The Effectiveness of Augmented Reality (AR)-Based Blended Learning Models to Increase the Creativity of Prospective Educators

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Abstract. This study aims to determine the effectiveness of the Augmented Reality (AR)-Based Blended Learning Model to Increase the Creativity of Prospective Educators. The research method used is Research and Development. The sample in this study were 14 students for the limited test and 42 students for the broad test. The effectiveness in this study can be seen from the results of the paired sample t-test. The result of the paired sample t-test in the limited test is Sig. (2-tailed) of $0.000 < 0.005$ both on the verbal and figural creativity test, which means that there is a significant difference between the learning outcomes of ICT media in the pre-test and post-test data. Furthermore, the results of the calculation of the area test on the paired sample t-test with the results of Sig. (2-tailed) obtained a significance result of $0.000 < 0, 005$ both at the level of verbal and gigural creativity, which means that there is a significant difference between creativity before and after using the augmented reality-assisted MOOCs model. With a significant difference between the results before and after the creativity test, it can be said that learning with the augmented reality-assisted MOOCs model in ICT courses is effective in increasing the creativity of prospective educators.

Keywords: Effectiveness · MOOCs · Blended Learning · Augmented Reality

1 Introduction

The changing world is now entering the era of the industrial revolution 4.0 where information technology has become the basis of human life [1]. The term Industrial Revolution 4.0 was first introduced by Professor Klaus Schwab. A famous German economist who wrote in his book: The Fourth Industrial Revolution [2]. In the context of education, the era of the industrial revolution 4.0 can also be called the "Education Era 4.0", where this

era is a very difficult challenge faced by educators [3]. Education 4.0 includes a meeting of neuroscience, cognitive psychology, and educational technology, using web-based digital and mobile, including applications, hardware and software [4]. Digital technology is the most influential thing in the education system in the world today. This is due to the aspects of effectiveness, efficiency and attractiveness offered by digital technology-based learning [5]. The educational transformation of the 4.0 industrial revolution era changes the learning paradigm, where students become the center of learning and the teacher's role as mentor and facilitator [6]. So that the world of education still has a high relevance in the era of the industrial revolution 4.0 or the era of disruption, educators (teachers and lecturers) in the learning process need to integrate learning outcomes in three fields simultaneously and in an integrated manner, namely the achievements of the old literacy fields, new literacy and scientific literacy [7].

Indonesia is currently facing the Covid-19 virus. The spread of this virus in Indonesia requires changes in the world of education. On March 24, 2020 the Minister of Education and Culture of the Republic of Indonesia issued Circular Letter Number 4 of 2020 concerning the Implementation of Education Policies in the Emergency Period for the Spread of COVID, in the Circular it was explained that the learning process was carried out at home through online/distance learning to provide a learning experience. meaningful for students [8]. Online learning is learning that is done without face-to-face, but through an available platform [9]. One of the ways in which online learning can be done is using a blended learning model. The concept of blended learning is a mixture of learning patterns [10]. Blended learning is a term that comes from English, which consists of two syllables, namely blended and learning. In addition to blended learning, there is the term hybrid learning. These terms contain the same meaning, namely blending, mixing or a combination of learning [11]. The blended learning approach helps create a shared understanding of important concepts with learning cultures and provides opportunities to strengthen them in a dynamic classroom setting [12]. Learning with blended learning can show better differences in terms of motivation, interest, and student learning outcomes compared to other methods, especially methods in direct learning [13]. The advantage of blended learning is that learning activities can be carried out in the classroom or outside the classroom by utilizing technology to add subject matter and questions given in class or online which are managed and controlled in such a way by the teacher so that learning activities can take place, as well as communication between students. and between teachers and students can be established both when in class and outside the classroom (online) by forming a discussion group that takes advantage of technological developments in this era because learning without communication will not produce results in accordance with the expectations of both teachers and students [14].

A learning model that can be used as a form of application from the digital era as well as to overcome problems during this pandemic is the use of MOOCs. Massive Open Online Courses (MOOCs) is a learning model or learning that can be done online on a large scale and the number of participants is widely spread from several different and far apart regions [15]. There are three main constructs that form the basis for the development and use of MOOCs [16]. These elements include the proposed curriculum, the

implemented curriculum and the achieved curriculum [17]. MOOCs have revolution-ized the education sector in no time, opening up opportunities for new pedagogies and business models that allow thousands of students access to free, high-quality education. This free access allows people all over the world to register for MOOCs [18]. MOOCs use technology diversification as a technology applied to distance learning, even if it is small in scope, traditional, and adapts to various things [19]. In addition to traditional course materials such as videos, readings, and problem sets, MOOCs provide interactive user forums, quizzes that help build a community for students, professors, and assistants to deliver online learning content over the Internet to virtually anyone who wants to take a course without fees and restrictions [20].

In addition to the learning solutions during the pandemic that have been offered, there are other problems that must also be found, namely infrastructure. Infrastructure in Indonesia is not evenly distributed, especially internet network connections, so online learning alternatives are needed that can accommodate learning with the limitations of the internet network. One thing that can be done is by developing Augmented Reality technology [21]. Augmented reality is a technology that combines two-dimensional and or three-dimensional virtual objects into a real three-dimensional environment and then projects these virtual objects in real-time [22]. AR technology allows users to interact with virtual objects naturally [23]. Augmented reality technology can connect the virtual world and the real world directly if it is supported by technological devices such as computers and smartphones [24]. In principle, there are 3 components needed to develop this AR technology, namely: 1. Computer 2. Head Mounted Display (HMD) 3. Marker [25]. The advantages of Augmented Reality are as follows: 1) More interactive, 2) Effective in use, 3) Can be widely implemented in various media, 4) Simple object modeling, because it only displays a few objects, 5) Making that does not take too much cost, 6) Easy to operate. While the disadvantages of Augmented Reality are: 1) Sensitive to changes in point of view, 2) Not too many manufacturers, 3) Requires a lot of memory on the equipment installed [26].

From the description above, the researcher will conduct research with the aim of knowing the Effectiveness of the Augmented Reality (AR)-Based Blended Learn-ing Model to Increase the Creativity of Prospective Educators [27]. For this reason, researchers will create AR-assisted MOOC-based blended learning to increase creativity for areas with limited internet connections.

2   Method

This research is an R&D (Research and Development) research. The limited test was carried out on 14 students and the broad test was carried out on 47 students. The test instrument used is a munandar creativity test which includes verbal and figural creativity tests. According to Munandar, the figural creativity test (TKF) measures indicators of fluency, flexibility, originality, and elaboration of creative thinking, while the verbal creativity test (TKV) consists of six subtests, which include (a) word beginnings, (b) word formation, (c) form three-word sentences, (d) the same characteristics, (e) the various uses, and (f) what are the consequences. The aspects of creativity that are measured in this test are fluency, flexibility, originality, and elaboration [28].

To determine the effectiveness of the developed model, whether there is a difference between the initial and final creativity scores for prospective educators, then testing is carried out using the t test using a significance level of 0.05. This test was carried out using the paired t-test of the mean difference between the two groups. The difference in the mean seen is from the results of the pre-test and post-test of the sample after using the developed AR-assisted MOOCs-based blended learning model. The hypothesis and the basis for the decision are seen as follows:

a. The proposed hypothesis
   Ho: There is no difference in increasing creativity (verbal and figural) in prospective educators before using the developed model and after using the MOOCs-based blended learning model that was developed.
   Ha: There is a difference in the increase in creativity (*verbal* or figural) on prospective educators between before and after using the developed MOOCs-based blended learning model.
b. Significance level, a = 0.05 (5%)
c. Decision making basis
   If the value of Sig > 0.05 then Ho is accepted and Ha is rejected
   If the value of Sig 0.05 then Ho is rejected and Ha is accepted

The results of the above analysis are used as a basis to determine the effectiveness of the AR-assisted MOOCs-based blended learning model developed in increasing creativity (verbal and figural) in prospective educators. If the value of Sig < 0.05 means that there is a significant difference between the results of the initial and final creativity of prospective educators. Thus, if there is a real difference, the model developed is effective in increasing the creativity (verbal and figural) of prospective educators. However, if the sig value > 0.05, it means that there is no significant difference between the results of initial and final creativity, which means that the developed model is not effective in increasing the creativity (verbal and figural) of prospective educators [29].

3   Result and Discussion

3.1   Result

Based on the data obtained according to Appendix 31, the data obtained from the initial and final creativity tests in the limited class showed an increase. The following is data on verbal creativity pretest and posttest (Verbal) (Fig. 1).

And based on the test results *The pairing t-test results are as shown in* Table 1.

Meanwhile, the results of the pre-test and post-test Figural creativity data can be seen in Fig. 2.

And based on the test results *Pairing t-test results are obtained as shown in the* Table 2.

Based on the data obtained according to Appendix 32, the data obtained from the initial and final creativity tests in class A field tests showed an increase. The following is data on verbal creativity pre-test and post-test (Verbal) (Fig. 3).
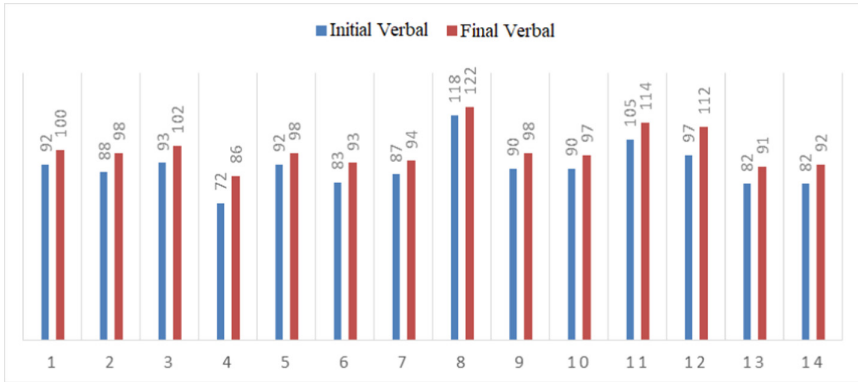
Fig. 1. Graphics of the results of verbal creativity in a limited class

Table 1. Results Pairing t-test verbal

		Paired Differences					t	df	Sig. (2-tailed)
		mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest Verbal - Postest Verbal	-9000000	2.88231	.77033	-10.66419	-7.33581	-11,683	13	.000
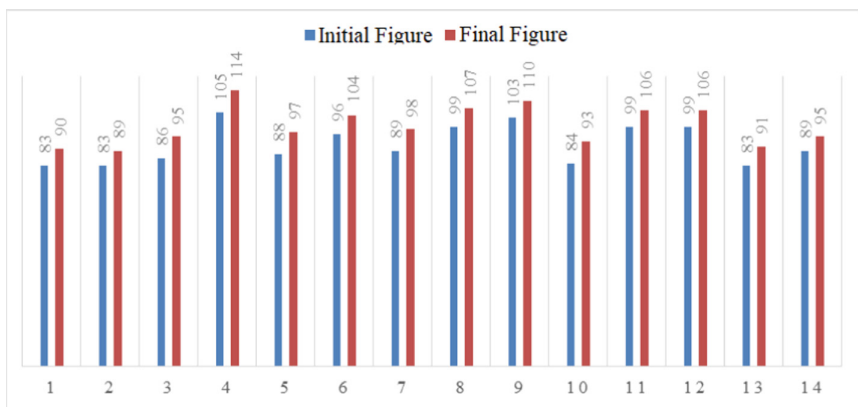
Fig. 2. Graphics of limited class Figural creativity

Table 2. Results *Pairing t-test Figural*

		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 Figural - Pos-Test Figural	-7.78571	1.12171	.29979	-8.43337	-7.13806	-25,971	13	.000
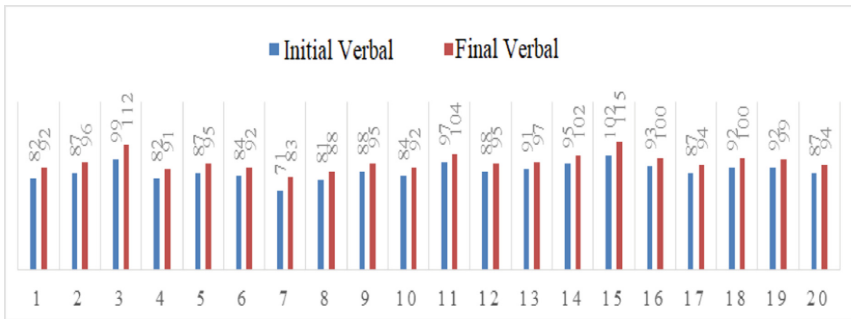
Fig. 3. Graph of the results of verbal creativity in class A

Table 3. Result of pairing t-test verbal class A

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest Verbal A - Postest Verbal A	-8.35000	2.08440	.46609	-9.32553	-7.37447	-17,915	19	.000

And based on the test results Pairing t-test results are obtained as shown in the Table 3 (Fig. 4).

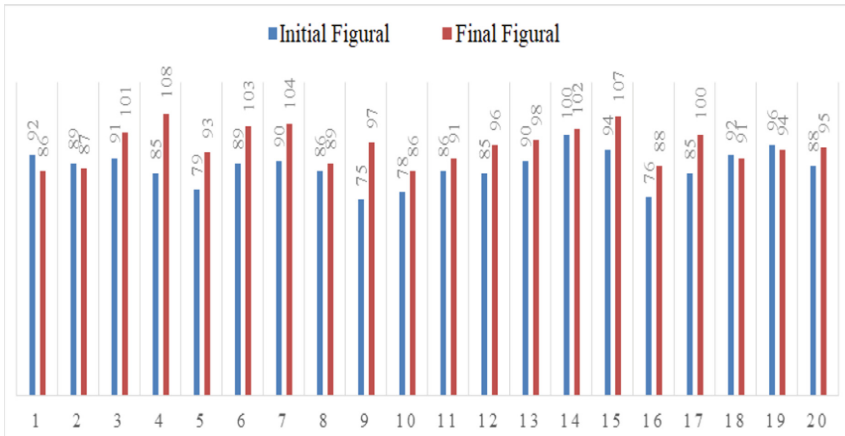And based on the test results *The pairing t-test results are as shown in* Table 4.

Fig. 4. Figural A wide test creativity test results

Table 4. Results pairing t-test figural class A

Paired Samples Test

		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 Figural A - Post-Test Figural A	-8.50000	7.86398	1.75844	-12.18045	-4.81955	-4,834	19	.000

Based on the data obtained according to Appendix 33, the data obtained from the initial and final creativity tests in class B field tests showed an increase. The following is a pretest and posttest (Verbal) verbal creativity data (Fig. 5).

And based on the test results The pairing t-test results are as shown in Table 5.

3.2 Discussion

From the results of the initial creativity test in the limited test in Appendix 31, it shows that there is a significant increase in creativity. This is shown in the results of the pairing t-test conducted. The basis for the decision taken is If the significant value obtained (2-tailed) < 0.05, it can be concluded that there is a significant difference between knowledge of creativity in pretest and posttest data. Furthermore, if the significant value obtained (2-tailed) > 0.05, it can be concluded that there is no significant difference
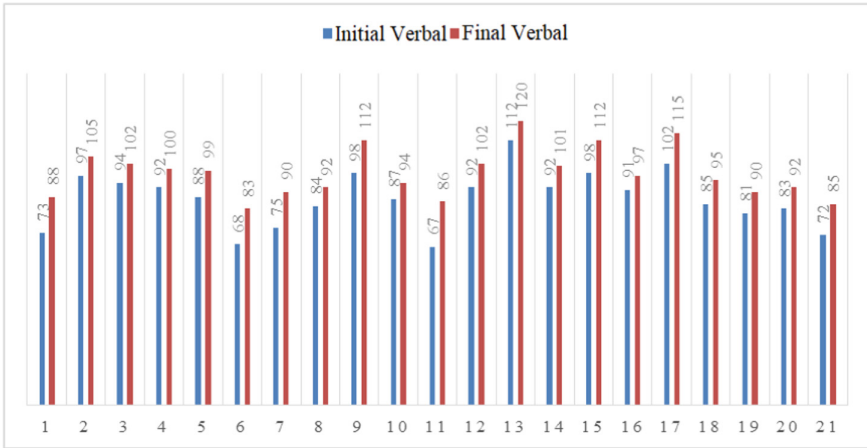
Fig. 5. Verbal B broad test creativity test results

Table 5. Result of pairing t-test verbal class B

		Paired Differences					t	df	Sig. (2-tailed)
		mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest Verbal B - Postest Verbal B	-10.90476	3.44826	.75247	-12.47439	-9.33513	-14,492	20	.000

between creativity knowledge in pretest and posttest data. Based on the results obtained in Table 1. Results Pairing t-test verbal and Table 2. *Results Pairing t-test Figural* both obtained that the value of Sig. (2-tailed) is 0.000 < 0.05, so we can conclude that there is a significant difference between verbal and figural creativity knowledge in pretest and posttest data. This also means that the MOOCs-based blended learning model provided is effective in increasing the verbal and figural creativity of prospective educators in limited classes.

From the results of the initial creativity test in the broad test conducted in 2 classes taking ICT learning media courses in appendices 32 and 33, it shows that there is a significant increase in creativity. This is shown in the results of the pairing t-test conducted. The basis for the decision taken is If the significant value obtained (2-tailed) < 0.05, it can be concluded that there is a significant difference between knowledge of creativity in pretest and posttest data. Furthermore, if the significant value obtained (2-tailed) > 0.05, it can be concluded that there is no significant difference between creativity knowledge in pretest and posttest data. Based on the results obtained in Table 3. Result of pairing t-test verbal class A and Table 4. Results pairing t-test figural class A both obtained that the value of Sig. (2-tailed) of $0.000 < 0.05$. This result is the same for the broad test class B. Based on this, based on the decision above, we can conclude that there is a significant difference between verbal and figural creativity knowledge in the pretest and posttest data in the broad test class (A, B). This also means that the MOOCs-based blended learning model provided is effective in increasing the verbal and figural creativity of prospective educators in large classes.

The initial creativity of prospective educators is still below the expected average value, both in the limited test class and the 2-class field trial. After being given treatment by providing material using a blended learning model based on MOOCs assisted by augmented reality, significant results were obtained. This is based on the results of the final creativity test which can show an increase in the creativity value of prospective educators.

Previous research that is in line with this research is the research conducted by Luntungan et al. (2013) with the results of the research that the application of the Blended Learning Model can increase creativity as seen from (1) The increase in the average score of the student creativity questionnaire in learning, from 67.35 in Pre Cycle, to 81.30 in the first cycle and 89.22 in the second cycle. (2) The average score for making outlines (summaries) of students increased from 67.83 in Cycle I to 77.61 in Cycle II. (3) The average value in the presentation of each student increased from: 68.70 in Cycle I to 75.43 in Cycle II (4) The average value of the student creativity test increased from: 57.52 in Cycle I to 60.35 in Cycle I, and 77.74 in Cycle II [30]. Other studies that are in line are research conducted by Waty et al. (2018) with the results showing the average response of creativity in the first cycle is 54.85% and in the second cycle is 75.95%. Based on these results, it can be concluded that learning using the blended learning model can increase creativity [31]. Furthermore, the research conducted by Kantun et al. (2016) with the results of the research is that the learning creativity of students has increased by using the Blended Learning model carried out by the researchers, as seen from the measurement (a) the results of observations of student learning creativity obtained a percentage of 47.5% (high category) in the first cycle, and 58.19% (very high category) at the end of the second cycle, (b) the average and the percentage of student achievement completeness increased, namely 68.73 in the first cycle and 75.04 in the second cycle, the number of students which reached the KKM in the first cycle of 73% increased to 80% in the second cycle. (c) from the affective domain, students also show an increase, becoming more diligent, diligent, and disciplined [32] (Fig. 6).

Fig. 6. Access Augmented Reality Without Internet Connection

4   Conclusion

The effectiveness of the MOOCs-assisted Augmented Reality-based Blended Learning model is effective in increasing the creativity of prospective educators. This can be seen from the results of the paired sample t-test in the limited test is Sig. (2-tailed) of $0.000 < 0.005$ both on the verbal and figural creativity test, which means that there is a significant difference between the learning outcomes of ICT media in the pre-test and post-test data. Furthermore, the results of the calculation of the area test on the paired sample t-test with the results of Sig. (2-tailed) obtained a significance result of $0.000 < 0.005$ both at the level of verbal and gigural creativity, which means that there is a significant difference between creativity before and after using the MOOCs model assisted by augmented reality.

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