# Let's Calculate Kids: The Development of 3D Augmented Reality Mobile Learning Apps to Enhance Learning Engagement in Basic Calculation for Preschools

**Mohd Hatta Mohamed Ali @ Md Hani**[1*]**, Siti Noormashetah Halim**[1]**, Norfaraliyana Muhamad Azli**[1]**, Masturina Balqiz Zamri**[1]**, Sam Faheeda Abdul Samad**[2]

[1]Department of Information Technology, Centre for Diploma Studies,
Universiti Tun Hussein Onn Malaysia, KM 1, Jalan Panchor, Muar, 84600 Johor,
MALAYSIA

[2]Human Resource Division, Registrar Office,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor,
MALAYSIA

*Corresponding Author Designation

**Abstract:** Mathematics is the best method of developing mental discipline while encouraging logical thinking and mental assertiveness. Furthermore, the COVID 19 epidemic is now sweeping the whole world including Malaysia and making it difficult to learn Mathematics. So, the method of learning Mathematics also needs to be enhanced according to the current situation. This paper will look at how learning techniques can be improved to make them more interesting and relevant especially in mathematics subjects. It is important that enhance teaching and learning method are provided for mathematics. This paper will examine mobile learning techniques (Lets Calculate Kids) for math subjects using the ADDIE methodology method. The use of the concept of Augmented Reality (AR) used in this application to prove the new changes in the learning system technologically. The target group then underwent many tests to confirm it. At the end of this article we can find out the expected findings that this project is successful in helping preschool children learn mathematics using the latest technological techniques. The effectiveness of the Lets Calculate Kids application in early mathematics acquisition is likely to be extended to the study of other topics in other industries.

**Keywords**: Augmented Reality (AR), Mobile Learning Application, Learning Engagement in Calculation, Mathematics

*Corresponding author: hatta@uthm.edu.my
2022 UTHM Publisher. All right reserved.
penerbit.uthm.edu.my/periodicals/index.php/mari

## 1. Introduction

Methodical learning through the use of technology is very popular with everyone in this age and age of Malaysian technology because it allows the learning system to be used more effectively and easily understood. The use of applications as a learning process provides new initiatives that may be inherited and used as a long term learning approach. Applications are technologies that have been transformed into specific purposes with many conveniences that can be used anywhere. Applications for computers and mobile phones will cover a wide range of topics. Learning in this technological approach is very important for such facilities, as it is very beneficial in attracting a group of young students who are interested in learning systematically. Because it is so useful in today's world of technology, revived online learning is generating significant community acceptance. For the use of each student, all technological approaches adhere to highly effective learning criteria. It is highly recommended that children use this application as a platform that will help the learning process in various ways other than just using books by exposing them to the world of technology from a young age [1].

When technology is mixed with conventional schooling, it has a strong influence. The most important thing in using technology in teaching and learning is how it is used to help students develop thinking skills. Students can use technology to overcome difficulties in their daily work if they take the right approach. The use of technology to enhance student centred learning is a successful technique. Students are able to interact in real time with their peers and learning will be more interactive if technology is used to give them space and opportunities to explore the real world or perform simulations with pre -planned applications. With Internet technology, students can interact in real time with peers and learning will be more interactive. When children are able to create their own mathematical concepts as a result of doing creative activities, this is known as mathematical learning. Computers, as we all know, are tools that can help us acquire better mathematical knowledge. The main reason why this subject is difficult to learn is because children's perceptions of mathematics are a difficult subject to learn and less interesting for them. This also makes children less interested in pursuing a career in mathematics. In fact, children also consider basic computing operations difficult to understand and learn [2]. When there is reciprocal learning between processes and objects, cognitive relationships are created as a result of these interactions, mathematical understanding can be gained [3].

Preliminary studies show that children's thinking in this area develops progressively, with obvious limitations on certain skills at various times. The early growth of mathematics is started at an early age to see their abilities. However, for the purpose of this final project, it will help the preparation of lessons in activities related to children's early acquisition of mathematics at the preschool level. Early math exercises that can interest the child. At this stage, the main focus is number identification, and number calculation [4].

In this section, we will conduct a search through a review of the literature. The literature review we conducted was a comprehensive summary of past or previous research on a particular topic. A literature review will also be conducted by researching scientific articles, books, journals and other sources that are important to a particular research topic. Past or previous studies will be counted, explained, summarized, objectively evaluated, and clarified in a comprehensive review [5].

### 1.1 Problem and Difficulties of Learning Mathematics

Mathematics is a basic subject that children need to learn at an early stage. This subject is considered less desirable and lacks readiness, however this is a compulsory subject for children to learn. Due to that, there are various issues that cause children difficulty in learning mathematics.

In addition, children who are given less early exposure to mathematics learning while in kindergarten will result in students who lack interest and in-depth knowledge in mathematics. Further, why these subjects are difficult subjects is because they face difficulties in basic calculations [6]. This is because mathematics subjects are less exposed in advance to children which makes children's culture shocked when they suddenly have to learn a subject that has never been taught before even though it has never been taught at home [7].

As a result, the problem in learning mathematics should be solved by finding a solution so that the standard of education in Malaysia can reach a new and higher level on par with international and in line with the passage of time.

## 1.2 Technique for Teaching

A teaching method is a technique that will be taught by a teacher or lecturer either in class or by chance. Therefore, there are two types of teaching methods that have been identified, namely traditional and advanced teaching[8].

This traditional teaching method is still used by the majority of school teachers to students and children [9]. With this traditional teaching method, students now only use the listening skills fully by the teacher during the learning process as a result of this technique. Whereas, in the advanced teaching method, this method uses a lot of IT technology while teaching and also uses existing technological materials to teach.[10].

In conclusion, students lack the skills of critical thinking, problem solving, or decision making because with the use of traditional teaching methods only rely on repetition and memorization of knowledge alone. Advanced teaching methods have been designed to enhance the comprehension that will be conveyed visually as it can provide an approach to students in this modern age, in line with current growth.

## 1.3 Advanced Learning using Augmented Reality (AR)

Advanced teaching with application development is a suitable way to be used as teaching material for children to improve teaching methods other than traditional teaching. The use of apps is a method of teaching that involves the use of technology and is thought to have beneficial impacts on learning [11]. By adding Augmented Reality (AR) into our apps Let's Calculate Kids achieves the advanced teaching feature

Furthermore, Augmented Reality (AR) is a new technology that has emerged in recent years and is primarily used in the sector of education. Educational scholars have been attracted to how AR technology works by supporting and offering more efficient learning versus its use. [12]. In the real world, AR can be used to provide additional and contextual information that helps learning in reality experience [13]. In reality, AR is a useful method of learning and encouraging student interaction during classroom sessions [14]. There are numerous benefits of Augmented Reality in education, and there is a great deal of potential for integrating AR into teaching and learning, especially in subjects that require suitable abstract visualisation, such as mathematics

In accordance with the modern era, which is facing the Covid-19 pandemic, AR also facilitates learning outside of the official classroom by establishing a learning experience that is linked to the regular classroom [15]. It also enables for the integration of physical display aids such as annotations and virtual illustrations, which can help students comprehend the application better. This is because AR provides unique teaching tools for manipulating and interacting with abstract concepts in the actual world, which can increase learning limits in topics like mathematics. As a result, the application of AR has the potential to transform traditional learning into advanced teaching by providing the best way for engaging students in learning and most importantly making teaching more exciting. Finally, the use of technology in education shows that it may boost motivation and knowledge in any learning situation.

## 1.4 An overview of existing Mathematics Learning Applications

Observation of existing applications is very important to develop an application. It can provide information about the application that has been developed, and also serves as a reference to improve the ideas that will be applied to the application to be developed. These are the selected applications listed below:

**Table 1: Applications that have been selected for an overview**

| Item | Math For Kids | Kids math-math game for kids | Math Kids- add, subtract, count and learn |
|------|---------------|------------------------------|-------------------------------------------|

| Icon | | | |
|---|---|---|---|
| Learning Method | VAK | VAK | VAL |
| Background Audio | Yes | No | Yes |
| The difficulty | No | No | Yes |
| Instruction | No | No | No |

This table is a comparison between the applications that have been developed related to mathematics with basic calculation topics in the application warehouse to see the strengths and weaknesses of each application developed to make improvements on our application project as shown in **Table 1**.

Moreover, each application that has been created has its own unique characteristics. As a result of the comparison of the three apps, all of the flaws in the existing apps will be repaired in Let's Calculate Kids, and add some new functional elements will be included to set it apart from other Google Play apps and allow users develop their basic math skills. Also an advantage that can be improved into the application of Let's Calculate Kids is with the addition of the concept of Augmented Reality (AR) to show how to calculate better and easily understood by children in detail.

1.5 Augmented Reality's Effectiveness (AR)

Augmented Reality (AR) is the application of information in the form of text, graphics, music, and other virtual enhancements combined with real-world items. AR is characterized from virtual reality by a "real world" component. In contrast to simulation, AR combines and adds value for user engagement with the real world. [16]. With the use of AR, classroom education can be extraordinary and more interactive, as AR can allow teachers to demonstrate examples of concepts virtually and add game elements to provide textbook material support. This will allow students to learn faster and memorize information [17].

Therefore, the use of augmented reality techniques as a teaching and learning medium has the potential to influence how new technologies are used in teaching and learning, as well as provide alternative possibilities for teachers. The use of AR as a medium of instruction has the potential to transform how technology is used in the classroom. Teachers and pre-schooler students have a variety of ways and strategies to choose from when it comes to using AR applications as a medium of teaching and learning. The benefit is that it allows pupils to save time in mastering a skill [18].

By building an application that uses AR can help students and attract their interest in mathematics subjects more easily understood and improve counting skills. Besides, it helps educators get to know more and take advantage of the latest technology in preschool education. The final hope for the products developed includes being able to attract students to learn mathematics subjects. Moreover, it can help educators improve their knowledge of digital content. Lastly, it can be able to guide preschool students on how to learn using the latest technology and use it for beneficial things.

2. **Materials and Methods**

The project employs the ADDIE design technique to investigate and build this learning application, and the phases involved are Analysis, Development, Design, Implementation, and Evaluation. This research is being carried out to discover the truth about what is happening in the present system in order to ensure that each element is able to regenerate from the existing system. Several studies were conducted for the creation of the Lets Calculate Kids application utilising the idea of AR to determine if this Android application is highly suited for the apps that have been done. As a result, the ADDIE

model will describe samples, instruments, data collecting, and data analysis procedures. **Figure 1** shows the ADDIE model.
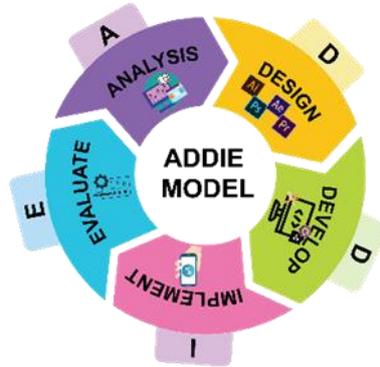


**Figure 1: ADDIE model**

2.1 Analysis

We have been done a research at this step of the analysis by discover the difficulties that exist in application development. Several investigations were conducted throughout the creation of this application. This is to be guaranteed that the construction of computational apps at this early level is feasible. The general public as well as kindergarten pupils aged 5 to 6 years old are targeted users for the Let Calculate Kids application. Several scopes must be targeted during this analysis phase, including project scope, project history, project objectives, application development scope, and learning issues.

2.2 Design

The storyboard and user interface are designed in the second step, design, of the development process. In order to verify that the design produced is acceptable and able to attract consumers, discussions with the target group were also held. This phase uses the notion of a prototype to create a storyboard that depicts the complete display. **Figure 2** depicts the storyboard design.
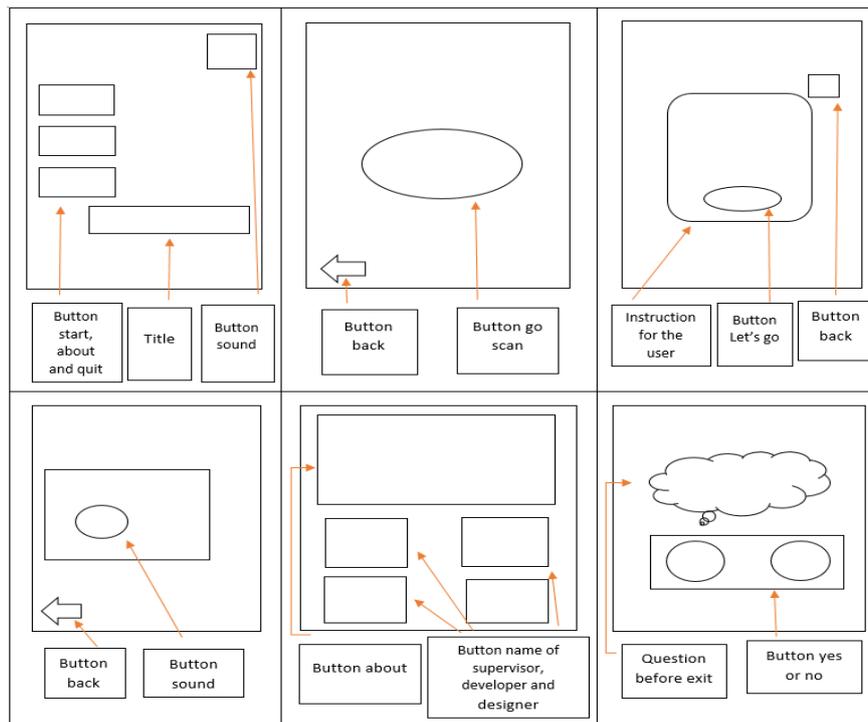
**Figure 2: Storyboard of Let's Calculate Kids**

2.3 Development

The application was developed in the third phase of development using the specifications and needs generated from the design phase. As indicated in **Figure 3**, certain software was utilized in the development process, such as Adobe Illustrator and Adobe Photoshop.
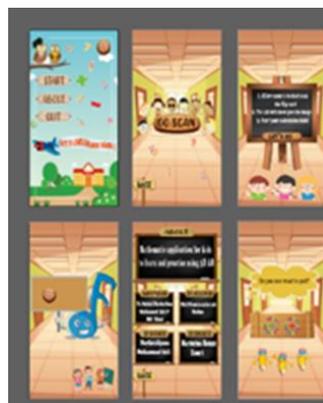


**Figure 3: Design Interface in Adobe Illustrator**

Next, in order to enable the app to be utilised on automobile platforms with augmented reality features, Unity was used to create Android apps. Unity is a cross-platform gaming engine created by Unity Technologies that used to create video games and simulations for computers, consoles, and mobile devices, as well as 3D components. **Figure 4** depicts the development environment.
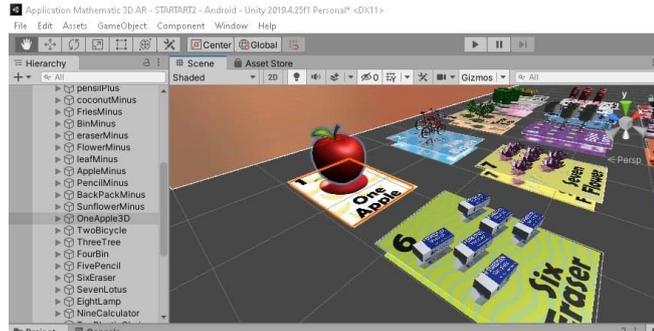
**Figure 4: The making of flipcard in Unity**

2.4 Implementation

The finished application is uploaded to Android-based mobile devices in the fourth step of execution. Let's Calculate Kids' usability is put to the test by students, teachers, and the general public. They were provided instructions on how to access and utilise the application at the beginning. The application teaches two major lessons: learning to recognise basic numbers and doing two fundamental computations, addition and subtraction. After students have mastered each section, they are given free time to utilise the application. The front page of the application is created with an engaging blend of colour, sound, animation, and interactivity in the **Figure 5**.



**Figure 5 : Main Interface of the application**

2.5 Evaluation

The procedure of evaluating the impact of application use was completed in the fifth step of the evaluation. We created a google form on the effectiveness in using the app from the general public respondents and kindergarten children aged 5 to 6 years to use our app during this phase. This is to study how effectively this application is used by the community and children in terms of its effectiveness in the classroom. We may evaluate the effectiveness of the application from the user's point of view before, during, and after use during this phase.

## 3. Results and Discussion

Let's Calculate Kids Augmented Reality (AR) Learning Apps have been the subject of numerous studies. This is accomplished through tests, pre- and post-surveys, as well as information and reviews from websites, linked articles, and online newspapers. Preschool parents and students were included in the survey. The total number of responses was 41, pre and post surveys were performed using Google Forms and sent to the general public aged 24 to 37 years old, with youngsters aged 5 to 6 years old learning mathematical topics in numbers and basic calculations. By disseminating online questionnaires to the general public and students, we were able to take a more effective step. They had to respond to 6 questions in the both surveys.

3.1 Results

**Table 2: Pre survey questionnaires**

| Question | Agree | Disagree |
|---|---|---|
| Are you happy with standard maths learning methods? | 75.6% | 24.4% |
| Do you believe that a less appealing learning environment is a stumbling block to studying Mathematics? | 82.9% | 17.1% |
| Do you believe that mysterious learning techniques are a stumbling block in the study of mathematics? | 92.7% | 7.3% |
| Do you believe that augmented reality learning applications can motivate students to learn Mathematics? | 68.3% | 31.7% |
| Do you think that using augmented reality learning apps can help students comprehend mathematical principles and applications better? | 75.6% | 24.4% |
| Do you believe that augmented reality based learning should be used as a learning tool for students? | 75.6% | 24.4% |

Pre-survey and post-survey questionnaires have been used. This questionnaire is important for demonstrating the problem statement's validity. The respondent is required a total of six questions to answer, and they were asked to react based on their own opinions. The pre-survey questionnaire findings are shown in **Table 2**.

**Table 3: Post survey questionnaire**

| Question | Agree | Disagree |
|---|---|---|
| Are you confident that the 'Lets Calculate Kids' software can assist toddlers in learning the fundamentals of math? | 94.1% | 5.9% |
| Do you believe the 'Let's Calculate Kids' app piques users' interest in mathematics? | 94.1% | 5.9% |
| Do you think the 'Let's Calculate Kids' software can help students study more effectively? | 91.2% | 8.8% |
| Do you believe that using augmented reality learning apps can help students learn more effectively and meaningfully? | 82.4% | 17.6% |
| Do you think that using augmented reality-based learning tool can help students comprehend basic mathematical concepts better? | 88.2% | 11.8% |
| Do you think the 'Let's Calculate Kids' app is a good learning tool? | 94.1% | 5.9% |

Next, there's the post-survey questionnaire, which is used to support the Let's Calculate Kids Apps' acceptance. Both of these surveys were created using Google Forms. An overview of the questionnaires is shown in **Table 3**.

3.2 Discussions

The development of Let's Calculate Kids was based on the addition of several important elements to improve preschool children's learning experiences, such as the use of AR. According to the results of the questionnaire, the use of Augmented Reality has a huge impact because AR in our apps uses

attractive colours, animations, graphics, and audio usage. Visual, auditory, and kinaesthetic (VAK) learning techniques are strongly supported by this AR [20]. In this apps, the flip card we created when scanning using AR and the emergence of objects into reality meets all the features of (VAK). The usage of appealing colours is important. Every application that is created has a significant amount of colour. Interaction with colour elements plays a big role in human-computer interaction. To keep users interested in using the application, the flip card is designed using appealing colour choices. The flip card next feature is the incorporation of animation and virtual reality. These features, when added into the app, will create a scene that will grab the attention of users, particularly children, who will be using the app. The thing will take on the appearance of a live being and will rise from the ground. As a result, it's preferable than to keep staring at a static character. Additionally, learning through animation and virtual reality has no age limits and may be used at all levels, including elementary, secondary, and even university. The flip card's use of graphic components aids the user's understanding during the learning process. The auditory component is equally important. This is due to its ability to create a non-boring environment when using the application. The use of audio also helps in the communication of information to users. The usage of relevant and entertaining audio can also help to increase user interest. Finally, respondents believe that Let's Calculate Kids helps engage children to use learning resources and enhance their experience in mathematics subjects.

## 4. Conclusion

Conclusion, mobile learning allows preschoolers to learn Mathematical subjects at their own pace, regardless of time or location. Mobile learning is a new field that will continue to gain popularity as additional capabilities are offered. This is because, in the busiest culture of the future generation, convenience is everything. In the future, mobile learning will open many possibilities to new technology. Preschoolers can be helped and their interest in Mathematics subjects can be helped boost more easily by developing applications that utilise Augmented Reality (AR). Furthermore, with a smartphone, preschoolers can master Mathematics courses. Also, this application can also help teachers who want to use technology as a method of learning by using gadgets. Lastly, Let's Calculate Kids based AR Learning Apps are being developed. AR learning apps can assist students in overcoming mathematical topic learning challenges and enhancing their learning experience. When compared to traditional teaching methods, the use of the Let's Calculate Kids Learning Apps AR Based Learning Apps has increased the user's spirit and provided a fun learning environment.

## References

[1]     H. Shamsuddin, J. Shamsuddin, A. H. Rabas, N. N. S. Abd Talib, N. S. Ismail, and A. Z. Khairani, "The Effect of Gender and Ethnicity on Selected Topics in Mathematics among Secondary School Students", *JPSMM*, vol. 11, no. 2, pp. 1-8, May 2021.

[2]     Y. Güven and F. Gök Çolak, "Difficulties of Early Childhood Education Teachers' in Mathematics Activities", *Acta Didactica Napocensia*, vol. 12, no. 1, pp. 89-106, 2019.

[3]     N. Muhamad, J. Harun, S. Md. Salleh and M. Megat Zakaria, "Penggunaan Game-Based Learning Bagi Meningkatkan Kemahiran Penyelesaian Masalah Kreatif Dalam Matematik", in *2nd International Education Postgraduate Seminar*, Universiti Teknologi Malaysia, 2015.

[4]     A. Anthonysamy, "Perkembangan Pemikiran Matematik Pada Peringkat Awal Kanak-Kanak: Satu Pendekatan Konstruktivisme", in *Prosiding Seminar Pendidikan Sempena Jubli Emas MPBL*, Kuching, 1998.

[5]     M. Coffta, "What is a literature review?", , *Bloomsburg University of Pennsylvania*, 2021. [Online]. Available: https://guides.library.bloomu.edu/litreview. [Accessed: 12- Dec- 2020].

[6]     "8 Sebab Mengapa Pelajar Lemah dan Gagal Subjek Matematik", *Cikgu Viral*, 2021. [Online]. Available: http://teacherviral.blogspot.com/2017/10/8-sebab-mengapa-murid-lemah-matematik.html. [Accessed: 10- Jul- 2021].

[7]     M. H. Mohamed Ali@Md Hani, N. I. N. Jasmi, N. A. Khalip, H. N. Hamdi, M. H. Jofri, J. Mohamed and M. Abdul Hamid, "Forest Multiplication: A game based Learning Apps to Enhance Learning Experience In Multiplication for Primary Students towards 21st Century Learning Skills", in *Multidisciplinary Applied Research and Innovation*, Muar, 2021, pp. 189-199.

[8]     "Teaching Methods: Traditional Vs Modern", *Stephen Perse Foundation*, 2021. [Online]. Available: https://sixthform.stephenperse.com/blog/?pid=458&nid=45&storyid=4728. [Accessed: 31- Jul- 2021].

[9]     H. Suid, "Faktor-Faktor Kelemahan Pelajar dalam Mata Pelajaran Matematik di Peringkat Sekolah Rendah", Undegraduate, Universiti Teknologi Malaysia, 2021.

[10]    C. Ompok and J. Bacotang, "Kesan kaedah mengajar terhadap pencapaian awal matematik dalam kalangan kanak-kanak prasekolah", *Jurnal Pendidikan Awal Kanak-Kanak Kebangsaan*, vol. 8, pp. 8-16, 2019.

[11]    E. Sri Mulyani, "Dampak Pemanfaatan Aplikasi Android Dalam Pembelajaran Bangun Ruang", *Jurnal Teknologi Pendidikan*, vol. 6, no. 2, pp. 122-136, 2018.

[12]    S. Bronack, "The Role of Immersive Media in Online Education", *The Journal of Continuing Higher Education*, vol. 59, no. 2, pp. 113-117, 2011.

[13]    W. Liu, A. D. Cheok, C. L. Mei-Ling and Y. L. Theng. "Mixed reality classroom: learning from entertainment.", in *Second International Conference on Digital Interactive Media in Entertainment and Arts*, Perth, 2007, pp. 65-72.

[14]    M. Cook, "Visual representations in science education: The influence of prior knowledge and cognitive load theory on instructional design principles", *Science Education*, vol. 90, no. 6, pp. 1073-1091, 2006.

[15]    L. Zangori and C. Forbes, "Preservice Elementary Teachers and Explanation Construction: Knowledge-for-Practice and Knowledge-in-Practice", *Science Education*, vol. 97, no. 2, pp. 310-330, 2013.

[16]    "Definition of Augmented Reality (AR) - Gartner Information Technology Glossary", *Gartner*, 2021. [Online]. Available: https://www.gartner.com/en/information-technology/glossary/augmented-reality-ar. [Accessed: 10- Oct- 2021].

[17]    S. Sinha, "Augmented Reality In Education: A Staggering Insight Into The Future", *eLearning Industry*, 2021. [Online]. Available: https://elearningindustry.com/augmented-reality-in-education-staggering-insight-into-future. [Accessed: 10- Jun- 2021].

[18]    N. Sapri and F. Khalid, "Keberkesanan Teknik Augmented Reality (AR) Dalam Meningkatkan Kefahaman Konsep Asas Matematik", in *National Conference on Best Teaching Practice & Innovation*, Kota Bharu, 2019, pp. 1039-1049.