# Augmented Reality in Education in Era 4.0

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**Abstract.** In the era of 4.0 with the growing use of wireless technology, *Augmented Reality* (AR) becomes an alternative to be used in learning media. Several studies have shown that this technology is effective as a medium for learning science and technology. Therefore, research is also needed to examine the effectiveness of AR technology in learning Islamic religious education. The aims of this study was to determine the effectiveness of AR on Islamic religious education learning. This study used a quasi-experimental method with a model of non-equivalent control group design. The experimental class consisted of grade 10 SMA (Senior High School) Sains Al-Qur'an Yogyakarta, Indonesia. The results showed that there was a significant difference between the control group and the experimental group. The experimental group was faster in understanding Islamic religious education learning than the control group.

**Keywords:** Augmented Reality; Islamic Religious Education; Era 4.0

## 1 Introduction

Changes in the world towards the 4.0 era, accompanied by technological developments, encourage changes in various aspects of life. Changes and developments in technology have also influenced developments in the world of education, especially the development of learning media [1]–[3] with the use of internet devices and networks, triggering the development of learning media based on Android which allows visualizing real objects that we know as Augmented Reality. Augmented Reality (AR) as a technology that combines real and virtual objects at one time and one interaction [4], [5]. AR has an important role in communication, research, industry and art in the aspects of combining with smartphones [6]. AR is also ready to change our education [7] as well as become mainstream due to the development of smartphones with location-based services [8], because AR can be an alternative for exploring 3D objects and data.

Augmented Reality has been widely used as a means of conveying specific information such as price information and specifications [9], also used in product marketing [10]. While in education, AR can be used in lessons [11]–[16], but it is more widely applied in the field of science [17], [18], for example as a medium for the introduction of organs and digestion [19], [20]. AR is still rarely applied in religious learning. The study of AR in Religious Education, for example what Karamouzis & Kaffalas did about music in major religions [3]. This study focuses on increasing interest in learning and the learning process, where students using AR get unique experience in learning [3], whereas in Islamic education there is a literature review

and content analysis on the use of AR in learning prayer [21]. The benefits of AR in education are beneficial for students and educators [22], which one AR makes learning more interesting [1], [6] and improves students' understanding of the material [23]. In the religious field, AR also facilitates learning, for example learning about the church, doctrine and text of the Bible [23], In Islam, AR can also improve understanding and practice of prayer [21].

However, the results of research that mention the benefits of AR in increasing understanding and practice of new prayers are limited to literature review and content analysis, so it needs to be tested further in the form of experiments to determine the effectiveness of AR in Islamic religious learning. So, this study aims to determine the effectiveness of AR in learning Islamic Religious Education in the Senior High School (SMA) Ilmu Al-Qur'an Yogyakarta.

## 2   Methodology

This study employed a quasi-experimental model non-equivalent control group design with a control group and an experimental group (Class X of SMA Ilmu Al-Qur'an Yogyakarta), totaling 60 students, with details of 30 experimental group students (using AR media) and 30 students in control group (conventional class). The data analysis technique used nonparametric statistics with the Mann Whitney test, because the data were not normally distributed. So, it didn't qualify for the parametric statistical test. Analysis using SPSS version 23. Augmented Reality (AR) is declared effective if there is a significant difference in scores between the experimental and control groups. The hypotheses built were, Ho: there is no significant difference in scores between the experimental and control groups, and Ha: there is a significant difference in scores between the experimental and control groups. With the assumption (Ho) is rejected and (Ha) is accepted if the probability value (p) $\leq 0.05$.

## 3   Results and Discussion

In the current era of the Industrial Revolution 4.0, technological advances have the potential to significantly improve the quality of learning processes and outcomes, including the development of learning media. With the development of learning technology at the end of the 20th century, the education system changed rapidly. This is due to the ability of technology to provide a proactive, easy, and comprehensive teaching and learning environment [24]. One of them is *Augmented Reality* (AR).

Measuring the effectiveness of AR with the use of technology in learning media is carried out by comparing the learning outcomes of the group using the media (experimental group) with the learning outcomes of the group that does not use the media (control group). Table 1 shows the descriptive statistics of the two data from the results of the assessment of the experimental group and the control group which shows the difference in the average of the two groups.

**Table 1.** Descriptive Statistics

|                    | N  | Minimum | Maximum | Mean  | Std. Deviation |
|--------------------|----|---------|---------|-------|----------------|
| Experimental group | 30 | 80      | 95      | 85.83 | 5.100          |
| Control group      | 30 | 75      | 85      | 79.83 | 4.251          |
| Valid N (listwise) | 30 |         |         |       |                |

The descriptive statistical of table 1 show that the average value of the experimental group with a value of 85.83 is greater than the average for the control group which is 79.83. Meanwhile, the statistical test results to determine the difference in the two groups values using the Mann Whitney test are shown in Table 2. Where is the Asymp value Sig. (2-tailed) of 0.000 less than 0.05, so that Ho, who stated that there is no difference in learning outcomes between the experimental group (using AR media) and the control group (conventional group) was rejected and Ha was accepted. It means that there is a difference in learning outcomes between the experimental group (using AR media) and control group (conventional group).

**Table 2.** The Results of Statistical Analysis with Mann Whitney

|                      | Learning Outcomes |
| -------------------- | ----------------- |
| Mann-Whitney U       | 185.500           |
| Wilcoxon W           | 650.500           |
| Z                    | -4.070            |
| Asymp. Sig. (2-tailed) | .000            |
| a. Grouping Variable: group | |

Based on the descriptive statistics and different test results with Mann Whitney show that there are differences in the value of learning outcomes from the experimental group and the control group, so it can be said that Augmented Reality is effectively used in Islamic learning.

The results of this study show that *Augmented Reality* (AR) is effective for learning, especially in Islamic religious education in the era 4.0. This is in line with the results of research by Yuliono et al. [25] which revealed that AR media is effective for learning, strengthens the research results of Khairuldin et.al, [21] which state that AR can improve understanding and practice in Islamic education, namely in understanding prayer. It is also effective on children with special needs [2], [26], [27], Gabajova, et al. [28] in his research also showed that learning using AR technology was 44.07% more effective than conventional methods. In addition, AR has been shown to increase motivation to learn, interact, and collaborate [20]. Khan, et al. shows that the use of *Augmented Reality* can increase learning motivation by 14%, attention to learning by 31%, self-confidence in learning by 11% and learning satisfaction by 13% [29].

In 2018, a meta-analysis study of 100 journals indexed by the Social Science Citation Index (SSCI) for 10 years (2007 - 2017) on the effect of using AR in the learning process revealed that the application of AR in learning can improve student academic achievement when compared to the traditional way of learning [17]. AR applications are still under development and their capabilities are always dynamic. Fluctuating features and capabilities require staff to make continuous adjustments [30]. With careful design practice, AR technology can be used relatively to reach information, easy to use, and inexpensive [31].

AR's capacity to bring multimedia to the real world via web-labeled devices such as smartphones and tablet means that information can be available to students at the right time and place it is needed. This has the potential to reduce cognitive load by providing students with a perfectly placed scaffold, and enabling learning in other settings [7]. The potential use of AR in various types of learning material is needed to understand the wide range of AR media learning.

In practicum material, *Augmented Reality* facilitates the learning process and provides high efficiency [32]. Saltan & Arslan show that the use of *Augmented Reality* in formal education can improve academic achievement, student activity in learning, motivation and satisfaction with the available learning environment [33]. Ottogalli, et al. found that Virtual Reality and *Augmented Reality* are the key to technological advances in the Era 4.0 which are able to make

it easier for someone to learn something in real experience without having to bring it into reality [34]. However, AR also inseparable from obstacles, for example in the difficulty of its use [35], including in religious education AR has challenges to be able to cover spiritual and sacred aspects as well as the limits of religious norms [23].

## 4 Conclusion

The industrial revolution 4.0 was marked by a strong integration between the digital world and industrial production. In this digital era, all machines are connected via the internet system or cyber system. Among its characteristics is the use of wireless or wireless technology to increase the efficiency of each job. *Augmented Reality* is able to convey information or learning material in the form of audio visual with wireless so that it is in accordance with the 4.0 era. The use of AR technology in Islamic Education learning can be an alternative to realize effective, fun and efficient learning in the 4.0 era.

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