Independent Learning	Control	38.7	70.8	53	moderate	39.0	71.7	54	moderate
	Experiment	35.2	80.9	71	high	35.6	81.1	71	high
Learning outcomes	Control	43.4	68.2	44	moderate	40.7	72.7	54	moderate
	Experiment	41.3	83.5	72	high	40.0	86.3	77	high

The percentage increase in normalized gain (N-gain) of independence and student learning outcomes in both schools is presented in Table 7, which shows that the percentage increase in N-gain independence and learning outcomes in both schools in

the experiment class is higher than the control class. The percentage increase in N-gain of students ' learning independence per indicator for each sample is presented in Table 8. The percentage increase in N-gain of learning outcomes per indicator is presented in Table 9.

Table 8
Percentage of N-gain increase in learning independence per indicator

Indicator	School A						School B					
	Experiment Class		N-gain (%)	Control Class		N-gain (%)	Experiment Class		N-gain (%)	Control Class		N-gain (%)
	Pretest	Post-test		Pre-test	Post-test		Pre-test	Post-test		Pretest	Post-test	
self-confident	28.7	80.2	72	35.9	67.3	49	28.8	77.9	68	34.8	67.7	50
able to work alone	47.6	77.4	57	44.4	67,9	42	40.8	77.7	62	42.2	74.0	55
able to make decisions	35.5	80.6	70	42.5	71,8	50	35.2	79.2	68	39.2	64.4	41
responsible	38.3	84.5	75	39.5	73,0	55	38.3	83.5	73	41.8	73.7	54
desire to complete forward	30.0	80.1	73	31.9	73,8	61	34.8	84.8	76	38.6	71.6	53
discipline	28.5	82.3	75	42.7	74,6	55	33.9	85.0	77	42.7	70.7	48
active in learning	35.5	82.8	73	32.0	71,0	57	37.7	82.2	71	32.2	81.9	73

Table 9
Percentage of N-gain increase in learning outcomes per indicator

Indicator	School A						School B					
	Experiment Class		N-gain (%)	Control Class		N-gain (%)	Experiment Class		N-gain (%)	Control Class		N-gain (%)
	pretest	post-tets		pre-test	post-tets		pre-test	post-test		pretest	post-test	
C1	39	84	71	45	83	70	40	88	78	38	74	44
C2	40	86	76	49	68	38	30	85	78	37	72	43
C3	49	84	68	42	75	57	49	82	65	41	86	52
C4	41	84	73	47	69	40	48	92	83	44	76	46
C5	42	82	69	43	62	34	39	84	74	49	70	30
C6	37	82	71	33	57	36	38	88	80	36	60	23

The relationship between students' independence and learning outcomes was analyzed using the Pearson product-moment, and the results are presented in Table 10. The findings showed a positive correlation between independence and learning outcomes, as indicated by the correlation coefficient of 0.563 in School A, which is in the medium category, and the R^2 linear value of 0.317. A similar pattern was found in School B, with a value of 0.717, which is in the high category, and R^2 linear value of 0.515. This means the higher the value of learning independence, the higher the learning outcomes obtained, as indicated in the graphs presented in Figures 4a and 4b.

Table 10
Correlation of student independence and learning outcomes

		School A		School B	
		Learning Independence	Learning Outcomes	Learning Independence	Learning Outcomes
Learning Independence	Pearson Correlation	1	.563**	1	.717**
	Sig. (2-tailed)		.000		.000
	N	62	62	59	59
Learning Outcomes	Pearson Correlation	.563**	1	.717**	1
	Sig. (2-tailed)	.000	.000		
	N	62	62	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

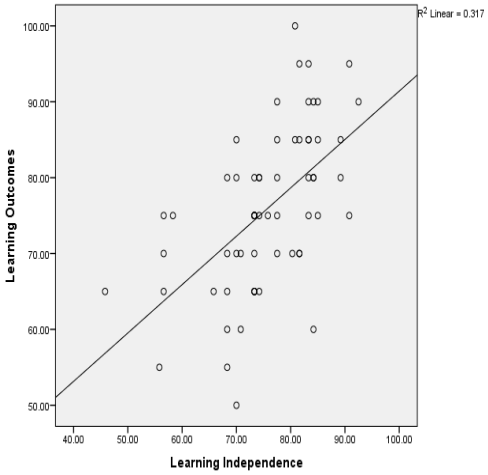


Figure 5a.
Correlation of independence with learning outcomes for School A

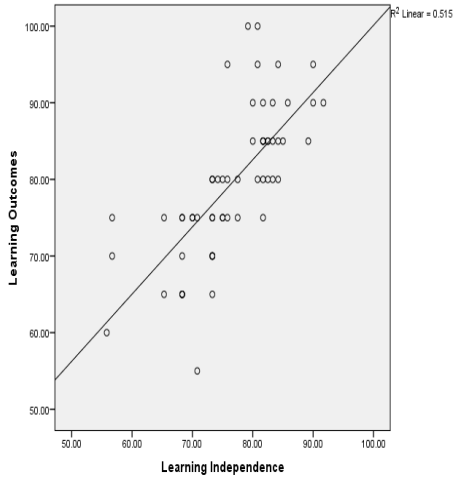


Figure 5b.
Correlation of independence with learning outcomes for School B

DISCUSSION

Based on the research that has been done, there is a significant effect of the application of BL with an Edmodo-assisted scientific approach to independence and student learning outcomes, and there is a positive relationship between independence and student learning outcomes. This is supported by Sukatin et al. (2023) and Puspitasari & Dewi (2021), who found that the application of BL during the pandemic could increase student learning independence. Puspitasari & Dewi (2021) found that the independence could be explored in the aspect of giving a response. According to Sari et al.(2017), who found that by using LMS, students are increasingly active, interactive, innovative, fun, challenging, and motivated so as to maximize independence and learning outcomes.

Each meeting uses discovery learning with the syntax of stimulation, problem statement, data collection; data processing; verification; and generalization. First, students will be

introduced and create Edmodo accounts. The first learning occurs offline, which is outlined in Figure 1. Researchers provide a stimulus by showing a video of several phenomena, including images of two shoes with different treads, one with a pointed tread and another with a flat tread; both shoes are pressing on moist soil. Students identify problems, conduct experiments, and make conclusions from their findings. This activity directed students to observe, ask, try, analyze data, and communicate (scientific approach).

Some students have yet to be present at the first meeting, and some are late. When students collect data from investigation activities through experiments, most of the students show interest and get involved in observing, questioning, trying, and analyzing. However, in communicating the findings, some students still do not dare to express their opinions, so the discussion activities have yet to run smoothly. This is due to their lack of confidence because they have not gotten used to the new atmosphere. The tasks collected need to be in accordance, and the quiz results need to be higher. In the first meeting, the independence of student learning was still less explored. Based on the concept of the material studied, most students still incorrectly conclude their findings.

The second and third meetings were conducted online using the LMS-Edmodo and virtual meetings through Google Meet. Students sign in to the Edmodo by entering a username and password and then filling out the attendance list on the homebound students feature. Researchers show a short video about the beauty of the waterfall Sipiso-Piso (waterfall in the area where students live) with a video link https://youtu.be/BVvRPEN1GdU. The researcher asked the question: "When traveling to the Sipiso-piso waterfall, you see the water is the result of other river water reservoirs. The river has a channel section that narrows in certain areas. When the water touches your skin, how do you feel?" Furthermore, the students are directed and guided to dig up information from any source, such as teaching materials, worksheets, and media available in the library feature. Each student is directed to do an experiment individually by using simple experimental tools that can be found around to investigate the factors that affect the magnitude of pressure on the liquid. Students do the discussion session on the polling feature and continued with presentations through virtual meetings. At the end of the lesson, students take the quiz and are reminded to complete the tasks available in the assignment feature. At the second meeting, the independence and student learning outcomes were better than the first meeting. This is because students are increasingly interested because they can explore information from various sources and are motivated and enthusiastic to learn since this is a new thing for students.

The learning process at the third and sixth meetings online is not much different from the second meeting. Learning at the fourth and fifth meetings were carried out offline, and the stages of learning were the same as the first meeting. At each meeting, the independence and student learning outcomes are increasingly explored. Based on the polling feature, the percentage of students active in discussion activities is increasing for each meeting. The more students dare to express their opinions, the more confident they are in their abilities because, at the beginning, they have learned the material first and reinforced it with findings from the results of their investigations through experiments.

The discussion session also runs well; students compete to answer every question from other groups and teachers, and the answers given are precise and quality. This is reinforced by the increasing quiz results, the more often students answer, the better the quiz results.

Students are also increasingly disciplined to obey the rules and be present on time, whether in offline or online learning. Based on the assignment feature, students complete and collect tasks on-time, and from the homebound students feature, the percentage of student attendance is increasing and on time, which never happened during the pandemic. Student discipline is also seen when conducting real experiments in class, including the orderly use of experimental tools and materials and cleaning up after using them. Students' cooperation is also getting better; they are used to sharing tasks, sharing experiences in facing and solving problems, and discussing them to make decisions together. This is in line with the findings of Bradley (2021), who found that LMS can improve collaboration, discussion, and communication and help the process of problem solving and decision making. According to Nasrullah *et al*., (2021), LMS-Edmodo facilitates student collaboration and communication between students, teachers, and student-students, so that interaction in the classroom is unlimited.

Students are also becoming increasingly responsible, characterized by doing tasks for routine or pleasure without being reminded and collecting the tasks on time, as can be seen from the assignment feature. Students also have the courage to admit their mistakes and are willing to accept punishment. This is evident when students do real experiments in the classroom; when the students litter the classroom, they responsibly sweep it. Students are increasingly enthusiastic to learn because they feel interested in learning using the LMS-Edmodo. This affects their learning outcomes, as can be seen from the results of the investigation. Based on the findings, students can conclude that "the smaller the cross-sectional area, the greater the pressure on the object, and vice versa". This is supported by Sari et al. (2017) and Kasim & Khalid (2016), who stated that utilizing LMS as a media for learning, communication, and productivity can improve the learning quality, which can affect student performance, students can learn the material first so that it is more easily to be understood before being taught by teachers, which affects their learning outcomes. The use of technology can affect learning outcomes by increasing students' interest (Fitriyana et al., 2020; Ceylan & Kesici, 2017). The learning process is more effective and efficient because it combines various types of methods, media, and learning resources that are more varied. There is no need to wait for the teacher to teach, and the learning is more flexible because it can be used anytime and anywhere. This is supported by Harahap et al. (2019), who found that some of the advantages of online learning are (1) The flexibility of time and places; (2) the various and plentiful of learning resources; and (3) learning is more colorful.

The application of BL makes students more confident and daring to express their opinions during the learning process. The confidence in their abilities increases as they interact with their group, other groups and teacher, especially in solving problems. When students solve a problem, they are confidently to make a decision about best solution. Their confidence also increases during the discussion because of their belief in

the correctness of the concepts. Students are increasingly active in learning because they take advantage of the teaching materials and media available in the library feature, and student activity is also supported by their parents. Parents can monitor the child's development according to the parents' code feature, which also increase the student's responsibility.

Students have to download and study learning materials before joining the online or offline class, and they are also looking for information from other sources on the internet. Individually and in groups, students are able to work alone to do experiments by following the steps on the worksheet. Students try to take a scientific approach by observing, asking questions in discussion forums, collecting and analyzing data, and sharing their findings. The conclusions obtained by students are also getting better and more precise because students can actually find and construct their knowledge related to science concepts based on the results of their findings, which affect their learning outcomes. This is in accordance to Husain et al. (2017), who stated that LMS is means to produce learners to become independent and excellent in obtaining information. At the fourth meeting, 87% of students were able to do the quiz correctly and faster than before. In every meeting, we hold a quiz, and the results are constantly improving. This also occurs because the award badge feature helps teachers to award students who have done quizzes and tasks excellently and been on time. Students are very enthusiastic about participating in experiments to satisfy their curiosity. They are more orderly, responsible, and careful in conducting experiments. This happens because of their desire to compete. Independence and student learning outcomes are improving because using a scientific approach to learning gives students the opportunity to get real-world experience by doing it themselves, following the process, observing objects, collecting and analyzing, and drawing a conclusion about the process that they experienced. According to Yurt (2014) proves that real experience through real experiments with a scientific approach can increase student confidence and build their understanding. Students who have increased confidence in learning will be encouraged to learn and do challenging tasks (Uzuntiryaki, 2008). (Uzuntiryaki, 2008).

Every student always uses learning media available in the library, such as video, animation, and simulation. Media is beneficial for students because it can make it easier for them to do experiments, and students also seem more enthusiastic, active, motivated, and able to work alone. This is supported by Martin (2005), who found that video is helpful for online learning activities, especially in creating interaction between teachers and students. Simulation media can help students quickly understand the concept of science because it can concretize abstract concepts, activities can be repeated, and it increases creativity and problem-solving ability (Simanjuntak et al., 2021).

Unlike the experiment class, in the control class with conventional learning, students are more passive in responding to a problem or question. This is because students tend to feel afraid to express opinions, ask questions, or give responses; this is seen when given a question, none of the students answered unless appointed. The learning process is teacher-centered, there is no scientific activity, and the media that is used whiteboards and WhatsApp, causing students to feel bored and not have the desire to learn, which

reduces their learning independence and their learning outcomes. The percentage of N-gain in learning independence with the application of BL in school A is 71% (high category), and the learning outcomes are 72% (high category). Meanwhile, the increase for the conventional method was found to be 53% and 44% (medium category). It was discovered that the percentage increase for independence and learning outcomes in school B was found to be 71% and 77% (high category), while in conventional learning, the increase in N-gain independence and learning outcomes was found to be 54% and 54% (medium category). The percentage of increase in N-gain independence and learning outcomes of students in the experiment class was higher than the control class, so it can be concluded that the increase in student learning independence of the application of BL with a scientific approach assisted by LMS-Edmodo in both schools was high.

Independence and learning outcomes in conventional learning also increased, although not as much as in the application of blended learning. The learning process is teacher-centered; students' learning independence is demanded; students also tend not to do and collect tasks, and if they do collect tasks, they mostly copy them. The improvement of learning outcomes for conventional grade students is better on the application of mathematical formulas (C3), while in terms of analysis (C4), evaluating (C5), and creating (C6), it is very low.

The application of BL in science learning using the Pearson product moment correlation test (R) in school A is 0.563 in the medium category and in school B is 0.717 in the high category. There is a positive relationship between independence and student learning outcomes. In other words, as students increase their independence, their learning outcomes will also increase significantly with the application of BL using a scientific approach using LMS-Edmodo.

BL that combines offline and online learning through Edmodo is proven to have an effect on student independence and learning outcomes. Students who have high self-confidence will be able to communicate their opinions and obstacles so that they can find solutions to them. Students who have learned independence have high discipline by trying to be on time, do tasks, pay attention, and be diligent and orderly at every meeting. Students have the self-awareness to dig up information from various sources, do tasks, quiz, and actively join in discussion sessions. Students who have good learning independence are aware of the consequences of their actions and have the desire to compete forward to gather information from various sources, such as the LMS-Edmodo or other sources.Students who have learned independence also have good self-confidence, which can be seen in their ability to express their opinions through chat and discussion forums.

Constraints faced by researchers in this study include the lack of supervision by parents because they are not familiar with online learning.

CONCLUSIONS

1) The application of blended learning with a scientific approach, assisted by LMS-Edmodo, has a significant effect on student independence and learning outcomes.

Independence and science learning outcomes of students in the application of blended learning are better than conventional science learning on material substance pressure and its application in daily life.

2) There is a positive relationship between student independence and learning outcomes. In other words, the higher the learning independence, the better the learning outcomes.
3) The percentage increase in N-gain independence of learning with the application of LMS-Edmodo in schools A and B is 71% (high category), while conventional learning in school A is 53% and in school B is 54% (medium category). The percentage of N-gain learning outcomes with the application of LMS-Edmodo in school A is 72% and in school B is 77% (high category), while the conventional learning in school A is 44% and in school B is 54% (medium category).

IMPLICATIONS AND SUGGESTIONS

The findings of this study can influence how technology that combines online and offline learning is used to aid in the education of individuals. This can be a consideration for policymakers and related parties implementing a learning system in the form of blended learning that can optimize interaction, participation, and involvement of students to be more active, more flexible, save costs and time, provide opportunities for students to engage in scientific, collaborative activities, increase student satisfaction, and involve the role of parents in order to train students to learn independently, which can have an effect on the learning outcomes of students. Schools that wish to implement blended learning must have the necessary facilities and infrastructure, and teachers must be able to use the technology for learning activities. In addition, the school must disseminate its policies to parents and students so that parents and students are prepared.

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REFERENCES

Adedoyin, O. B., & Soykan, E. (2020). COVID-19 pandemic and online learning: the challenges and opportunities. *Interactive Learning Environments*, *0*(0), 1–13. https://doi.org/10.1080/10494820.2020.1813180

Ahied, M., Muharrami, L. K., Fikriyah, A., & Rosidi, I. (2020). Improving students' scientific literacy through distance learning with augmented reality-based multimedia amid the COVID-19 pandemic. *Jurnal Pendidikan IPA Indonesia*, *9*(4), 499–511. https://doi.org/10.15294/jpii.v9i4.26123

Al-Kathiri, F. (2015). Beyond the classroom walls: Edmodo in saudi secondary school EFL instruction, Attitudes and challenges. *English Language Teaching*, *8*(1), 189–204. https://doi.org/10.5539/elt.v8n1p189

Anthony, E. (2019). (Blended) Learning: How Traditional Best Teaching Practices Impact Blended Elementary Classrooms. *Journal of Online Learning Research*, *5*(1), 25-48.

Arends, R. I. (2009). *Learning to Teach Ninth Edition* (9th ed.). The McGraw-Hill Companies.

Arista, F. S., & Kuswanto, H. (2018). Virtual physics laboratory application based on the android smartphone to improve learning independence and conceptual understanding. *International Journal of Instruction*, *11*(1), 1–16. https://doi.org/10.12973/iji.2018.1111a

Ariyani, F., Fuad, M., Suyanto, E., & Muhammad, U. A. (2023). Lampung Language Online Learning during the COVID-19 Outbreak: How are the Teacher's TPACK Skills? *International Journal of Instruction*, *16*(1), 311–332. https://doi.org/10.29333/iji.2023.16118a

Boonroungrut, C., Saroinsong, W. P., & Thamdee, N. (2022). Research on students in COVID-19 pandemic outbreaks: A bibliometric network analysis. *International Journal of Instruction*, *15*(1), 457–472. https://doi.org/10.29333/iji.2022.15126a

Bradley, V. M. (2021). Learning Management System (LMS) Use with Online Instruction. *International Journal of Technology in Education*, *4*(1), 68. https://doi.org/10.46328/ijte.36

Ceylan, V. K., & Kesici, A. E. (2017). Effect of blended learning to academic achievement. *Journal of Human Sciences*, *14*(1), 308. https://doi.org/10.14687/jhs.v14i1.4141

Chen, C. H., Huang, C. Y., & Chou, Y. Y. (2017). Integrating augmented reality into blended learning for elementary science course. *ACM International Conference Proceeding Series*, 68–72. https://doi.org/10.1145/3029387.3029417

Costa, P. D. da, & Araujo, L. (2018). Quality of teaching and learning in science. In *Joint Research Centre (JRC)*. https://doi.org/10.2760/8605

Danver, S. L. (2016). The SAGE Encyclopedia of Online Education. *The SAGE Encyclopedia of Online Education*, 916–925. https://doi.org/10.4135/9781483318332

Eva, N., Hutagalung, F. D., Peng, C. F., & Zaid, S. M. (2023). Self-Regulated Learning in COVID 19 Pandemic: A Comparative Study between Indonesia and Malaysia. *International Journal of Instruction*, *16*(1), 625–642. https://doi.org/10.29333/iji.2023.16135a

Fayanto, S.-, Kawuri, M. Y. R. T., Jufriansyah, A., Setiamukti, D. D., & Sulisworo, D. (2019). Implementation E-Learning Based Moodle on Physics Learning in Senior High School. *Indonesian Journal of Science and Education*, *3*(2), 93. https://doi.org/10.31002/ijose.v3i2.1178

Fitriyana, N., Wiyarsi, A., Ikhsan, J., & Sugiyarto, K. H. (2020). Android-based-game and blended learning in chemistry: Effect on students' self-efficacy and achievement. *Cakrawala Pendidikan*, *39*(3), 507–521. https://doi.org/10.21831/cp.v39i3.28335

Fleischner, T. L., Espinoza, R. E., Gerrish, G. A., Greene, H. W., Kimmerer, R. W., Lacey, E. A., Pace, S., Parrish, J. K., Swain, H. M., Trombulak, S. C., Weisberg, S., Winkler, D. W., & Zander, L. (2017). Teaching Biology in the Field: Importance, Challenges, and Solutions. *BioScience*, *67*(6), 558–567. https://doi.org/10.1093/biosci/bix036

Gathong, S., & Chamrat, S. (2019). The implementation of science, technology and society environment (STSE)-based learning for developing pre-service general science teachers' understanding of the nature of science by empirical evidence. *Jurnal Pendidikan IPA Indonesia*, *8*(3), 354–360. https://doi.org/10.15294/jpii.v8i3.19442

Harahap, F., Nasution, N. E. A., & Manurung, B. (2019). The effect of blended learning on student's learning achievement and science process skills in plant tissue culture course. *International Journal of Instruction*, *12*(1), 521–538. https://doi.org/10.29333/iji.2019.12134a

Horn, M. B., & Staker, H. (2015). *Blended: Using Disruptive Innovation to Improve Schools*. Jossey-Bass A Wiley Imprint.

Humaira, S. A., & Hurriyah, I. A. (2018). *Students' Perspectives towards Self-Directed Learning out of Classroom*. *January*. https://doi.org/10.2991/iconelt-17.2018.2

Husain, K., Wahab, P. A., Ilias, M. F., Mohd Pisol, M. I., & Muhammad, F. H. (2017). *Learning Management System Towards Learner's Independent Learning*. *149*(Icest), 155–157. https://doi.org/10.2991/icest-17.2017.52

Jansson, I., & Ene, K. W. (2016). Nursing students' evaluation of quality indicators during learning in clinical practice. *Nurse Education in Practice*, *20*, 17–22. https://doi.org/10.1016/j.nepr.2016.06.002

Kadbey, H., Dickson, M., & McMinn, M. (2015). Primary Teachers' Perceived Challenges in Teaching Science in Abu Dhabi Public Schools. *Procedia - Social and Behavioral Sciences*, *186*, 749–757. https://doi.org/10.1016/j.sbspro.2015.04.055

Kasani, H. A., Mourkani, G. S., Seraji, F., & Abedi, H. (2020). Identifying the Weaknesses of Formative Assessment in the e-Learning Management System. *Journal of Medical Education*, *19*(2). https://doi.org/10.5812/jme.108533

Kasim, N. N. M., & Khalid, F. (2016). Choosing the right learning management system (LMS) for the higher education institution context: A systematic review. *International Journal of Emerging Technologies in Learning*, *11*(6), 55–61. https://doi.org/10.3991/ijet.v11i06.5644

Le, H., Janssen, J., & Wubbels, T. (2018). Collaborative learning practices: teacher and student perceived obstacles to effective student collaboration. *Cambridge Journal of Education*, *48*(1), 103–122. https://doi.org/10.1080/0305764X.2016.1259389

Littenberg-Tobias, J., & Reich, J. (2020). Evaluating access, quality, and equity in online learning: A case study of a MOOC-based blended professional degree program. *Internet and Higher Education*, *47*(July). https://doi.org/10.1016/j.iheduc.2020.100759

Martin, F., Budhrani, K., Kumar, S., & Ritzhaupt, A. (2019). Award-winning faculty online teaching practices: Roles and competencies. *Online Learning Journal*, *23*(1), 184–205. https://doi.org/10.24059/olj.v23i1.1329

Martin, M. (2005). Seeing is believing: The role of videoconferencing in distance learning. *British Journal of Educational Technology*, *36*(3), 397–405. https://doi.org/10.1111/j.1467-8535.2005.00471.x

Omorogbe, E., & Ewansiha, J. C. (2013). The challenge of Effective Science Teaching in Nigerian Secondary schools. *Academic Journal of Interdisciplinary Studies*, *2*(7), 1–8. https://doi.org/10.5901/ajis.2013.v2n7p181

Pratama, H., Azman, M. N. A., Kassymova, G. K., & Duisenbayeva, S. S. (2020). The Trend in Using Online Meeting Applications for Learning During the Period of Pandemic COVID-19: A Literature Review. *Journal of Innovation in Educational and Cultural Research*, *1*(2), 58–68. https://doi.org/10.46843/jiecr.v1i2.15

Pribadi, B. A., & Chung, K. S. (2022). Designing Online Learning: Comparative Study between Indonesian Open University and Korea National Open University. *International Journal of Instruction*, *16*(2), 643–660. https://www.e-iji.net/dosyalar/iji_2023_2_34.pdf

Puspitasari, Y. D., & Dewi, I. S. (2021). Student Learning Independence through Blended Learning Flipped Classroom type during the COVID-19 Pandemic. *International Journal of Educational Research & Social Sciences*, *2*(6), 1553–1560.

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online University Teaching During and After the COVID-19 Crisis: Refocusing Teacher Presence and Learning Activity. *Postdigital Science and Education*, *2*(3), 923–945. https://doi.org/10.1007/s42438-020-00155-y

Rasmitadila, Aliyyah, R. R., Rachmadtullah, R., Samsudin, A., Syaodih, E., Nurtanto, M., & Tambunan, A. R. S. (2020). The perceptions of primary school teachers of online learning during the COVID-19 pandemic period: A case study in Indonesia. *Journal of Ethnic and Cultural Studies*, *7*(2), 90–109. https://doi.org/10.29333/ejecs/388

Rawashdeh, A. Z. Al, Mohammed, E. Y., Arab, A. R. Al, Alara, M., & Al-Rawashdeh, B. (2021). Advantages and disadvantages of using E-learning in university education. *Electronic Journal of E-Learning*, *19*(2), 107–117. https://academic-publishing.org/index.php/ejel/article/view/2168

Reimers, F., Schleicher, A., Saavedra, J., & Tuominen, S. (2020). Supporting the continuation of teaching and learning during the COVID-19 pandemic. Annotated resources for online learning. *Oecd*, 1–38. https://www.oecd.org/education/Supporting-the-continuation-of-teaching-and-learning-during-the-COVID-19-pandemic.pdf

Sari, A., Baedhowi, P., & Indrawati, D. (2017). *The Use of Learning Media with Moodle Approach to Improve the Quality of Education: A Literature Study*. *158*(Ictte), 54–59. https://doi.org/10.2991/ictte-17.2017.33

Sayfouri, N. (2016). Evaluation of the learning management system using students' perceptions. *Medical Journal of the Islamic Republic of Iran*, *30*(1).

Schneiderhan-Opel, J., & Bogner, F. X. (2020). How fascination for biology is associated with students' learning in a biodiversity citizen science project. *Studies in Educational Evaluation*, *66*(June), 100892. https://doi.org/10.1016/j.stueduc.2020.100892

Schunk, D. H. (2012). Learning Theories An Educational Perspective Sixth Edition. In *Pearson Education, Inc.* The University of North Carolina at Greensboro-Pearson.

Setiati, S., & Azwar, M. K. (2020). COVID-19 and Indonesia. *Acta Medica Indonesiana*, *52*(1), 84–89. https://www.researchgate.net/publication/340645813

Setyowati, R. R., Rochmat, S., Aman, & Nugroho, A. N. P. (2023). *Virtual Reality on Contextual Learning during COVID-19 to Improve Students ' Learning Outcomes and Participation*. *16*(1), 173–190.

Simanjuntak, M. P., Hutahaean, J., Marpaung, N., & Ramadhani, D. (2021). Effectiveness of problem-based learning combined with computer simulation on students' problem-solving and creative thinking skills. *International Journal of Instruction*, *14*(3), 519–534. https://doi.org/10.29333/iji.2021.14330a

Sukatin, Mahdayeni, Ginanjar, A., Fatonah, N., Meiliani, E., & Fami. (2023). Blended Learning Model to Improve Learning Independence of University Students. *Al-Ishlah: Jurnal Pendidikan*, *15*(1), 433–442. https://doi.org/10.35445/alishlah.v15i1.2394

Suprihatin, D., Winarni, R., Saddhono, K., & Wardani, N. E. (2022). Scientific Approach to Promote Scientific Writing Skills using Blended Learning System. *Journal of Positive School Psychology*, *6*(7), 3800–3811.

Thorne, K. (2003). *Blended Learning: How to Integrate Online and Traditional Learning*. Kogan Page.

Uzuntiryaki, E. (2008). Exploring the sources of Turkish pre-service chemistry teachers' chemistry self-efficacy beliefs. *Australian Journal of Teacher Education*, *33*(6), 12–28. https://doi.org/10.14221/ajte.2008v33n6.2

Yurt, E. (2014). The predictive power of self-efficacy sources for mathematics achievement. *Egitim ve Bilim*, *39*(176), 159–169. https://doi.org/10.15390/EB.2014.3443