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Blended Learning in English and English-medium Physics Classes Using Augmented Reality, Edmodo, and Tinkercad Media

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Abstract

Globalization and the emergence of IT also rendered English more relevant for second language learners. This study aims to determine the effectiveness of blended learning in improving student learning outcomes in English and physics, using augmented reality, Edmodo, and tinkercad media. This is a quasi-experimental study with data randomly obtained from 70 students of Public Senior High School (SMA) 2 on Lubuk Pakam, Indonesia. The samples were divided into two groups, each totaling 35 students. One of the classes is an experiment with blended learning, while the other is a control class comprising the conventional method. Furthermore, the research instrument consisted of a learning outcome test, in the form of an objective test administered during the pre-test and post-test in the form of an observation sheet. The effectiveness of blended learning in improving learning outcomes was analyzed using the independent sample t-test with SPSS 17. The results showed that the blended learning model effectively improves student learning outcomes through the independent and paired t-test samples of 0.148 and 0.000, significance differences, respectively. This study concludes that blended learning using augmented reality, Edmodo, and tinkercad media effectively improves student learning outcomes and can make them active.

Keywords: *Blended learning, augmented reality, Edmodo, tinkercad, learning, outcomes*

Introduction

English has been one of the useful ways to link people. Approaches to support and enhance the efficiency of English teaching and learning have been particularly important for scientists and

educators in the area of English language education particularly in the development of industrial revolution 4.0 in the field of innovation has led to changes in new knowledge and technology, which tend to affect the education sector. Furthermore, teachers have continued to make innovative efforts in learning technological developments due to globalization. According to Kiryakova et al. (2018), innovation creates an environment that enriches and encourages students to learn effectively. The emergence of information communication technology has led to a change in orientation from teacher-centered to student-centered learning. Furthermore, the orientation that was originally a presentation of knowledge from one party became a guidance activity for knowledge exploration.

In this study, the problems posed stem from the need to diversify the learning model according to high school millennial students' needs. Hussin (2018) stated that the birth of the millennial generation is one of the reasons for changing the vision of education, thereby leading to the creation of new learning processes. According to Sirakaya & Cakmak (2018), millennial students expect modern technology because they are accustomed to a computerized environment.

However, the current means of learning, which allows students to meet face to face with their teachers in class, is known as conventional learning. This learning process is bound by time and space, with underutilizing technology and not in accordance with students' expectations. This leads to low student learning outcomes and activities, especially on the English and Physics subjects, which are discussed in this research. Therefore, learning is needed to be able to increase student motivation and enthusiasm, as well as to overcome these problems. Derlina, Dalle, Hadi, Abdul Mutalib, & Sumantri stated that teachers must be able to design and implement learning in accordance with student needs and technological developments. Advances in technology produce online-based learning sources and media with interesting e-learning and blended applications. E-learning provides pure electronic learning via the internet, intranet, or multimedia networks, while blended learning (BL) combines face-to-face and e-learning between teachers and students in the classroom.

There are various advantages associated with blended learning, especially in terms of flexibility in space and time, as well as variations in interactions between teachers and students. Albiladi & Alshareef (2019) stated that BL is a creative idea to connect technology, teaching platforms, and online learning approaches. It also helps teachers to design student-centered learning activities and facilitate lifelong learning (Rahim, 2019). English and Physics are two of the

subjects that are considered difficult by students, and less liked by them. One of the problems associated with learning subject is the low mastery of concepts and their learning activities.

Computer-assisted simulation and language learning activities encourage collaboration and language resources between students (Alkhudiry, Al-Ahdal, & Alkhudiry, 2020; Al-Ahdal, 2020). Studies show that such education goals are achieved by confirming the efficiency of the blended learning model in language education particularly in EFL and ESP (Almakrob & Al-Ahdal, 2020; Kacetl & Semradova, 2020; Petraki & Khat, 2020; Shariq, 2020).

A survey carried out at SMA Negeri 2 Lubuk Pakam in Indonesia illustrated that teachers had applied several learning methods, and teaching aids carried out practicum in laboratories, using information technology media such as Microsoft PowerPoint, video, and animation. However, despite using these media, student learning outcomes are still below the minimum completeness criteria with a score of 65 before remedial. This is due to the limited time associated with the face-to-face approach to the broad Englishmaterial scope. Therefore, teachers often explain and implement conventional learning, which tends to occur in one direction with low involvement and learning activities.

The use of BL learning in this school is possible because, based on a survey in the 2019/2020 odd semester, all students have a smartphone connected to the internet. Furthermore, the school has wifi facilities that can be used, therefore, it is predicted that assuming learning is carried out using information technology, the activities and outcomes changes for the better.

The implementation of BL in the teaching and learning process uses three media, namely augmented reality (AR), Edmodo, and tinkercad. Kong & Song (2014) defined Edmodo as a learning environment supported by social networks. This can be in the form of a platform used to mediate the learning process for teachers, students, and parents in digital classrooms, to allow them to share notes, links, documents, and design better instruction (Qomariyah et al., 2019).

Augmented reality (AR), as a learning medium, combine virtual and world reality to produce two (2D) and three (3D) real and unified dimensional objects. Media AR is one of the advantages because it is interactive and operates in a 3D environment that is integrated into mobile applications such as windows, IOS, tablets, and smartphones (Al-Said, 2015; Ambarwulan & Muliyati, 2016; Budiman, 2016; Qumilaila, Susanti, & Zulfiani, 2017; Vaquero-Melchor & Bernardos, 2019); Kerr & Lawson, 2020). In AR technology, users can determine the real world around them by adding virtual objects generated by the computer (Sáez-López et al., 2020).

Students' interest in learning motivates them, increases their understanding of abstract ideas in learning activities(Pedaste et al., 2020; Sirakaya & Cakmak, 2018). The AR technology can be assisted by tinkercad, which has several powerful features, such as the ability to import and export files used to create prototypes, decorations, minecraft models, and other unique shapes that can enhance students' creativity.

Edmodo is used as a mode of instruction to optimize the management of the learning environment. This application enables communication between teachers and students, irrespective of time and place. Teachers can provide instruction and learning assignments, review student assignments without having to meet face to face. Also, students can post assignments without meeting the teacher. Edmodo is an alternative to learning in online classes, therefore, for teachers, students, and parents, this application allows to share information, notes, links, and documents, with the ability to design a better and interactive learning instruction.

Several studies have shown the numerous advantages associated with the application of BL, such as an increase in students performance compared to those that use traditional methods (Poon, 2013; de George-Walker & Keeffe, 2010; Ceylan & Elitok Kesici, 2017; Oweis, 2018; Utami, 2018; Albiladi & Alshareef, 2019; Rahim, 2019; Qomariyah, & Rejekiningsih, 2019). They stated that the academic learning outcomes and student performance at BL were better than those taught conventionally. Furthermore, most students liked and had positive perceptions of BL learning.

Therefore, based on various learning problems, it is necessary to improve the teaching process according to students' technological developments needs to improve their learning outcomes and activities. Numerous problems offer the use of BL combined with augmented reality, Edmodo, and tinkercad media to solve problems related to academics as follows: a) students can use smartphones as learning media when learning face-to-face. b) The use of learning resources that are relatively more numerous and varied. c) The school already has a wifi network that can be used by the residents. d). teachers and students have smartphones and laptops. Therefore, with this situation, the BL application in the teaching and learning process can be implemented at SMAN 2 Lubuk Pakam.

The problems associated with this study are as follows:

1. Does BL learning using AR, Edmodo, and tinkercad media effectively improve student learning outcomes in English and Physics subjects in grade 2 SMAN 2 Lubuk Pakam odd semester in 2019/2020?

2. What is the level of student learning activity in blended learning using AR, Edmodo, and tinkercad media?

Method

This is a quasi-experimental study with a randomized pretest-posttest control group design. The experimental class applied BL using AR, Edmodo, and tinkercad media, while the control class used conventional face-to-face learning. The study population comprises 70 students of class XII SMA Negeri 2 Lubuk Pakam, Deli Serdang Regency, North Sumatra Province. The sample was divided into two classes, equal groups into the experimental and control groups using the random sampling technique.

The instrument used in this study was an objective form of learning outcome test, collected during the pre-test, post-test, and learning activity observation sheet. The outcome was validated by English and Physics education experts, which was further tested in class XII to determine those that have studied the material. This trial aims to determine the validity, reliability, differentiation, and difficulty level of the questions. After the trial, the questions were revised to obtain valid and reliable learning outcomes tests.

Data were collected during the pre and post-test as well as analyzing the use of the mean difference t-test (t-test for independent samples). Prior to the analysis, the normality and homogeneity prerequisite tests were conducted, while the data normality and homogeneity tests were analyzed using the Kolmogorov-Smirnov and Shapiro-Wilk statistics. Furthermore, to determine the BL model's effectiveness, the data were analyzed using a paired sample t-test, while the SPSS 17 software program assisted statistical calculations. The research design is shown in Table 1.

Table 1. :

Research Design

R	Experimental	P_1	X1	P_2
R	Control	P_1	X_2	P_2

Information :

R: Random sampling

X1: Treatment with BL learning

X2: Treatment with face-to-face learning conventionally

Results and Discussion

Results

The submission of results to determine the effectiveness of BL using AR, *edmodo* and *tinkercad* in improving learning outcomes is divided into the following.

1. Descriptive presentation of pre-test and post-test data from the experimental and control group.
2. Data analysis of pre-test and post-test in the experimental and control group
3. Hypothesis testing using independent t-test and paired sample t-test

Descriptive Analysis Results of Pre-test Data

The *pre-test* data were tabulated and analyzed using SPSS 17. Table 2 shows the recapitulation of the *pre-test* data analysis results.

Table 2.

Description of Pre-test Data

Class	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test	35	23.33	76.67	41.2381	11.93901
Experiment	35	13.33	76.67	36.6667	14.11901
Pre-test controls	35				
Valid N (listwise)					

Normality and Homogeneity of Pre-test Data

Tables 3 and 4 shows the results of the *pre-test* normality and homogeneity test data. The *pre-test* mean values of the experimental and control groups were analyzed using the Kolmogorov-Smirnov and Shapiro-Wilk statistics. According to the results, the significance values for the experimental and control groups were 0.200 and 0.154. This means that the data comes from a normally distributed population at the 0.05 significance level.

Table 3.

Pre-test Data Normality Test Results

Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	*Df*	*Sig.*	Statistic	*Df*	*Sig.*
Pre-test Experiment	.113	35	.200	.953	35	.142
Pre-test Control	.129	35	.154	.949	35	.104

Liliefors Significance Correction

Table 4.

Pre-test Data Homogeneity Test Results

	Levene Statistic	*df1*	*df2*	*Sig.*
Pre-test	.411	1	68	.524

The data homogeneity test using SPSS 17 had a significance value of 0.524> 0.05, hence the *pre-test* data is declared homogeneous. Table 5 shows the results of the mean difference test and independent t-test Table 5.

Table 5.

T-test results for pre-test data

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Diffe-Rence	Lower	Upper
Learning outcomes	Equal variances assumed	.411	.524	1.463	68	.148	4.571	3.125	-1.665	10.808
	Equal variances not assumed			1.463	66.173	.148	4.571	3.125	-1.668	10.811

Table 5 shows the *pre-test* data had a significance value of 0.148> 0.05, hence no difference in the mean pre-test of the experimental and the control class.

Results of Post-test Data Analysis

Table 6 shows a recapitulation of the *post-test* mean scores, where there is a difference in the mean score between the experimental (84.1905) and the control class (71.8095).

Table 6.

Description of Post-test Data

Class	N	Minimum	Maximum	Mean	Std. Deviation
Post-test Control	35	43.33	96.67	71.8095	13.77557
Post-test Experiment	35	70.00	100.00	84.1905	7.38055
Valid N (listwise)					35

Normality and Homogeneity of Post-test Data

Tables 7 and 8 show the results of the *post-test* normality and homogeneity test data. The *post-test* mean scores of the experimental and control groups were analyzed using the Kolmogorov-Smirnov and Shapiro-Wilk statistics. According to the results, the significance values for the experimental and control groups were 0.196 and 0.056. This means that the post-test data come from a normally distributed population at the level $\alpha = 0{,}05$.

Table 7.

Post-test Data Normality Test Results

Class	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Post-test Control	.124	35	.196	.966	35	.337
Post-test Experiment	.146	35	.056	.955	35	.164

Liliefors Significance Correction

Table 8.

Post-test Data Homogeneity Test Results

	Levene Statistic	*df1*	*df2*	*Sig.*
Post-test	2.151	1	68	.147

Testing statistics based on the mean significance obtained 0.147> 0.05, hence the *post-test* data is declared homogeneous.

Blended Learning Effectiveness Test in Improving Learning Outcomes

Table 9 shows the results of the BL effectiveness test using AR, *edmodo*, and *tinkercad* in improving learning outcomes from different tests between the experimental and control groups. These results are based on the difference in values between the *pre-test* and *post-test* following the t-test statistical sample in pairs. Table 9 shows the level of significance at sig. 000 for the two-party t-statistic. Therefore, there is a significant difference in the average value between the experimental and the control class. BL using AR, *edmodo*, and *tinkercad* were tested effectively to improve student learning outcomes.

Table 9.

The results of the effectiveness test between pre-test and post-test (t-test for Paired Samples)

		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-test – Post-test	-39. 048	18.608	2.224	-43.485	-34.661	-17.557	69	.000

Student Learning Activity Data

Learning activities include various physical and mental events in interrelated learning for optimal outcomes. The learning activities referred include face-to-face (*offline*) and *online* student activities, and the responses to the implementation of BL using AR, *edmodo*, and *tinkercad*. Offline student activity data were obtained from observations with measuring instruments as observation sheets. Furthermore, online student learning activities are analyzed based on reviews of assignments sent to *edmodo*. Table 10 shows the description of student learning activity data.

Table 10.

Data on Offline Learning Activity

Sub Indicator	Mean	Criteria
Getting to class on time	96,76	Very active
Preparing for learning needs	92,00	Very active
Behaving orderly not to interfere with the learning process	93,52	Very active
Studying the learning that will be delivered	76,57	Active
Paying attention to the information conveyed by the teacher	90,86	Very active
Speaking as necessary so as not to interfere with the learning process	88,38	Very active
Giving responses to information conveyed by the teacher	82,29	Very active
Expressing opinions during the discussion	82,28	Very active
Thinking critically	74,86	Active
Carrying out group discussions until the specified time limit	85,72	Very active
Summing up the learning material in your own words	82,48	Very active
Total	945,72	Very
Average	85,97	active

According to Table 10, the results of *offline* student activity from the observation sheet has an average of 85.97%, which is in the very active category. This means that BL using AR, *edmodo*, and *tinkercad* media increases student activity, especially discipline in class. However, the sub-indicators of learning the material before entering class and students' critical thinking still needs to be improved. This is because it is still at 76.57 and 74.86%, still far from the other sub-indicators.

Table 11.

Data on Online Learning Activities

Sub Indicator	Mean	Criteria
Preparing for learning needs	92	Very active
Behaving orderly so as not to interfere with the learning process	93,52	Very active
Studying the learning that will be delivered	76,57	Active
Paying attention to the information provided by the teacher	80,19	Very active
Doing assignments given by the teacher	85,91	Very active
Making a series according to the instructions on the Student Activity Sheet	80,19	Very active
Thinking creatively as such can vary the range	72,38	Active
Collecting assignments on time	86,28	Very active
Total	667,04	Very active
Mean	83,38	

According to Table 11, the value of student activity during online learning has an average of 83.3, which is in the very active category. This means that BL using AR, *edmodo*, and *tinkercad* media increase student learning activities.

Table 12.

Student Response Activity Data

Sub Indicator	Mean	Criteria
Having the motivation to learn	82,28	Very good
It is easier to understand the subject matter	82,67	Very good
Increase curiosity	84,38	Very good
Students can take the test anytime and anywhere	90,09	Very good

The learning media used makes students enthusiastic	80,38	Very good
Students can study independently	85,15	Very good
Making students active	87,24	Very good
Easily understand the steps to take to start the test	87,43	Very good
The test given is according to the material and LKPD	82,10	Very good
The test results can be seen directly	92,57	Very good
Total	854,29	Very good
Mean	85,43	

Table 12 shows that the students responded very well to the implementation of BL learning. The implementation of BL using AR, *edmodo* and *tinkercad* media can make students active in learning.

Discussion

Effectiveness of Blended Learning Using Augmented Reality, Edmodo and Tinkercad in Improving Student Learning Outcomes

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Blended learning combines face-to-face (*offline*) with *online* learning using AR, *Edmodo*, and *tinkercad*. It involves alternating *offline* and *online* learning using computer-mediated instructions. Implementation of BL in the experimental class consists of 6 and 12 hours of offline and online lessons. In *offline* learning, students are taught using AR media and supporting teaching materials, such as LKPD and video. Contrastingly, teaching involves using AR, *edmodo* and *tinkercad* in online learning. The BL learning process begins with offline class meetings. In *offline* classes, the teacher provides information about the subject matter, guides students on activities to be conducted online, an explanation of AR, *edmodo*, and *tinkercad* media, as well as discussions and questions and answers on the tasks and the *pre-test*. After *offline* activities, students take *online* classes within a specified time. During online classes, teachers use *edmodo* facilities, including assignment features, quizzes, and others to deliver assignments and news, such as student activity

sheets (LKPD) listed on AR media. In general, AR contains core and basic competencies, indicators, learning objectives, subject matter supported by images, AR cameras assisted by markers, 2D animation, learning videos, LKPD, and learning outcome tests. The LKPD contains several activities that should be conducted with the help of *tinkercad*, such as making electronic circuits and simulating them. Assignments are sent via *edmodo* on a predetermined time. After *online* learning, *offline* class resume, where group representatives present the results of their discussions and assignments before the class. Other students are given the opportunity to ask questions and submit opinions, while teachers are facilitators during the discussion. Afterwards, the learning material is concluded. This pattern was followed repeatedly, and a test was carried out to obtain *post-test* data at the last meeting.

Table 9 shows the results of the BL effectiveness test using AR, *edmodo*, and *tinkercad* between the experimental and control groups. This is obtained from the difference in values between the *pre-test* and *post-test* from the paired sample *t-statistic test*. Table 9 shows the .000 level of significance for the *t-statistic (2-tailed)*. This means that there is a significant difference in the average value between the experimental and the control group in the BL application. Therefore, BL using AR, *edmodo*, and *tinkercad* effectively improves student learning outcomes, hence recommended in the learning process. The results of this study are in line with (Ceylan & Elitok Kesici, 2017; Utami, 2018; Albiladi & Alshareef, 2019), which stated that student learning outcomes in classes taught with BL are better than using conventional face-to-face learning.

Learning outcomes in the BL class can be attributed to the superiority of AR, *edmodo* and *tinkercad* media, which has better means and interactions for learning. BL is effective in improving learning outcomes because students interact with the subject matter, peers, teachers, and parents anytime and anywhere. AR has the following advantages: (1). Downloading a unidirectional electrical circuit application to a student's smartphone does not require an internet network, (2). It is flexible because it can be used anywhere and anytime, (3). The implementation is widely in various media, (4). It is a media for smartphones, *game consoles*, educational and corporate products, printed media such as magazines, brochures, and books.

Augmented Reality is designed as slides supported by a menu panel for students to choose the desired slide menu easily. The AR menu panel contains tutorials on using AR, AR cameras, core and basic competencies, indicators, learning objectives, subject matter, LKPD, and learning outcome tests. When using AR, students learn through the material presented in 3D, such as

images, animations, and videos. Students can: 1) observe the current and electron flow, as well as the potential differences in both simple circuits and Kirchoff's law, 2) see the flow of currents and electrons when measuring currents and voltages in a circuit using a measuring instrument, 3) see a simulation of the flow of electricity to residents' homes and can be used in electrical equipment in daily life.

After scanning a 2D image, students can see a series of images in 3D that almost resemble the original. This activity is enjoyed because students were curious to see the appearance of the series appearing when the 2D image was scanned. This curiosity is a motivation to improve learning outcomes. AR contains sight and sound features that far exceed rigid images in books. It can combine virtual objects with 2D into virtual and real information, interactive and operate in a 3D environment integrated with mobile applications, including windows, IOS, *tablets*, and *smartphones*. Furthermore, AR helps students understand the subject matter, hence can be used as an effective tool to increase motivation and learning activities, cognitive acceleration, and self-management (Pedaste et al., 2020).

Tinkercad's features consist of *class, teach, 3D Design, Circuits, and 3D Designs Codeblocks, Circuits, Codeblocks,* and *Gallery*. It has several advantages, including (1). Has complete electronic components to assemble circuits from simple to complex, (2). Can be opened via the web, hence no need to install and download applications on *smartphones* or PCs that take up storage space, quota, and battery life, and (3). Students electronic circuit assignments are stored in their respective accounts.

Tinkercad is a web-based program used for solid modelling and 3D printing. It has electronic circuits with complete components for creating circuits and simulations. Importantly, it is used to support the completion of LKPD on AR while making electric current circuits. Students may compare the results when practising in the laboratory with *Tinkercad* or vice versa. Also, *Tinkercad* supports collaboration between teachers and students by providing a classroom platform, where only students with codes follow it. However, it can only send a link to the electrical circuit assembled, hence takes Edmodo to support collaboration between teachers and students more broadly.

Edmodo has several features, including A*ssignment, File and Links, Quiz, polls, Gradebook, Library, Award Badges,* and *Parents Codes*. It has several advantages, including (1). No need to use a PC because it can be utilized on a *smartphone*, (2). There is no need to download applications

on a smartphone for students' storage space, quota, and battery life not to be drained with because of frequently opening applications via the *Edmodo web*, (3). The class grouping system is the same as classes at school, (4). Can be monitored by parents and the school.

Edmodo plays essential in optimizing the learning environment. This is because it can increase student activity and participation in the learning process and provides flexible opportunities for students to learn, discuss, obtain and share learning resources through images, articles, animation, journals, *blogs*, presentation slides, videos, or *e-books*. *Edmodo* is also a forum for teachers to provide assignments, news, and tests and serves as a media for students to collect assignments and take tests. It helps view and relearn the collected assignments any time, irrespective of the place. Furthermore, *Edmodo* media makes classroom management tidier. For instance, students' assignments are not in piles of paper that might be scattered.

Blended learning is effective improves performance because it generates internal students' motivation, which encourages them to study learning material, do assignments, and conduct other learning activities. According to Oweis (2018), learning outcomes increase in case there is internal student motivation to be involved in various learning activities.

AR, *Edmodo*, and *tinkercad* are advantageous because a combination of online learning media is effective, yet cannot be meaningful without the support of conventional face-to-face *offline* meetings between teachers and students. However, learning is a two-way process, where students need feedback from teachers and vice versa. Through this method, effective and targeted learning outcomes can be obtained.

Offline meetings are needed for teachers to guide students using AR, *edmodo*, and *tinkercad* media. However, these media cannot replace the role of peers, teachers, and the social environment to shape student character as the main point of educational goals. In the face-to-face class, students deliver assignments in groups before the class, discuss their work results, and take written tests. The teacher reviews student assignments and plans for the next lesson. This means the advantages of AR, *edmodo*, and *tinkercad* are maximized when combined with face-to-face learning, different from the situation in the control class. In general, learning in the control class does not use AR, *edmodo*, and *tinkercad* media. The activities are very limited, with a minimal number of learning hours only during face-to-face meetings following curriculum stipulations. Learning in class starts from explaining the material with makeshift PowerPoint media, providing sample questions, recording subject matter, working on questions, and doing homework.

There are several advantages of BL using AR, *edmodo*, and *tinkercad* in improving student learning outcomes. For instance, learning is attractive to students because they can study anywhere, anytime, and with anyone. This can be from home, office, a mall, a cafe, or anything else as long as students bring their *smartphones*. The flexibility of learning without time and place limits allow students to study individually based on their needs. For instance, they can stop or continue learning a concept according to their level of mastery of the concept. In case there is something difficult to understand, they can ask questions to teachers or friends online. Additionally, they can access and select the information needed. AR media is installed on students' *smartphones* in the form of an application that can be opened without using a quota. For this reason, it can be used anytime, irrespective of the place. In case students do not understand or want to better contextualize a concept, they can watch the learning video in AR.

The unidirectional electric circuit AR media contains a menu panel to make it easier for students to choose the desired menu. The panel includes a menu to start an AR camera or scan marker, usage tutorials, core competencies, basic competencies, learning indicators, two-dimensional (2D) and three-dimensional (3D) images, illustration images, learning videos, 2D animation, LKPD containing online practicum guides, and practice questions supported by the value and *smile emoticons*. BL flexibility facilitates productive discussion and increases student interaction, hence improves learning outcomes (Sajid et al., 2016).

Secondly, BL, AR, Edmodo, tinkercad, 3D animation (generated from AR cameras), learning images, and videos make it easier for students to understand the concept of physics. This is because they are able to learn and visualize electrical concepts, such as the flow of electrons, current sources, and the concept of electricity in everyday life using practicum tools in the laboratory. Furthermore, animations and videos of learning materials and LKPD on unidirectional electric circuit AR help students use the existing tools and materials in the laboratory with online tinkercad. This is in line with research carried out by Sumardi & Muamaroh (2020), which stated that learning media makes it easier for students to understand and remember the subject matter.

Thirdly, BL, AR, Edmodo, and tinkercad enrich students' learning experiences. Furthermore, the combination of these makes learning activities more numerous and varied, which is in contrast to conventional learning in class with very limited activities, such as listening to the teacher, working on questions, etc. In BL, students are more experienced during discussions, tend to ask questions actively, being peer tutors, virtually practice, learning to make studies, which can be discussed

offline, share learning material from various sources, and provide constructive ideas in groups. In addition, through Edmodo, students are also encouraged to determine references to complete assignments given by the teacher independently. They also share documents in various forms, pictures, animations, and videos. Students can also download teaching materials from shared links and share them in class through Edmodo. Therefore, it acts as a means of discussion between students and teachers. Apart from the freedom to share and obtain teaching materials, students are also given writing papers and articles to enable them to possess the right writing experience. Online learning activities at BL help students prepare for offline learning activities and be actively involved in the process (Utami, 2018).

Fourthly, BL encourages independent learning, increases student involvement in class, and improves communication, discussion, and collaborative skills. This tends to discipline students, thereby enabling them to have good motivation and spend time learning lessons individually and in groups on BL's media. Furthermore, it enables them to learn independently, examine learning material, and use multimedia tools, which are accessed online, irrespective of the time and location. Students also have the opportunity to develop communication skills both inside and outside the classroom through online interactions. Therefore, teachers use this to optimize learning and increase independence learning, thereby enabling them to interact with others and complete their assignments using Edmodo. Furthermore, teachers and students responded to the assignments sent through Edmodo, therefore motivating them to do better.

Students also gain independence and form the habit of opening their material more often, such as during breaks. Some of them preferred to study using videos, group discussions, asking their closest friends' questions in AR, and by guiding those that are not proficient through chaining tools on tinkercad. They also show other differences in classes on the AR applications used in classes, as well as their learning outcome and assignments carried out to their parents. They carry out these activities to enable their parents to appreciate them and lend them their smartphone with better camera resolution to get better images. The interactions between students, such as sharing teaching materials, discussing through whats app groups, during offline class hours, carrying out group assignments at home, guiding friends that have not finished working on LKPD, asking questions, getting feedback from the teacher, as well as appreciating friends, teachers and parents, is an interesting experience and motivates them to learn. In addition, BL can increase their learning independence because when students need remedial or material enrichment, they only need to open

the material in Edmodo or in AR. This interaction and collaboration between students, teachers, and parents raise their motivation, enthusiasm, and independence in learning (Okaz, 2015).

Fifthly, BL makes students accustomed to studying inside and outside the classroom. This means that the learning facilities displayed by Edmodo, AR, and tinkercad, such as teaching materials, content, and videos available on AR, can be viewed at any time, thereby creating a positive habit. Students can study with their smartphones when sitting with friends, for example, during class breaks, on their way to school, or while waiting for a public vehicle without feeling embarrassed. However, conditions associated with conventional learning, such as opening textbooks in public places, can cause resentment. This is in line with the research carried out by Junco (2012), which stated that in BL, student interactions and activities are more numerous and varied because they are involved in learning activities both inside and outside the classroom.

Sixth, students have a positive response to the implementation of learning because their perceptions and responses are influenced by the interpretation of the teacher's learning activities. The appearance of learning concepts that are attractive and easy to understand encourages interest. It provides a willingness for them to participate and join in conversations related to the concept being discussed. A positive response to learning is related to the novelty of studying English and Physics via smartphones, where new things are always interesting and tense. Furthermore, they use the internet and visual elements in AR, Edmodo, and tinkercad media to encourage active participation in various learning tasks.

A positive response is shown from a voluntary attitude and being happy to complete the assigned task. Students tend to independently discuss with friends or teachers inside and outside the classroom. With this enthusiasm, they showed each other their results, especially those related to the 2D scanned images in AR. In addition, their positive responses also occur because their active learning can always be monitored by teachers, fellow classmates, and parents. Online monitoring of how students learn by teachers, classmates, and parents is one of the advantages of e-learning that positively impacts learning outcomes. Students' positive responses to learning are shown by their attitudes to possess a high desire and enthusiasm to convey their interests, needs, and learning problems to teachers and others online.

Furthermore, they participate actively during the preparation, implementation, and follow-up of their online learning. Students also tend to be more creative in completing each learning activity until the objectives are achieved. In addition, they tend to complete their assignments voluntarily

without being under pressure from the teacher (Sumardi & Muamaroh, 2020). Overall, they generally possess a positive perception of BL implementation because learning allows them to repeatedly and review the subject matter.

Conclusion

Based on data analysis on BL learning using AR, Edmodo, and tinkercad media in English and Physics subjects at SMAN 2 Lubuk Pakam, the following was concluded. Firstly, BL learning using AR, Edmodo, and tinkercad media proved to be effective in improving student learning outcomes through independent tests sample t-test with sig. 0.148 and paired sample t-test results with sig. 0,000, which means that there is a significant difference in student learning outcomes in the experimental and control classes. Secondly, blended learning can make students active in acquiring knowledge. Finally, this study implies that a blended learning model can be a powerful and efficient way to promote quality instruction for ESP teachers. It is anticipated that the findings would encourage further studies at other university levels, in particular for ESP, and could also enhance language education and the education in English-medium Physics Institutions as well.

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