Blended Learning on Physics Using Augmented Reality

Aisyah (a*), N. Bukit (b), and Derlina (b)

Department of Physics Education, Postgraduate State University of Medan, Medan, Indonesia*
Lecturer Department of Physics Education, Postgraduate State University of Medan, Medan, Indonesia

* aisyahaisyah228@gmail.com

Abstract. This study aimed to determine the increase in student activity through a blended learning approach in physics using augmented reality. This type of research is a classroom action research with a population of all students in Deli Serdang Regency. The research instrument used was a student observation questionnaire and Student Activity Sheet. The results of data analysis explained that the blended learning approach in physics using augmented reality can improve student learning activities.

1. Introduction
The rapid development of technology has very much control in every area of life. Some life problems have been resolved including tasks that require energy and can be concrete automated and easily because of technology. Therefore promotion of the technological revolution is being carried out continuously, especially in the field of education.

In fact, after computers are used in education, it is easy for teachers to provide knowledge for students to obtain [1]. Media such as e-learning, video conferencing [2], virtual introduction or augmented reality [3], Artificial Intelligence, large information and examinations, distributed computing and portable settings, online networks, the Internet of Things are changing the flow of education and teaching landscapes into new types [4] namely: allowing students to interact directly with the environment; uniformity of observations and perceptions for student learning experiences; motivation for learning; display messages and learning information that are consistent and can be repeated or stored [5] so as to enable learning outside the classroom walls [6].

Considering the advantages of technological development especially in the learning media, technology that can facilitate in achieving learning goals should be considered as an acceptable addition [7]. Therefore, learning media are needed in accordance with the criteria and needs of students in the present without ignoring the moral vision of learning.

Technology that provides easy online access to information and social media has an undeniable effect on academic life and student learning hours [8]. Therefore, it is important to examine the impact of digital technology and social networking or the like on education.

Based on the study in the field, the results are obtained: 1) all students (35 students) have cellphones in the smartphone category. However, as much as 64.28% said that the teacher had never used a smartphone as a learning medium; 2) all students say they are accustomed to using the internet. However, 78.57% said that teachers never use online learning and the internet during the learning
process; 3) As many as 39.28% stated that the teacher had never used 3D, the teacher had used powerpoint and video as learning media, while 42.86% stated that the teacher had provided media in the form of animation, namely the atomic form. 5) The learning process to apply methods that are in accordance with the curriculum still finds obstacles especially in terms of time, classroom management when practicum in the laboratory, the limitations of teaching aids on some subject matter; 6) Time constraints when applying scientific learning models and classroom settings in the laboratory are more difficult, causing teachers to explain more often to students and guide students fully when doing practical work.

Based on the problems above, this research will see an increase in student activity with a blended learning approach using augmented reality learning media which is implemented as an effort to help teachers apply learning by utilizing various types of media and approaches in learning that are appropriate to technological developments that students must face.

Blended learning is a combination of online platforms with traditional classrooms [9] which is an effective approach for passive knowledge involvement of students and enhances learning outside the conventional face-to-face learning environment [10]. Blended learning allows more learning opportunities that motivate students to participate in and outside the classroom setting [11]. The blended learning environment also gives students an online and face-to-face place to Meeting schedule, collaborate, and work on meaningful projects [12].

Blended learning has been researched by several researchers who state that effective blended learning is needed in conducting innovative pedagogies approaches through examining student backgrounds, design features and learning outcomes that involve face-to-face sessions and online aspects. However, in this study there were no independent variables that were identified as significant predictors of student performance so that they must pay attention to the readiness of students to become predictors [13]. Blended learning can also be used as alternative learning for teachers to support student learning progress. However, to apply this model, teachers must develop their computer and internet literacy levels [14]. The results also showed that students performed better when using blended learning that implemented computerized teaching. But the results of independent learning still use manual examination [15], besides that, for educators, blended learning is also very important to consider job strategies that benefit from the learning management system [16]. So, both students, teachers, and educational institutions must prepare themselves because the use of learning management systems will continue to grow as the times continue to move towards an online platform.

As with blended learning, augmented has also become the spotlight for researchers especially in the field of information technology. Therefore, in this study augmented reality is used to support the learning process of blended learning. Augmented reality is the incorporation of Virtual Environment objects into the Real Environment that is displayed using technology devices in real time [17]. Augmented Reality (AR) increases the user's perception, helping him to better understand the reality around him and interact with the real world [18]. Furthermore, AR can be categorized by three properties which are a combination of real and virtual objects, interactive in real time and 3D registration of virtual and real objects [19]. So, augmented reality also allows learning outside of class hours by creating learning experiences related to formal classrooms. In addition, it allows the addition of physical teaching aids with virtual annotations and illustrations that can improve student understanding in the classroom [20].

Some research has been done on augmented reality and has been shown to have potential applications in education. The ability of augmented reality for physical interaction with the application gives students assistance in exploring learning [21], extending student skills in a professional environment such as a laboratory during training [22]. This is in line with research which states that the use of mobile devices to display AR applications increases the academic success of students in the learning process compared to the use of traditional learning methods [23].
2. Methods
This research is a classroom action research that aims to determine student activity. The instrument used in this study was an observation sheet of student learning activities and the results of assignments given to students. Data analysis in this research is qualitative data in the form of information in the form of observation data of learning activities. [24] Class action research has four stages that need to be carried out, namely (1) planning of action (planning), (2) implementing action (acting), (3) observing (observing), (4) reflecting (reflecting).

3. Result and Discussion
The results of this study are increased student activity through the application of blended learning in physics using augmented reality learning media. In the first stage, is it action planning, at this stage the basic problems faced in learning are constructed, so it is very necessary to see activities with blended learning using augmented reality learning media. With this analysis, you will get a general description of basic facts, expectations and alternatives, which facilitate the determination or selection of educational material. Learning analysis, analysis of learning component phases includes analysis of core and basic competencies, indicators, objectives, and learning material, analysis of learning situations, analysis of learning content.

The next step in the first stage after completing the analysis phase is to prepare the learning media that is needed. In this study the learning media used in blended learning (e-class) are edmodo and tinker cad applications. Edmodo as a forum to convey assignments and exchange ideas when outside the classroom while Tinker cad as a place to work on a series of simulations for student activity sheets with the following stages:

a. The teacher registers a personal account as a teacher then shares the class code with students
b. Students register personal accounts using the class code provided by the teacher.
c. Teachers input students into small groups according to their respective classes. So, display of e-class can be seen in figure 1:

![Figure 1. E-Class Display](image)

The next step is making augmented reality learning media with the following stages:

a. Equipment both software and hardware Meeting schedule the requirements of making augmented reality
b. Make the object first to be displayed. In general, the objects created are 3D objects, photos, videos, or animations. In this research, 3D images and animations are made with blender software, photos are made with Adobe Photoshop, and videos are edited with Adobe Primier.

c. Save the object in the library

d. Make Markers as markers that have special patterns that will be detected by the camera to display objects. In this study the marker used in the form of electrical circuit images

e. Save the marker pattern created with the help of other applications such as Vuforia.

f. Generating objects from markers created with the help of the builder. In this study using Unity

g. Build a program that has become an application that runs on the operating system. In this study using Android. Pictures in Augmented reality can be seen in Figure 1.2:

![Augmented Reality Display](image)

**Figure 2. Augmented Reality Display**

The second stage is the implementation of the action, at this stage the learning process is carried out by implementing blended learning using augmented reality at this stage the researcher follows a predetermined design. The third stage is observation, it should be done simultaneously with the second stage because the students' activities under study take place during the learning.

The learning process begins with face-to-face in a real class in the form of conveying learning concepts, guiding students towards learning and assignments that will be done in cyberspace. The next step is to carry out online learning in cyberspace by distributing teaching materials aside from the learning materials that are in student print books. In addition, giving assignments will be undertaken by students and collected in online classes according to the agreed schedule. In cyberspace, students are allowed to ask questions and discuss learning properly in a real class. After online learning is carried out, the next step is to return to the real class with the task of reviewing and discussing the assignments that have been done in the online class.

Based on the learning that has been done then, the results of working on the Student Activity Sheet are shown in table 1:

| Schedule     | Percentage | Category     |
|--------------|------------|--------------|
| First Meet   | 85.62 %    | Very Good    |
| Second Meet  | 85.95 %    | Very Good    |
| Third Meet   | 89.49 %    | Very Good    |
| Average      | 87.02 %    | Very Good    |
Based on the student activity sheet that is done it can be concluded that the activities of students are in the very good category with an average of 87.02%. The results of student observations based on indicators can be seen in table 2:

| Indicator | 1st Meet Category | 2nd Meet Category | 3rd Meet Category | Value Category |
|-----------|------------------|------------------|------------------|----------------|
| Readiness of Students in Following Learning | 82.93 %Very Active | 90.23 %Very Active | 95.14 %Very Active | 89.43 %Very Active |
| Student Readiness in E-Class | 78.15 %Active | 77.34 %Active | 80.19 %Active | 78.56 %Very Active |
| Learners Readiness in Participating in Discussion Activities in Real Class | 81.72 %Very Active | 85.13 %Very Active | 91.14 %Very Active | 86.00 %Very Active |
| Student activities in discussion activities in Real Class | 72.22 %Active | 78.63 %Active | 83.2 %Active | 78.02 %Active |
| Average | 78.75 %Very Active | 82.83 %Very Active | 87.42 %Very Active | 83.00 %Very Active |

Data from observations of student activities based on indicators has an average of 83% in the very active category. Meanwhile, based on the observation sheet of student activity according to sub-indicators at each meeting can be seen in table 1.3:

| Schedule | Percentage | Category |
|----------|------------|----------|
| First Meet | 78.48 % | Aktif |
| Second Meet | 80.83 % | Sangat Aktif |
| Third Meet | 86.88 % | Sangat Aktif |
| Average | 82.06 % | Sangat Aktif |

Data from observations of student activities according to sub-indicators has an average of 82.06% in the very active category.

The fourth stage is replication, this stage is the stage of analyzing and correcting deficiencies at each stage. At the first meet on online learning students learn the material provided, work on Student Activity Sheets, and work on scientific work. At this meeting students still face many obstacles, especially online learning and the use of augmented reality is still unfamiliar to students, so researchers must explain repeatedly. Students still have difficulty in doing scientific work and are passive in online learning and there are some students who are late sending their assignments. So, to advance to the next stage the teacher must explain and give examples again, asking students to study at home material that will come through learning media, making sure students download lesson material while at school because at school has wifi.
The Second meet students began to become accustomed to online learning and students had already studied the learning material in advance, students began to be familiar with online learning, actively asking questions and giving ideas during discussions. At the second meeting, student activity experienced an increase both seen from observational data based on indicators and sub-indicators as well as the Student Worksheet even though it was not too significant, namely less than 3%. However, it is unfortunate because in cyberspace there are some students who duplicate assignments from other students who first collect their assignments. So, in the third stage the researchers changed the application which became a container for students to send assignments, so that it was more closed and students could not easily duplicate assignments from other students. At the third meet the students' answers were more varied including ideas in making scientific works. However, there are still some students who are late in collecting assignments due to slow internet quota and internet network. Nevertheless, at this meeting student activity experienced a significant increase from the previous phase, namely 3.54% in the Student Activity Sheet, 4.41% in the observation of activities based on indicators, and 5.83% in activity observations based on sub-indicators.

Judging from the development of student activities in each learning process it is found that the value of activities contributes to the blended learning approach in physics using augmented reality learning media. This is consistent with the results of research [25] a blended learning approach; it is innovative in its approach, resulting in active learning, learning that is more personal, student centric and more attractive to students. [26] Student activity in classes that use blended learning increases more than classes that do not use blended learning. [27] Blended learning is suitable in the teaching and learning process because it can improve learning access to learning materials and activities, support and enhance the teacher's role, student experience and social environment. [28] Student learning activities taught using learning media are better than student learning activities taught using textbooks.

4. Conclusion
Based on the data obtained that the blended learning approach using augmented reality can increase student activity. If seen from the Student Activity Sheet in the very good category with an average of 87.02%. Based on the observation sheet of student activity according to the indicator has an average of 38% in the very active category and according to the sub-indicators has an average of 82.06% in the very active category.

5. Discussion
It is expected that the next researcher will make e-classes more closed so that students' assignments are not easily duplicated by other students. Blended learning using augmented reality requires teachers who are proficient in technology. Both teachers, students, and schools are expected to have good resources, especially the internet.

References
[1] Raja R & Nagasubramani P C 2018 Impact of Modern Technology In Education Journal of Applied and Advanced Research 3 1 33-35
[2] Rezende J W Albuquerque E S & Ambrosio P 2017 Use of Augmented Reality to Support Education - Creating a Mobile E-learning Tool and using it with an Inquiry-based Approach Proceedings of the 9th International Conference on Computer Supported Education 1 100-107
[3] Mora C E & González-Marrero A 2017 Virtual Technologies Trends in Education Journal of Mathematics Science and Technology Education 13 (2) 469-486
[4] Shahroom A A & Hussin N 2018 Industrial Revolution 4.0 and Education International Journal of Academic Research in Business and Social 8 9 314-319
[5] Derlina Dalle J Hadi S Mutalib A A & Sumantri C 2018 Signaling Principles In Interactive Learning Media Through Expert’s Walkthrough Turkish Online Journal of Distance Education 19 4 147-162

[6] Ma J Li C & Liang H N 2019 Enhancing Students’ Blended Learning Experience through Embedding Metaliteracy Education Research International 20 19 1-8

[7] Suratno A & Aydawati N E 2016 Exploring Students’ Perception And ICT Use In Indonesian High School A Journal of Culture, English Language, Teaching & Literature, 16 2 178-200

[8] Gökdokuz T 2015 The Positive And Negative Effects Of Digital Technologies On Students Learning The Eurasia Proceedings of Educational & Social Sciences 2 173-177

[9] Soomro S Sommro A B Bhatti T & Ali N I 2018 Implementation of Blended Learning in Teaching at the Higher Education Institutions of Pakistan International Journal of Advanced Computer Science and Applications 9 8 259-264

[10] Ibrahim & Nat 2019 Blended learning motivation model for instructors in higher education institutions International Journal of Educational Technology in Higher Education 16 12 1-21

[11] Albiladi W S & Alshareef K K Blended Learning in English Teaching and Learning: A Review of the Current Literature Journal of Language Teaching and Research 10 2 232-238

[12] Riel J Lawless K A & Brown S W 2016 Listening To The Teachers: Using Weekly Online Teacher Logs For ROPD To Identify Teachers’ Persistent Challenges When Implementing A Blended Learning Curriculum Journal of Online Learning Research 2 2 169-200

[13] Kintu M J & Kagambe C Z E 2017 Blended Learning Effectiveness: The relationship Between Student characteristics, Design Features Andoutcomes International Journal of Educational Technology in Higher Education 14 7 1-20

[14] Utami I S 2018 The Effect Of Blended Learning Model On Senior High School Students’ Achievement SHS Web of Conferences 42 27 2-6

[15] Oweis T I 2018 Research Article Effects of Using a Blended Learning Method on Students’ Achievement and Motivation to Learn English in Jordan: A Pilot Case Study Hindawi Education Research International 1-7

[16] Thomas D 2018 Blended Learning Behavior of University Students and Academic Performance in Thailand Romanian Journal English Study 5 2 12-24

[17] Pohlmann M & Silva F P 2019 Use Of Virtual Reality And Augmented Reality In Learning Objects: A Case Study For Technical Drawing Teaching International Journal of Education and Research 7 1 21-32

[18] Iftene A & Tranbadat D 2018 Enhancing the Attractiveness of Learning through Augmented Reality International Conference on Knowledge Based and Intelligent Information and Engineering 3 5 166-175

[19] Bistaman I N M Idrus S Z S & Rashid S A 2017 The Use of Augmented Reality Technology for Primary School Education in Perlis, Malaysia International Conference on Green and Sustainable Computing 2017 9 2-9

[20] Alkhattabi M 2017 Augmented Reality as E-learning Tool in Primary Schools’ Education: Barriers to Teachers’ Adoption International of Emerging Technologies in Learning 12 2 91-100

[21] Rizova T & Rizova E 2015 Augmented Reality As A Teaching Tool In Higher Education International Journal of Cognitive Research in Science, Engineering and Education 3 1 7-16

[22] Mekacher 2019 Augmented Reality (Ar) And Virtual Reality (Vr): The Future Of Interactive Vocational Education And Training For People With Handicap International Journal of Teaching, Education and Learning 3 1 118-129

[23] Ozdemir M Sahin C, Arcagok S & Demir M K 2018 The Effect of Augmented Reality Applications in the Learning Process: A MetaAnalysis Study Eurasian Journal of Educational Research 74 165-186
[24] Agustin M Yensy N A Rusdi 2017 Upaya Meningkatkan Aktivitas Belajar Siswa Dengan Menerapkan Model Pembelajaran Problem Posing Tipe Pre Solution Posing Di Smp Negeri 15 Kota Bengkulu Jurnal Penelitian Pembelajaran Matematika Sekolah 1 1 66-72
[25] Sahni J 2019 Does Blended Learning Enhance Student Engagement? Evidence from Higher Education Journal of e-Learning and Higher Education 2019 1-14
[26] Pramesti N M G A & Harimurti R 2016 Effect of Application of Blended Learning Model To Improve Student Learning Activities Class X TKJ Jurnal IT-Edu 1 2 76-82
[27] Sari I F Rahayu A Aprilianandri D I & Sulisworo D 2018 Blended Learning: Improving Student’s Motivation in English Teaching Learning Process International Journal of Languages’ Education and Teaching 6 1 163-170
[28] Maulida R & Syahputra A 2019 Implementation of Multimedia-Based Learning Media To Increase Student Activities And Cognitive Learning Outcomes Journal Inpafi 7 3 47-54