The Effect of Augmented Reality on Students' Motivation and Spatial Ability: A Literature Review from 2016-2020

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Received:
16 July 2022
Accepted:
23 September 2022
Published:
30 September 2022

Citation: Silvi, I. (2022). The Effect of Augmented Reality on Students' Motivation and Spatial Ability: A Literature Review from 2016-2020. *Journal of Educational Technology and Instruction, 1*(1), 25-35.

Abstract—Student motivation in learning is one of the most important things during the learning process, lack of motivation makes students lazy and unmotivated during the learning process. On the other hand, with increased motivation, students will hone their ability to understand, remember and communicate the subject matter they get during the learning process or what is called spatial ability. The application of Augmented Reality in the learning process is expected to build students' motivation and spatial abilities. The development of technology is expected to make the learning process more interactive and communicative. In this literature review analysis, we will discuss the contribution of Augmented Reality to increasing students' motivation and spatial abilities during the learning process. twenty articles downloaded from springer database from 2016-2020. based on this literature review, the application of Augmented Reality to strengthen students' motivation and spatial abilities during the learning process.

Keywords: Augmented Reality, Motivation, Spatial Ability.

1. INTRODUCTION

Augmented Reality is a technology that combines the virtual world with the real environment. but its position is only as a complement in the real world in order to further maximize the goals to be achieved (Irwanto et al, 2022; Moro et al, 2021; Geoirgiou, 2018). in principle, AR application is the use of software and hardware into a real environment by creating interactive and dynamic content. Technology is growing, making smartphone platforms which are basically only used for long-distance communication, can now be developed to support Augmented Reality applications, especially in the learning process. It is hoped that with Augmented Reality it can add information and a deeper understanding of the subject matter for students.

With Augmented Reality, it is expected to be able to overcome one of the main problems in students, namely students' motivation and spatial abilities in the learning process (Mumtaz et al, 2017). In the classroom, teachers often find a lack of motivation to learn in students. Many studies have examined how to build motivation that comes from the students themselves. because self-motivation is very influential on the process and final results that will be accepted by students (Sontay & Karamustafaoglu, 2021). lack of motivation will have an impact on the monotony of the learning process and minimal acceptance of subject matter, so that students will become lazy in continuing the learning process. the lack of motivation will also have an impact on students' spatial

abilities, where this spatial ability covers the student's process of perceiving, storing, remembering, creating, and communicating subject matter received during the learning process. so that in this study, researchers will raise issues related to the role of Augmented Reality in building students' motivation and spatial abilities during the learning process.

In this literature review, the researcher raised 5 variables including student motivation, students' spatial ability, country of correspondence, number of authors in one article and year of publication of the article. one of the previous studies related to the Augmented Reality literature review was conducted by Manoela, et al. 2019. where the literature review study examines evaluation variables and the education system, and the results are an increase a number of articles evaluating the impact of Augmented Reality in education. They also show that Augmented Reality has been applied in various areas and contexts (phon et al, 2015; Mundy et al, 2019; Salem et al, 2020; Frydenberg & Andone, 2018). Most articles report positive results because of implementing Augmented Reality. However, most studies lack teacher involvement and the use of multiple metrics to evaluate educational benefits.

2. METHODS

In this study, researchers will conduct studies related to articles that discuss the role of Augmented Reality in increasing students' motivation and spatial abilities during the learning process, where the range of years taken is from 2017 to 2020 which will later be included in the literature review. For article search, the researcher took from Springer database. From the articles that have been collected, it can be concluded that by searching for articles with the keyword Augmented Reality, the number of articles is 34,849 articles. Then the researcher limited the search to articles that could be accessed, so the number of articles that could be accessed was 3,967 articles. The researchers then narrowed the scope of the article with the keywords of students' motivation and spatial ability, the number of articles for the keywords Augmented Reality and motivation was 1,158 articles. From the total data, it was filtered again, and 18 articles were obtained that met the criteria for the Effect of Augmented Reality on increasing student motivation. while the number of articles with the keywords Augmented Reality and students' spatial ability was 800 articles. From the total data, it was filtered again, and 4 articles were obtained that met the criteria for the Effect of Augmented Reality on increasing student spatial ability. for the article grouping framework starting from the search process to the articles that can be analysed, the researcher uses a literature prism model to make it easier to group articles. The following is the grouping of articles using a literature prism:

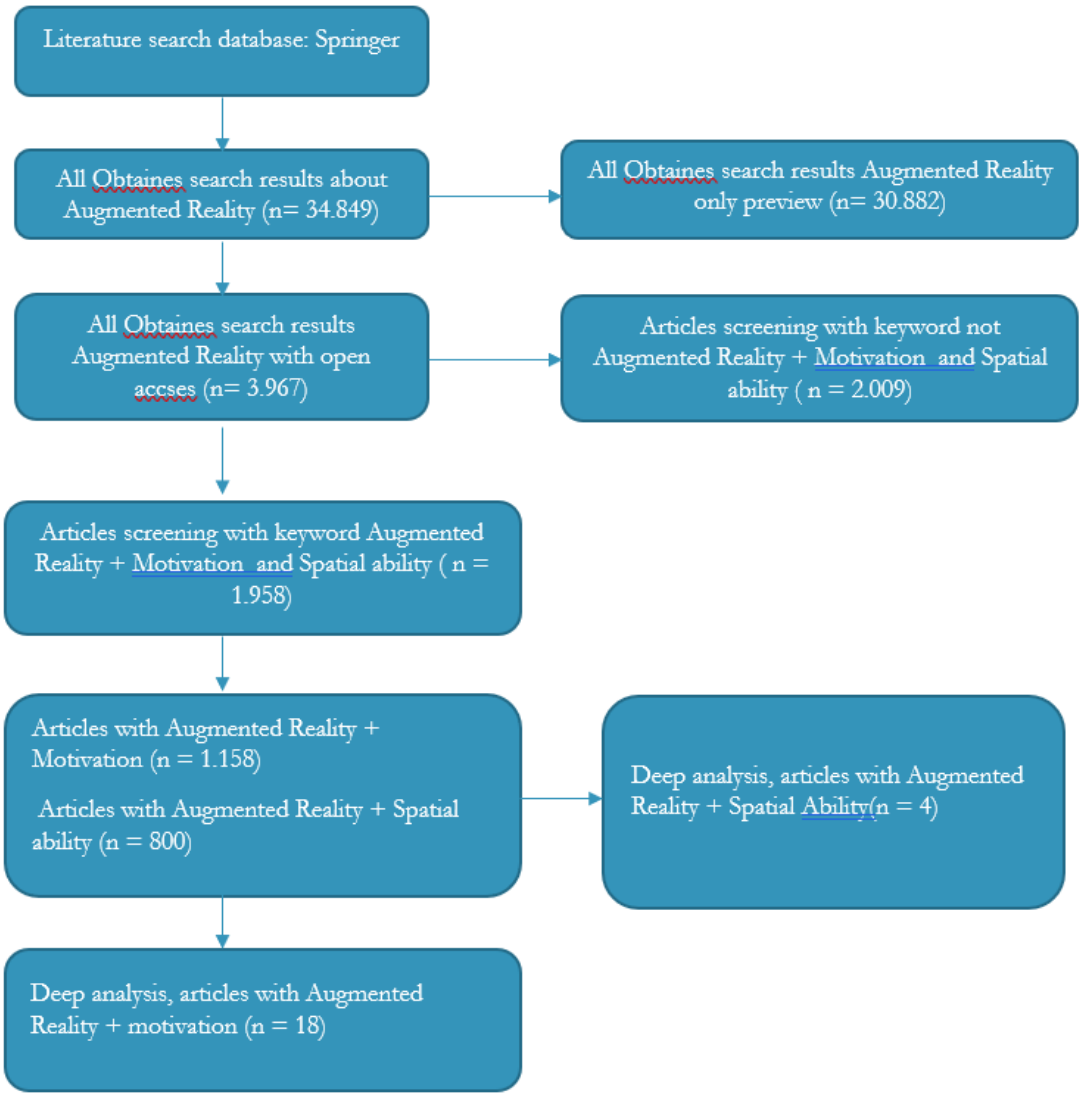

Figure 1. literature review prisma

3. RESULTS

In this literature review, the authors took 5 variables under study including students' motivation and spatial ability. and the addition of three more variables including the number of authors, the country of correspondence and the year the article was published. The following are the results of a review of the articles that have been compiled:

3.1 Motivation Variable on the number of articles that can be accessed

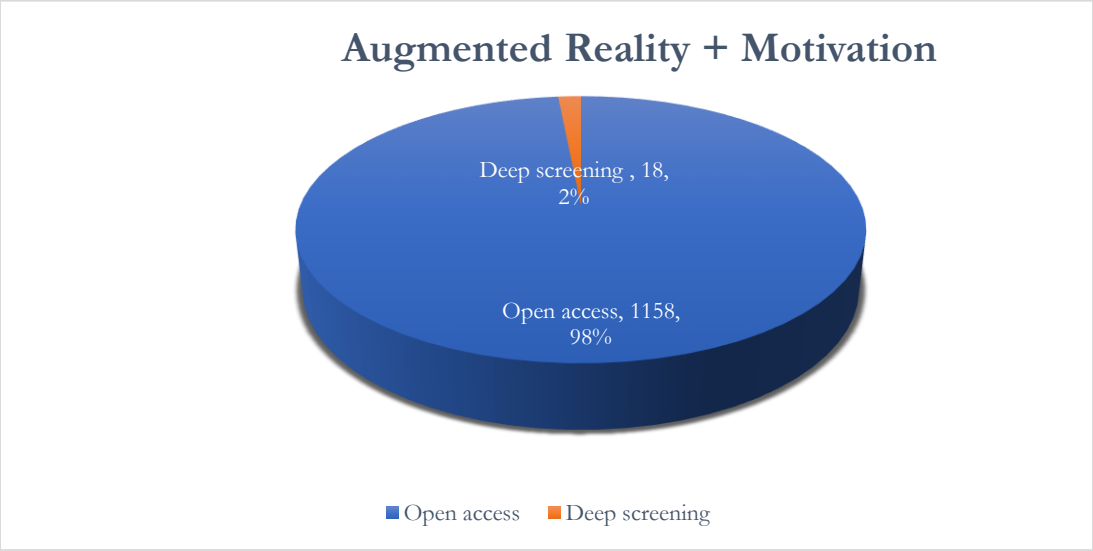

Figure 2. Motivation Variable on the number of articles that can be accessed

3.2 Spatial Ability Variable on the number of articles that can be accessed

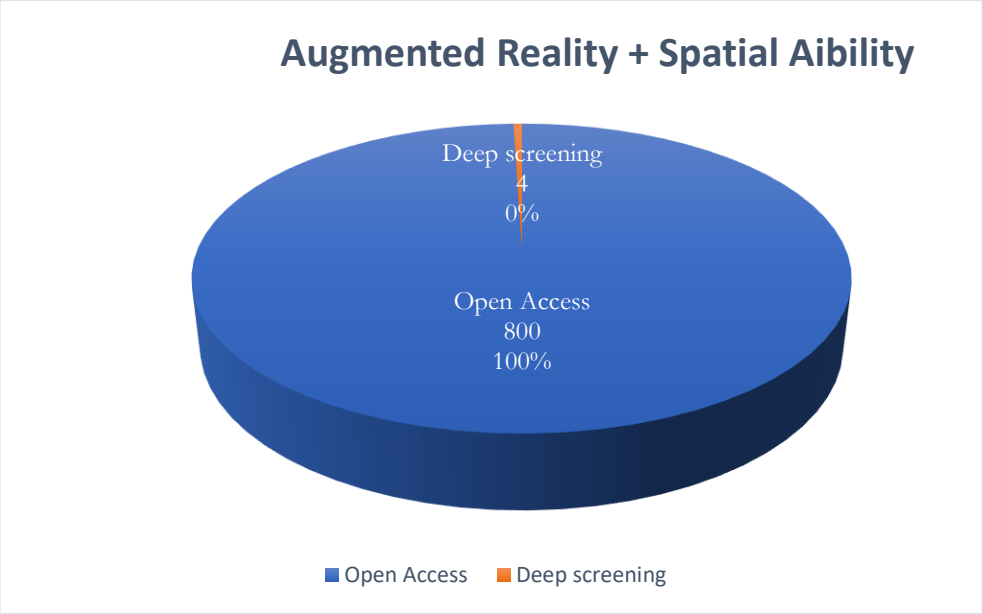

Figure 3. Spatial Ability Variable on the number of articles that can be accessed

3.3 Variable of Total Authors in the article

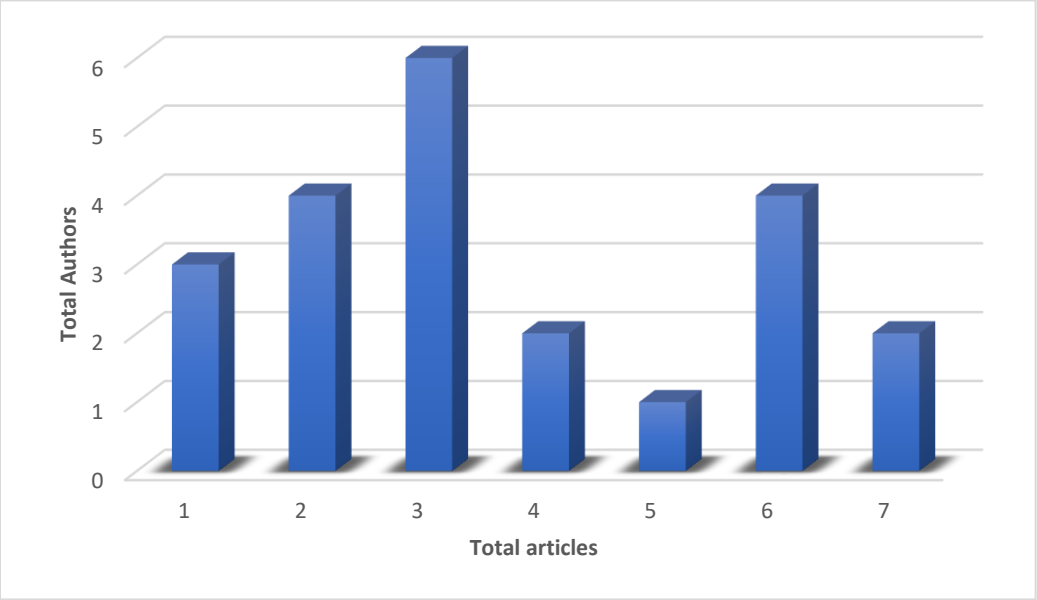

Figure 4. Variable of Total Authors in the article

3.4 Variable of Country Correspondence in the article

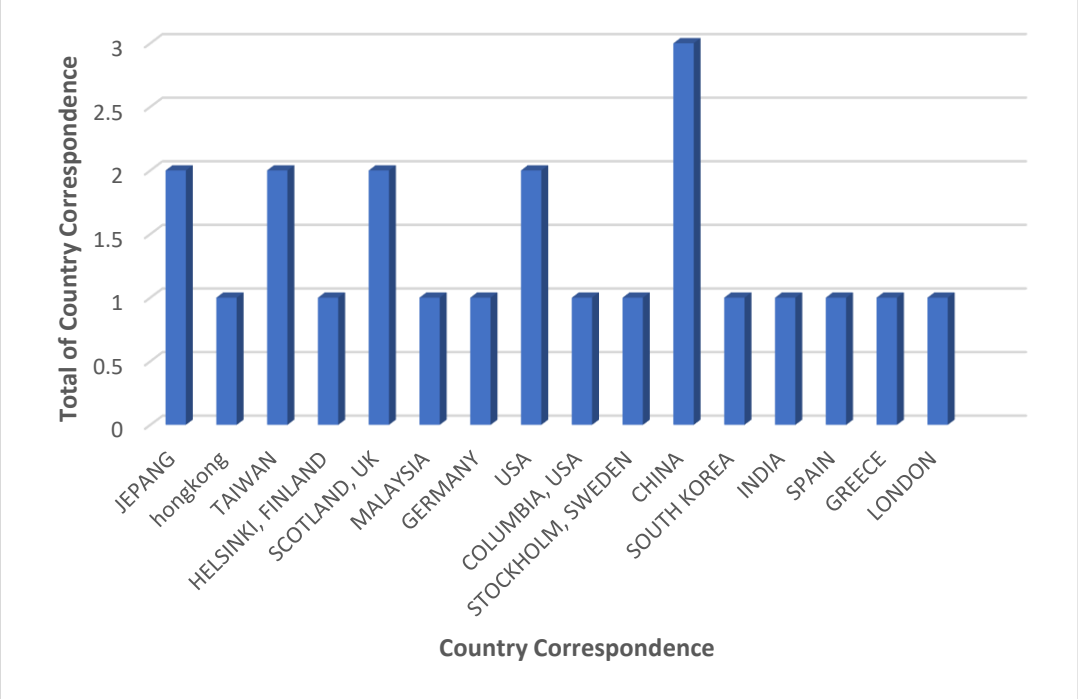

Figure 5. Variable of Country Correspondence in the article

3.5 Variable of Article Published

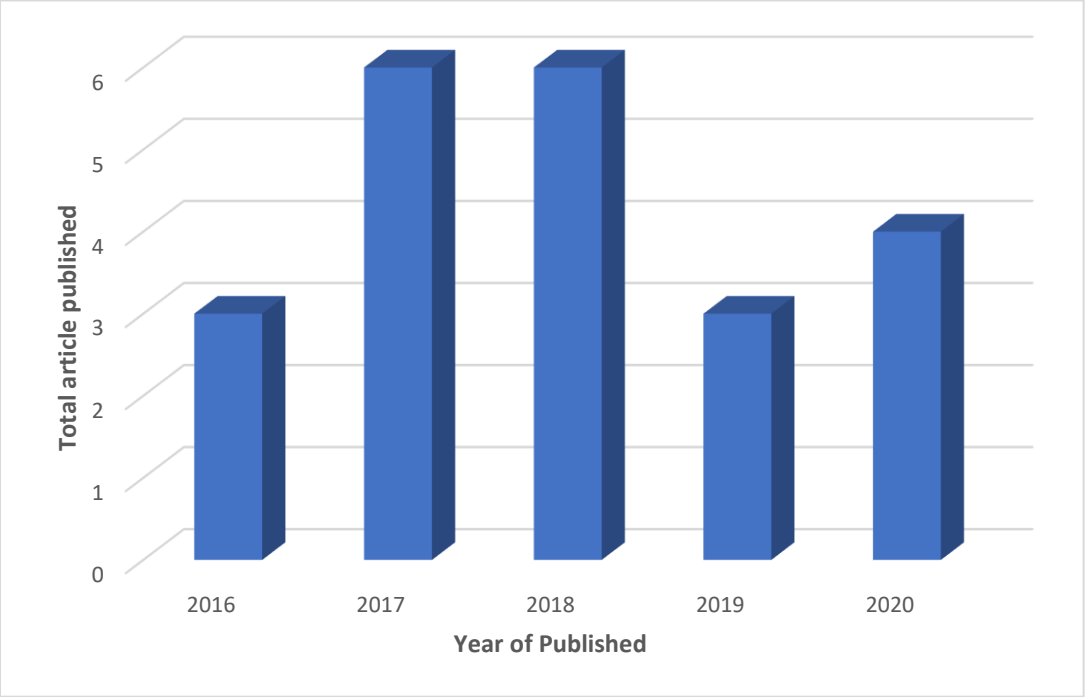

Figure 6. Variable of Article Published

4. DISCUSSION

Based on the results obtained from the 5 variables that the researchers tried to raise, including Augmented Reality affecting students' motivation and spatial ability, then variables related to the number of authors in the article, the country of correspondence and the year the article was published, from the results of an in-depth analysis, the total motivation variable was 18. articles from 1,158 articles that can be accessed, for the spatial ability variable as many as 4 out of 800 articles that can be accessed. and for the number of authors in the article, there are at most 7 authors and at least 1 author. then for the correspondence country variable, the most in China and the last variable is the year of publishing the most articles with the keywords Augmented Reality, Motivation and Spatial Ability in 2017 and 2018.

In the first variable, the issue raised is the effect of Augmented Reality on student motivation, where out of 1,158 articles filtered in the Springer database, there are only 18 articles that can be analyzed in depth. this is due to the large number of mixed articles and non-articles that are also filtered when searching with the keywords Augmented Reality and motivation and the most basic is the selected articles which will later be analyzed, namely only articles that include the country of correspondence and few articles are found that want to include it. This is done so that the filtered articles are articles that can be accounted for in the future. The issue of student motivation is an issue that is still unsolved. There are many studies in solving motivational problems,

until now they have not been able to overcome students' motivation problems in the learning process. Motivation in students is not only influenced by the students themselves but also from external factors. This is something that cannot be controlled in research. Previous research related to the effect of Augmented Reality on student motivation, was conducted by Sarkar, et al. 2020, where the results obtained are that the design of AR learning activities encourage students to discuss concepts with classmate, enhancing immersive student experience as students move together around and within their homes to find and identify corners.

In the second variable, the issue raised is the effect of Augmented Reality on students' spatial abilities, where out of 800 articles filtered in the Springer database, there are only 4 articles that can be analyzed in depth. The reason is the same as the first variable, where only articles that include the country of correspondence will be analyzed in depth. Spatial ability is an ability that must be possessed by students. This is because spatial abilities support students' critical thinking power, ability to remember and most importantly the ability to communicate what they see, hear, and understand, able to convey properly and correctly (Danisman & Erginer, 2017; Kim & Bednarz, 2013; Chang et al, 2013)). previous research was conducted by Zhang, 2017. whereby applying Augmented Reality and RTS games the results showed that the proposed method met the requirements augmented reality system in terms of efficiency and accuracy.

In the third variable, the researcher raises the issue of the number of authors in making articles. The highest number is 7 authors, and the least is 1 author. This variable was appointed because the researcher wanted to know how many writers were able to collaborate in making articles. In the fourth variable, the researcher raised the issue of the country of correspondence not the country of the author's origin. this is related to the third variable where the number of authors in one article and the discovery of authors from various countries (collaboration) makes it very difficult to choose which country to appear. Therefore, the country of correspondence will represent the country of the author of the article.

In the fifth variable, the researcher raised the issue of the year the article was published. This variable is very important because we can know when the most productive year in writing this article. where we can also know when the issue of motivation and students' spatial abilities in the learning process becomes a problem that must be resolved immediately (Garzon et al, 2020; Kim & Irizarry., 2021; Musyaffi et al., 2021).

5. CONCLUSION

The learning process can be said to be successful and quality if there is interactive interaction between teachers and students. building student motivation in learning is one of the keys to the life of the learning process. also supported by the sharpening of students' spatial abilities in receiving subject matter, then meaningful learning can be realized. Augmented Reality is expected to be able to solve problems related to the lack of student motivation in learning and be able to improve students' spatial abilities during the learning process.

6. LIMITATIONS AND RECOMMENDATIONS

This literature review study focuses on how the effect of Augmented Reality on students' motivation and spatial abilities, plus 3 additional variables, namely the number of authors in the article, country of correspondence and year of publication of the article.

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