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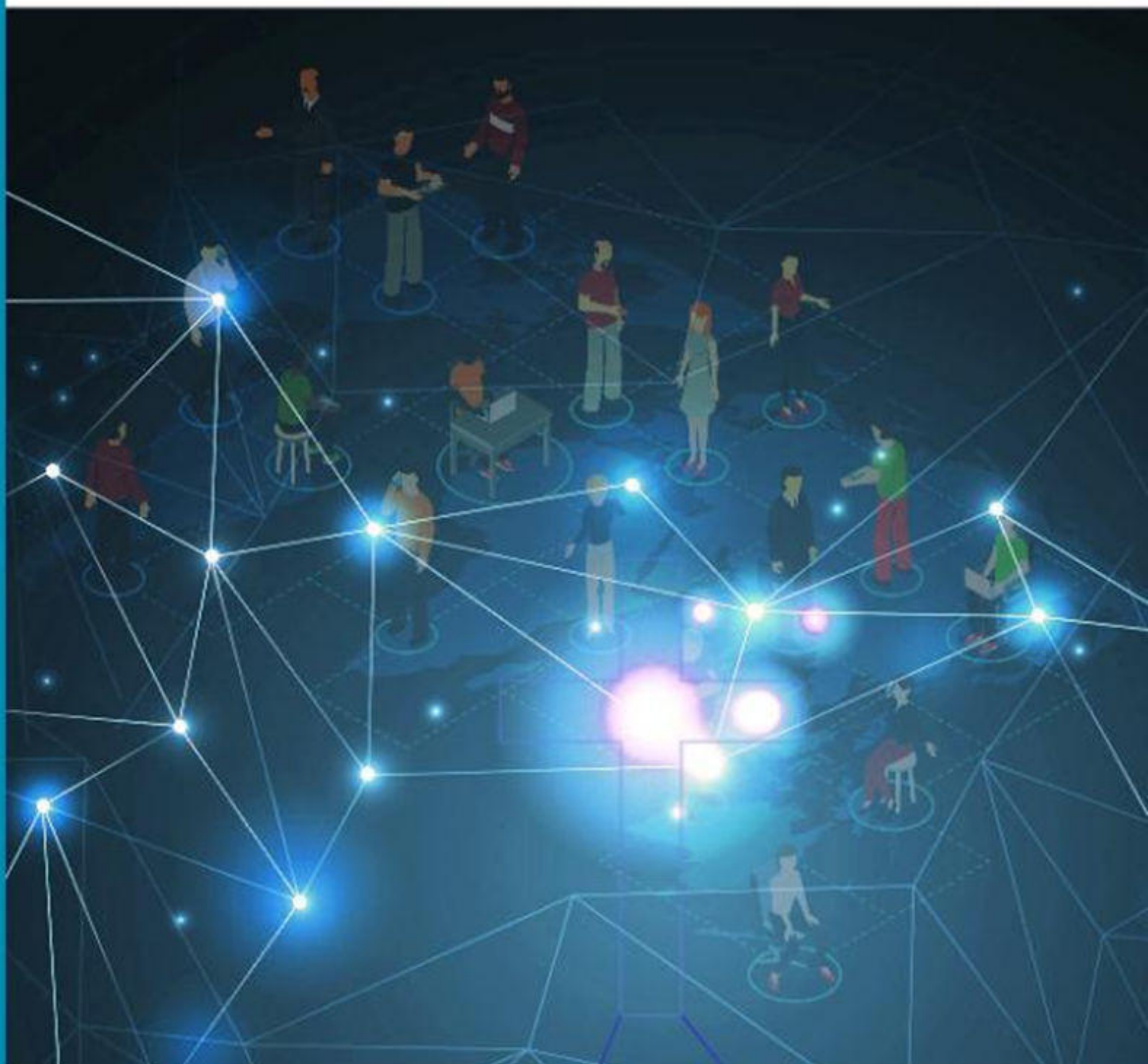
ICCE

INTERNATIONAL CONFERENCE ON CHRISTIAN EDUCATION

Christian Education in Digital Technology Era: Challenges and Opportunities

June 4th, 2022



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ICCE INTERNATIONAL CONFERENCE ON CHRISTIAN EDUCATION

Christian Education in Digital Technology Era: Challenges and Opportunities

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Welcome from the Rector of Universitas Pelita Harapan

Shalom and gratitude be to our Lord Jesus Christ! It is because of His love and mercy; we can gather together here in this event.

We are now in the end of the pandemic, where more than two years unprecedently we were forced to move to virtual education and embrace digital technology. Out of the millions of educators in Indonesia, both in primary, secondary, and higher education, quickly must learn and implement online teaching and learning. Every educator is required to adapt to various digital learning media, suddenly digital technology is not only a tool but the environment where we are living and interacting with one another. Not only do the schools have to provide the system to support virtual learning, but educators also have to be equipped to design instructions that fit with the virtual setting. This need eventually triggers various parties to adapt, move, and innovate. Educators use a variety of media as a virtual meeting bridge with students. Not satisfied with just meeting virtual, educators also make some innovations by using other features and exploring any applications that will help provide creative materials and teaching materials.

However, despite of all the improvements and innovations in delivering teaching and learning in digital technology setting, there are many obstacles and challenges. The question remains, are students learning effectively? Especially for Christian educators, we need to keep asking the question, whether we have faithfully and effectively carried the mission of Christ-centered education, facilitating holistic transformational education in this digital technology era?

Christian education must consciously be aware of the current educational challenges while embracing the opportunities through the rapid development of digital technology. We should continuously ponder how to be faithful to our calling as Christian educators in this era of disruption. We should strive to be an exemplary institution in presenting Christian education during the fast-changed of digital technology. We believe that every technological progress is the fruit of cultural mandate to advance humans' life, fostering life given by God. On the other hand, Christians are also aware with our fallen nature, that there is a possibility of missing the point in any good effort that we are trying to do. Further as human beings, are we going to develop holistically if education is reduced by totally virtual learning? These are some questions that we need to keep thinking and discussing.

UPH, especially Teachers College, is grateful that we can host the first International Conference of Christian Education, especially inviting best panelist speakers to inspire us. We hope that through the ICCE event, there will be a forum for us, educators and practitioners of Christian education, to discuss the opportunity and challenges of doing our mission in the midst of such rapid technological advances. We also hope that this event will encourage us that amid various challenges that exist, God is faithful in sustaining us thus giving us hope to embrace the opportunities that are wide open to further our service to provide a quality, holistic, and transformational education.

Finally, enjoy the conference, Lord Jesus bless you.

Dr. (Hon.) Jonathan L. Parapak, M.Eng.Sc.

Welcome from the Dean of Faculty of Education, UPH

Today what is happening in the classroom is different from practices before the pandemic. Changes will continue to occur, especially with the advancement of digital technology, which will become increasingly sophisticated. The interaction of education with technology is inevitable. As Christian educators, we embrace digital technology development. We believe students as the Image of God, and the purpose of educating them is to see them flourish with creativity and innovation for the development of human civilization. However, every technological development that brings about good changes may unwittingly change something essential. For example, now we cannot escape from digital technology. It is ubiquitous; from communication, working, shopping, and many more, all are on the digital platform. It has changed the way we interact with one another. To what extent has it changed us? How can Christian education embrace but also be aware of these?

That is the background of the International Conference on Christian Education with the theme, Christian Education in Digital Technology Era: Challenges and Opportunities. Christian educators must continue discussing this topic to carry out our mission faithfully. Continuously we need to learn and relearn to prepare our students well and be ready to embrace their future as disciples of Christ.

UPH Teachers College is very grateful for the cooperation with various parties, ACSI Indonesia and Australia, and Bandung Theological College, which made this first international conference possible. Likewise, we are blessed with the plenary speakers who are experts in their fields and will share their research and insights. We hope that all the presenters and participants will benefit most from this event. The committee has worked very hard to prepare for this event and we hope that by the end of the conference, the conversation will not stop. Let us continue strengthening Christian education in Indonesia through this forum, and we will meet again at the following conferences.

In the end, as our God has led all the preparation for this conference to take place, let His wisdom guide our conversation! All praise and glory be to God alone!
God bless.

Oh Yen Nie, S.E., M.Ed.

Welcome from the Head of Bandung Theological Seminary

The ever-evolving world is a part of the Cultural Mandate or the Creation Mandate, which is revealed in Genesis 1:28. Therefore, we should respond to the development of digital technology critically and positively for Christian education in various contexts.

We are grateful for the first International Conference on Christian Education (ICCE) today, June 4, 2022, as the result of the collaboration between the Faculty of Education UPH, ACSI Indonesia, ACSI Australia, Indonesian Christian Education Council, and Bandung Theological Seminary (STTB), to study the opportunities and the challenges of Christian education in digital era, by involving the experts from within and outside the country as the speakers.

Thank you, especially for the willingness of Mr. David Smith (from Calvin University, US), Mr. Darren Iselin (from ACSI Australia), and Mr. Agus Susanto (from ACSI Indonesia), as the speakers, and for all the committee from the Faculty of Education UPH who has been working hard to prepare this conference.

Hopefully, all the opportunities and the challenges in Christian education in the digital era that are studied through this conference will equip fellow educators with more comprehensive and sharper insights from the biblical point of view, so that the purpose of Christian education which is to produce Christian leaders who have a good spirituality, high competence, and strong dedication, can be more realized though this conference.

Welcome to this conference. God bless you!

Sutrisna Harjanto, Ph.D.

Welcome from the ACSI Indonesia National Director

Dear ICCE presenters and participants.

The development of digital technology is rapidly changing the order of human life–which is also developing so swiftly as well. There are those who agree and follow the speed of development, accept it for granted, and even get involved in the development. Still, not a few are also indifferent to it, disagree and refuse to use digital technology for all kinds of reasons that are indeed or are made in accordance with their choice of decision. In addition, there are those who try to be neutral ("wise"), by looking at digital technology such as a double-edged sword or fire which can be used either for good or evil purposes. e We have already seen practical examples of these two possible uses of digital technology everywhere.

What about us as Christians? Specifically Christian educators? The term of Christian educator, this can be viewed narrowly or broadly. In a narrow sense, some categorize Christian educators as those who work as teachers or lecturers. But we can also see it from a broad sense, that Christian educators are anyone who has the responsibility to educate, direct, and give vision to other people or the surrounding community. And this means that all Christians are actually educators, because Christians are followers of Christ, and Christ has assigned a role to us, Christians, as salt and light of the world. This means that we as Christians must be a flavor for the world and be a statement of God's truth to the world as well.

I represent Christian schools and Christian educators who are members of the ACSI Indonesia organization. I herewith also welcome all the speakers and participants of 2022 International Conference on Christian Education. This conference is organized by Universitas Pelita Harapan in collaboration with several Christian education organizations including ACSI. I hope that this conference can continue in the future and there will be more Christian educational organizations including churches, and synods, to be able to collaborate, like what is stated by ACSI's motto: Stronger Together, for us to be strong together, as one body of Christ. Let's salt the world more and bring light to the world. I hope that through this ICCE more and more people who work as Christian educators will grow and more Christians in general will be more aware of their calling and will realize that we are all educators, tasters, and proclaimers of God's truth, who need to be equipped and strengthened at all times. Especially through the theme of the 2022 ICCE: “Challenges and Opportunities for Christian Education in Digital Technology Era.”

Finally, congratulations to UPH for initiating the first ICCE in 2022. Let us be those who wait on the Lord so that we may gain new strength, like an eagle that soars with the power of its wings, we run and do not become listless, we walk and do not grow weary (Isaiah 40:31).

Thank you, God bless us all.

Agus Susanto, Ph.D.

Welcome from the Chairman of the 1st ICCE UPH 2022 Committee

Shalom Aleichem, gratitude be to our Lord Jesus Christ, because of His love and favor, we can gather in this conference. It is such an honor for me to welcome you to the 1st International Conference on Christian Education (ICCE) UPH 2022, with the main topic, "Christian Education in Digital Technology Era: Challenges and Opportunities."

The rapid development of science and technology in today's digital technology era encourages the emergence of various educational innovations based on learning technology, making it easier for educators and students to access multiple educational contents. This is marked by the ease of obtaining access to information and internet connection speeds. The Covid-19 pandemic has increasingly encouraged the emergence of various forms of digital learning media globally. This unavoidable pandemic requires school administrators', education providers, educators, and students to be able to adapt to changes in learning patterns from face-to-face learning to online learning. An education system that combines digital technology with the learning process will open opportunities and challenges as real implications of the transformation and paradigm shift of education in the digital technology era, including Christian education in it. Therefore, the 1st ICCE UPH 2022 aims to 1) Explain the implementation of digital technology in learning and its implications for students' faith formation; 2) Discuss digital technology development in learning and its implications and influence on the way we communicate and relate to others in Christian educational context an excellent, holistic, and transformational; 3) Enrich understanding to Christian educators regarding the calling response to teach in digital technology era by looking at the opportunities and challenges.

For organizing the 1st ICCE UPH 2022, allow me, as the chairman of the organizing committee, to express my deep gratitude and appreciation to the Keynoted Speakers, Mr. David I. Smith, Ph.D. (Professor from Calvin University, USA), Mr. Darren Iselin, Ph.D. (Director of Research and Innovation Christians School Australia), and Mr. Agus Susanto, Ph.D. (ACSI Indonesia Director) for each conference material presented. We also express our gratitude and most profound appreciation to the Advisory Boards and the organizing partner, Mr. Dr. (Hon). Jonathan L. Parapak, M.Eng.Sc. (UPH Rector), Mr. Sutrisna Harjanto, S.Si., M.Div., Ph.D. (Chairman of Bandung Theological Seminary), Mr. Agus Susanto, Ph.D. (Director of ACSI Indonesia), Mrs. Sandra Scott (Executive Officer of International Partnerships and Service Christian Schools Australia) and Mr. Marks Spencer (Director of Public Policy Christian Schools Australia). Likewise, we would like to express our gratitude and most profound appreciation to the Supervisory Board, Mrs. Oh Yen Nie, S.E., M.Ed. (Dean of the Faculty of Education, UPH) and Mrs. Sarinah Lo, Ph.D. (Senior lecturer of Bandung Theological Seminary) and to the Steering Committee Mr. Dr. Budi Wibawanta, S.Sos., M.Si. (Vice Dean of the Faculty of Education, UPH) and Prof. Dr. Niko Sudibjo, S.Psi., M.A. (Department Chair of Educational Technology, Faculty of Education, UPH). Expressions of gratitude and highest appreciation are

conveyed to the entire organizing committee team, who have worked tirelessly to prepare for this conference so that it can be organized successfully. We also express our gratitude and appreciation to the presenters who have shared articles and published works in the form of proceedings and the participants who have involved in this conference.

Finally, we hope through the organizing of the 1st ICCE UPH 2022, as educators and leaders of Christian educational institutions, we can collaborate to do concrete works in the area where God has entrusted us in responding to the opportunities and challenges in the digital technology. We will appreciate constructive suggestions and criticisms to improve the quality of future conferences. To God be the Glory.

For we are his workmanship, created in Christ Jesus for good works, which God prepared beforehand, that we should walk in them. - Ephesians 2:10 (ESV)

Imanuel Adhitya Wulanata Chrismastianto, S.E., M.Pd.

A Review of Augmented Reality, Its Advantages and Usages in Education in Indonesia

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Abstract

Augmented reality (AR) is attracting many educators to use this technology in their courses due to its benefits, such as increasing user experience through their 3D virtual visualization features. However, its use seems to be quite limited in Indonesia, especially in the field of education. There are several types of augmented reality technologies that can be applied in different domains of education. The purpose of this paper is to provide a basic overview of the types of AR, its benefits, and the different subjects in which augmented reality in education in Indonesia is being used. For this purpose, seven organized articles over five years were selected and reviewed (2017-2021). The method used in this review is meta-analysis. Among other benefits of the use of AR in education, motivation was the most often identified in the results of this review. The application of augmented reality encompasses a wide range of disciplines in Indonesia, making the learning experience more engaging, pleasant, and entertaining.

Keywords: Augmented Reality, AR, Educational Applications.

1. Introduction

In recent decades, augmented reality (AR), like other experimental technologies born in response to scientific study, has transferred the science barrier to access content developers and ultimate consumers, making them more accessible.

AR is a technology that is gaining popularity in the digital world due to its vast strategic potential. At the moment, augmented reality (AR) is influencing a wide range of research and concepts used in education, as well as the creative process. (Wei, Weng, Liu & Wang, 2015; Wu, Lee, Chang & Liang, 2013). In any case, terms like innovation, technology, creativity, immersion, intrigue, and information characterize and complement the notion of augmented reality. In recent years, there has been a significant increase, if not a surge, in the development of instructional media in Indonesia. Within today's globalized world, the most effective way to reach out to young people is through the use of digital media in education.

As a result, instructors, as mediators in the teaching process, have begun to develop media as an educational aid. Educational techniques have begun to undergo significant changes. Students can better absorb content if they have appropriate technical help. Teachers can produce content using this technology or use something available (Syahidi, Supianto, & Tolle, 2019). Augmented reality is being used in a variety of educational settings. Among these are arts such as culinary, cultural preservation, nutrition, science, and mathematics, among many more (Cianciarulo, 2015).

"AR offers us new ways to interact with the physical world and changes how people learn with mobile devices" (Ozdemir, et al., 2018). "The results of field studies show that all elementary school students who enroll in science subjects have smartphones. Although all students already have smartphones, the use of smartphones as learning media in science materials is still not optimal". The application of technology in elementary education has a long way to go. Even though we are now in the twenty-first century, many unchanged aspects of education remain (Syawaludin, A., et al. 2019). The emergence of AR technology, which is still in its early stages, might be the start of a big shift in the learning process. Because of its interactive nature, its usage in the study of sciences in elementary school, as well as later educational levels, has a positive influence on education. "As indicated, the existence of learning media could improve the learning process. Therefore, various educational studies in Indonesia seek to develop learning media and study their effects on the learning process".

"Mathematics learning is known as the process of building or constructing concepts and principles. Teaching may seem passive and static, but learning must be active and dynamic" (Cahyono, et al. 2018). In accordance with the construction view, that is teaching and learning, where students build their meaning from their experiences and interactions with others.

Even more, when AR is used in the process of learning physics in high school, it is related to the notion of mathematics. AR can be designed to support the material content being studied, such as the kinetic theory of gases. The goal of AR application in high school physics learning is to help students to understand the concept well through simulation. The application of the Addie model of Instructional Design combined with AR in the learning of high school physics of class 11 depends heavily on the material of the kinetic theory of gases that is studied because it has the stages of analysis, design, development, implementation, and evaluation (Morison in Gusmida and Islami, 2017). In their research, Gusmida, and Islam (2017), AR was used using Adobe Photoshop CC 2015 for Design Markers, 3D objects using Blender 2.77, using a PC camera, and made using Unity 5.24 and Vuforia SDK.

When there is a change in the education system to online due to Covid- 19 pandemic, AR has also been a solution for the learning process. It is believed that implementing AR can increase students' learning motivation and HOTS thinking ability in high school science learning. AR has been widely used and has proven to be very effective in improving language skills. AR learning has been accomplished through the use of three-dimensional pop-up books and Pokémon GO applications, among other applications. In addition to technological advancements, the background to the use of AR is a lack of vocabulary mastery.

This study aims to offer a general description of several works from Indonesia that have used augmented reality technology for educational purposes. To examine these works and to understand how far Indonesia's AR development process has come. Due to the lack of available material or articles on this topic, this study aims to provide an overview of several Indonesian works that have used augmented reality technology for educational purposes.

As a solution, was opted for a literary review on the Internet of academic-scientific

articles was chosen through Google Academic where Augmented Reality had been implemented as an educational tool. The reason for this is that it is possible to evaluate what is known about the subject, what has been researched about it, and what elements remain unknown in this manner. Examining these articles aims to determine how far Indonesia's AR development process has progressed.

The type of applications employed in these publications is examined in-depth, selectively, and critically as one goal of this research. Also, do a retrospective analysis of the advantages obtained during a set time interval. Equally important, an attempt is made to demonstrate its applicability in a range of educational contexts, proving that it is not limited to the classroom environment. As a baseline, seven journals were organized over four years (2017-2021) were selected. Three fundamental questions raised and will be answered throughout this analysis to address the objective of the study. These are the questions:

RQ1: What types of AR were used?
RQ2: What advantages were obtained with the usage of this AR?
RQ3: What subjects were studied with its implementation?

1.1 Types of AR in Education

There are seven main types of AR, which may be divided into two groups: View-based augmentation and triggered (Edwards, Hoyt, & Reger 2016). Triggers are the features that would start the activation of the augmentation based on stimuli. Triggers can be dynamic object augmentation, GPS location, or a mix of enhanced object recognition, GPS location known as complex augmentation and marker objects, or paper. View-based augmentation, on the other hand, includes digitized magnifications with no relation to what is seen or static augmentation. *Table 1* shows a categorization of these forms of AR.

Table1 description of the many forms of AR

Category	Type	Characteristics
Triggered	1a. Marker-based: Paper	A paper marker activates stimuli.
	1b. Marker-based: Object	Almost any object may be turned into a marker.
	2. Location-based	Digital information is placed on a map or a live camera view. GPS may trigger stimuli.
	3. Dynamic Augmentation	Meaningful, interactive augmentation with the potential for object identification and/or motion tracking.
	4. Complex Augmentation	Enhance dynamic view by pulling online data depending on location, markers, or object identification.
	5. Game Object	Image target is selected based on image detail, sharpness contrast, and non-repeating patterns.

View-Based	6. Indirect Augmentation	Intelligently enhanced image of the actual world.
	7. Non-specific Digital Augmentation	Any camera view, regardless of location, may be augmented.

2. Literature Review

The three-step approach was used to achieve the goals of this study. The first step, collect the objective data, the second step was to evaluate the collected data, and finally, the results were used to answer the questions of this research.

Several studies were conducted to create some of the applications, particularly those relating to cuisine and culture, such as the Malang masks. One journal studied was "Local Wisdom through Learning Topeng Malang Dance" by Dewayani, which was written in 2017 and has all the relevant information on the subject (Dewayani, 2017). Robby Hidajat's "The Symbolic Meaning of the Role of Wayang Topeng in Malang, East Java, Indonesia" is another international journal used for mask investigation. This study highlighted how masks play a significant role in communities, such as in the village of Kedungmonggo with the entity "Pudhen" (Hidajat, 2005). Here, culture, tradition, and identity are all inextricably linked.

Moreover, the increased access to devices such as cell phones across the world has provided optimum conditions for the development of AR technology (Nincarean, Alia, Halim, and Rahman, 2013). As is the case in Computation and Education Journals, academic material on the use of AR in education covers both the opportunities and the challenges to its implementation (Hsin-Kai, Silvia Wen, Hsin-Yi, and Jyh-Chong, 2013). There is further literature based on studies into the use of AR industrial systems (Damiani, Demartini, Guizzi, Revetria, and Tonell, 2018).

Other systematic studies of the use of AR in education have been conducted, with an emphasis on the influence it has on learning, as well as its benefits and disadvantages. Akçayır and Akçayır (2017) compile a review of 68 research publications that employ augmented reality at various educational levels. The authors conclude that the majority of the study is conducted in basic education and yields benefits such as increased interest and commitment, self-learning, and the development of student-centered activities. Ibáez and Delgado-Kloos (2018), for their part, conduct a review of 28 papers and identify three primary categories of AR applications utilized in STEM (science, technology, engineering, and mathematics) learning: exploration, simulation, and gaming. Saltan and Arslan (2017) conduct a systematic evaluation of 23 research publications and conclude that the primary pedagogical methods of AR in education are situated, inquiry-based, collaborative, and game-based learning. Bacca, Baldiris, Fabregat, Graf, and Kinshuk (2014) conducted a systematic analysis of 32 papers and concluded that the major uses of AR in education are: topic explanation and assessment, laboratory experiments, games, supplementary information, and exploration of the environment.

Another discipline where AR applications have been implemented is in science and geometry. The journal under consideration was “Interactive Multimedia Development to Improve Critical Thinking Skills in Science Learning,” by Syawaludin, et al (2019). This research looks at how augmented reality in education enhances learning outcomes. The above objectives also backed up by a study conducted by Cahyono, et al (2018). The major advantage of AR in this study is that pupils can view three-dimensional objects in real-time.

Most agree that mathematics is one subject that children dislike. In Cahyano’s writing in 2019, the obstacle was very well realized by teachers. However, there are still many teachers who have not attempted to decrease or even transform learning into an enjoyable experience. The presented premise is how instructors may design and explore the potential of augmented reality (AR) to teach and learn in a variety of subjects and settings. Other subjects, like science, require the creation of methodologies as well, because children will easily grasp learning if it is closely related to experiences and objects. The development of AR-based interactive multimedia can be used and easily accessed utilizing students' smartphones as one strategy to promote critical thinking, according to Syawaludin's 2019 research.

Nazatul in Gusmida and Islami (2017) explain that Augmented Reality technology has the potential to increase students’ attention and motivation. Using handheld devices (tablets and smartphones) can visualize a layer of information on real objects. Augmented reality is one alternative to digital-based learning, and does not necessarily need the use of the internet to improve learning performance with independent and group learning. Furthermore, augmented reality is a technique in informatics that combines two-dimensional or three-dimensional virtual objects in real-time (Sulisworo, dkk. 2021).

In learning English, it is necessary to expand one's vocabulary. Its application in Indonesia remains difficult due to several factors, one of which is that the method used is still "conventional" and uninteresting. Unlike learning through AR, which provides interactive activities such as quizzes as one of the stimuli for increasing the desire to learn. "Reading storybooks is effective for developing children's vocabulary knowledge, but these days children can independently learn from richer contextual information from modernized media," according to one journal studied by Agata et al (2020).

The different AR applications use mechanisms that define the degree of complexity in which these systems are developed; they function as information activators and are classified in what is known as RA levels. For Prendes, (2015), The levels of AR are characterized as follows: Level 0 hyperlinks to other information by using bar codes, QR codes, or random image recognition. Level 1 augmented reality in which markers are used to recognize 2D patterns and 3D objects. Level 2 recognition is accomplished by GPS (Marín & Sam-pedro-Rquena, 2019), compass, and occasionally accelerometers, avoiding the requirement of markers. Level 3: enhanced vision using devices such as high-tech contact lenses and Google Glass, among others.

3. Research Method

3.1 Data Collection

Google Scholar was used to gather information based on academic literature where the application of AR in Education was present. There were many journals covering a variety of subjects, including physics, mathematics, physics, cuisine, language, and culture. For this aim, we tasked each researcher with selecting a minimum of two journals that were deemed most relevant for the study. During the Google Scholar search, the abbreviation "AR" and the phrase "Education" were always included as keywords. Furthermore, studies from the years 2017 to 2021 were reviewed.

Another essential element to mention is the topic diversity that was encouraged where AR was used, such as in the categories of cuisine, language, art and culture, mathematics, science, and physics. The authors filtered the findings collected to include only those that have been implemented in Indonesia. When the terms "AR" and "Indonesia" were searched in Google Scholar using quotation marks to get the exact phrase, only 596 results were retrieved.

3.2 Data analysis

First, it was expected that the authors would review just three journals during the collecting stage. It was reconsidered, since it was thought that would be a relatively small number, and it was determined for seven. As can be seen in *Figure 1*, these articles were analyzed. The type of AR employed in each study was one of the factors evaluated. Each of the authors worked independently in the identification in the Journals. Predominantly, the methodology section defined the type of AR implemented in each journal (RQ1).

The benefits stated in each article were the second criterion that was taken into consideration (RQ2). These benefits were generally found through searching in the results or discussions sections. The subjects covered in the articles were the final factor of concern (RQ3). Since they were rarely identified in a specific section, a more general screening was performed to identify them.

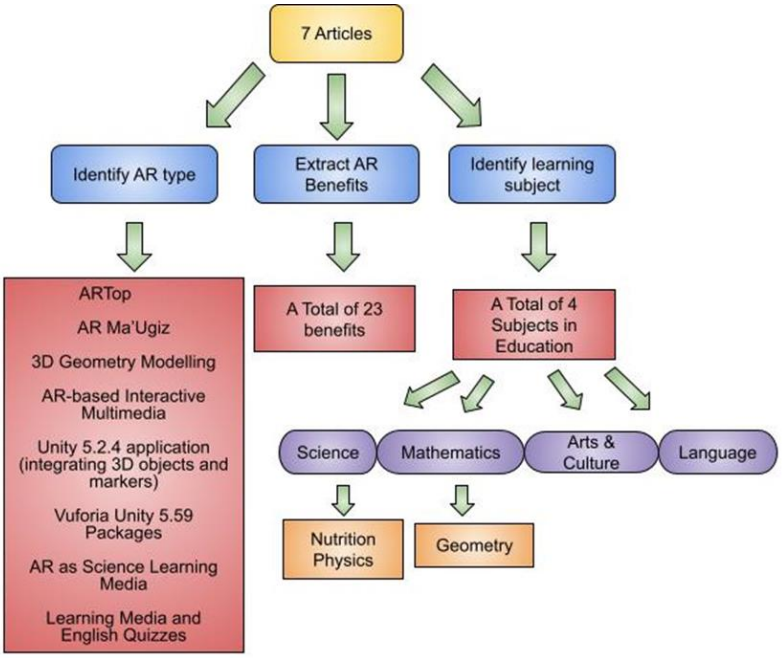

Figure 1. Data Analysis Process (Carlos, et al. 2022).

3.3 Mapping of reviewed studies

In this section of the study, a mapping of the seven selected articles was created. The following *table 2*, shows the different types of AR, the topics studied with it, and the benefits obtained. This table also attempts to answer the three questions posed earlier in this study: RQ1, RQ2, and RQ3. These questions are about the type of AR used, the advantages received, and the topics studied as a result of its application.

Table 2. Mapping of the Type of AR used benefits and subjects

No.	App/Type	Benefits	Subject
1	ARTop	Strengthening the quality of education Minimizes costs in learning. Increased understanding of the material Topeng Malang.	Arts and Culture Education
2	AR Ma'Ugiz	Promotes nutrition education for teenagers. Learn about traditional Sundanese food. Introducing values of local wisdom.	Nutrition Education/Science
3	3D Geometry Modelling	Get formal material in the form of a 3-dimensional model. Add learning experience. Introducing new learning methods.	Geometry Education/ Mathematics

4	AR-based Interactive Multimedia	Stimulate the mindset of students in thinking critically about something because they can visualize an abstract concept. Improves the capacity to solve spatial problems so that it can help with technical activities like object assembly. Help students in solving problems.	Science Education
5	Unity 5.2.4 application (integrating 3D objects and markers) Vuforia Unity 5.59 Packages	Real-time 3D media can be seen visually using a mobile android camera or a PC camera. Increase the understanding and motivation of the student	Physics/Science Education
6	AR as Science Learning Media	Explain several phenomena in further detail. Practical and effective development of new competencies in the 4.0 era. Accessed without an internet connection. Users can view virtual objects with the use of mobile technologies. Improving competencies in critical thinking and collaboration skills.	Science Education
7	Learning Media and English Quizzes	Increase students' interest in independent learning and make it easier for students to learn a foreign language. Provides more choices for students to enjoy interactive learning instead of passive learning. Easier to use because it can be accessed on computers or mobile devices (anywhere and anytime). Improve language skills by learning English in the form of three-dimensional pop-up books.	English Language Education

4. Results and Discussion

In this section, we will go through the findings from our analysis of articles that employ augmented reality in education in Indonesia.

4.1 RQ1: What types of AR were used?

ARTop on cellphones is one application employed in this research through exercise and practice approaches. The benefit of using cell phones with Android is the availability of time and repetition of the student's learning (Pramono, 2013). ARTop, which is based on Android, is an offline application that reduces expenses and speeds up learning.

The software used in another study was called "AR Ma'Ugiz." They created several 3D items using blender software, as well as videos using Wondershare Filmora and a storyboard. They implemented unity 3D software for this application because of its compatibility with several platforms. The SDK extension by Vuforia was installed to access the augmented reality features.

This other geometry AR modeling application uses marker bases. The markers used are generally in 2D shapes, such as cubes, cones, and tubes. Planning of 2D geometric shapes is done with the Corel Draw application (Cahyono, et al. 2018). In the process, data is exchanged after the camera scans the marker. The phone camera scans the marker and sends the data to the android device, and the android device will request information to the local database as a 3-dimensional model. Then the android device will display the 3-dimensional to the user.

Printed books combined with AR and then applied in learning have also begun to be applied. The products produced were AR-based interactive multimedia in the form of applications that can work on an Android system. Augmented reality (AR) allows virtual objects produced by computers to be placed on physical objects in real-time (Ozdemir, et al., 2018). The use of this media is integrated with teaching materials that contain markers to support the performance of AR technology.

Moreover, Adobe Photoshop CC 2015 was used to design the marker, Blender 2.77 was used to design 3D objects, and the camera was used to increase motivation and students' understanding. The AR stage was realized using Unity 5.24 and the Vuforia SDK to provide the camera and the real-time three dimensions media. It can be seen using an android camera or using a computer camera. The camera can aid the teacher in the development of a multitude of classroom-based multimedia resources (McHugh in Gusmida and Islami, 2017).

The Augmented Reality Module (accessible without an internet connection) improves students' skills by combining two-dimensional or three-dimensional virtual objects into the real three-dimensional space, projecting these virtual objects in real-time (Sulisworo, et al., 2021).

In another type of AR, it was found that the application was created in Unity 2018.2 version on Windows 10 64-bit, utilizing the Vuforia SDK add-on tool. Android phones were used for the learning tool tests. The distance between pixels is used to evaluate the target image. The target image identification method compares the printed picture captured by

the camera to the image stored in the Vuforia database.

The universalization of mobile devices enables ubiquitous interpersonal communication and the performance of activities linked to computer equipment that previously could only be carried out in places and times specifically dedicated to it.

In any case, mobile devices enjoy a popularity that can be transmitted to educational methodologies, just as video games or marketing strategies are currently doing.

4.2 RQ2: What benefits were obtained with the usage of this AR?

One of the most general and notable characteristics of the advantages identified in these seven articles is the impact on user motivation through the usage of AR in their learning process. The graph below, *Figure 2, illustrates* the many characteristics of motivation that were observed.

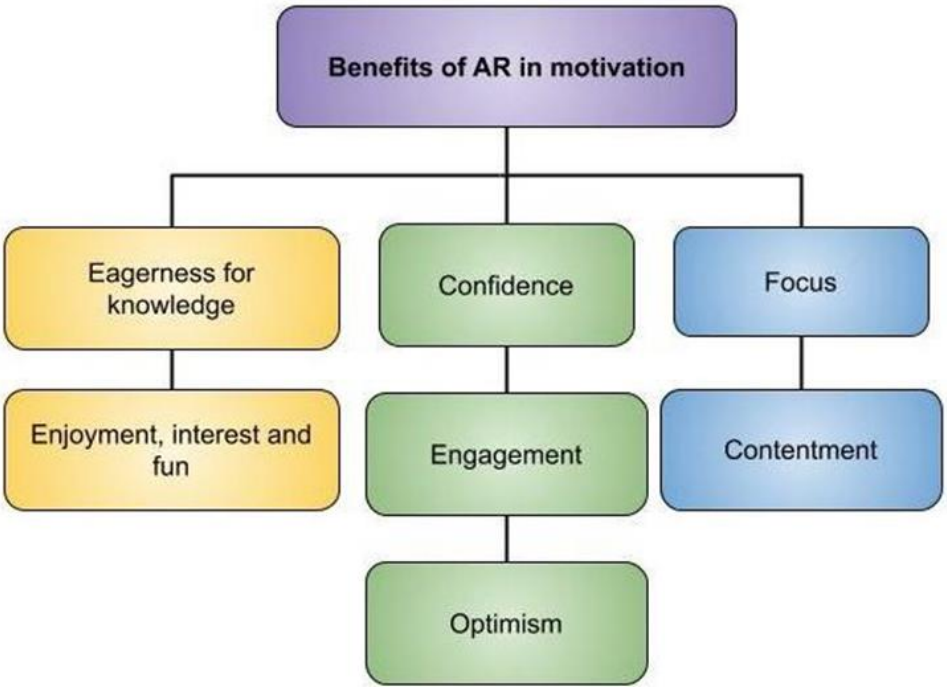

***Figure* 2.** Benefits present in motivation (Carlos, et al. 2022).

The benefits of using AR technology in various disciplines of education in Indonesia were identified in seven of the selected publications. A more in-depth examination of the benefits based on the AR technology employed will be provided here.

AR Ma'Ugiz

AR Ma'Ugiz, which focuses on nutrition, promotes users, particularly young people, to live a healthy lifestyle by choosing traditional Sundanese food as an alternative to junk food. Users can also benefit from knowing how these meals are made.

ARTop

ARTop's developers intended to improve the quality of education in the arts and culture, notably through the use of Malang masks. As a result, the semiotic meaning, structures, and symbolism of these masks are studied. The AR enables a more in-depth study of them at a minimal cost, boosting understanding of one part of the Malang people's traditional culture, their masks.

3D Geometry Modelling

Some benefits of employing this technology for learning include connecting learning with real-world things, boosting student knowledge, and making learning more engaging, and easier.

AR-based Interactive Multimedia

AR-based Interactive Multimedia increases critical thinking abilities, making learning more entertaining and concise without changing the essential subject, and is, of course, inexpensive.

Unity 5.2.4 application and Vuforia Unity 5.59 Packages

The unity 5.2.4 application and Vuforia unity 5.59 packages can improve students' attention to visualize a layer of information on real objects using handheld devices such as tablets and smartphones (Nazatul et al., in Gusmida and Islami, 2017).

AR as Science Learning Media

Augmented Reality for Science Learning effectively develops new competencies, can enrich existing media by adding various deeper and more complete activities available on smartphones, can improve learning performance, explain various phenomena, and shows promising results for improving critical thinking and collaboration skills (Sulisworo, 2021).

Learning Media and English Quizzes

Another advantage of using this application in the area of language, particularly English, is determining the degree of understanding of pupils in the first grade of an elementary school in acquiring vocabulary.

Focusing on the positive aspects of this technological resource, we may emphasize the ability to work with constructivist techniques, the tools it provides to handle abstract and difficult-to-access themes, and the advantages it can provide to supplement printed content with other resources.

4.3 RQ3: What subjects were studied with its implementation?

In terms of the subjects studied with the use of augmented reality, this study highlighted the vast range of subjects in which augmented reality has been used in Indonesia. The authors did not limit the articles to a single or predetermined field, on the contrary, a broad notion of the application of AR was sought.

Certainly, most of the articles were concerned with the quality of education in Indonesia. In the arts, for the study of Malang's mask-making heritage. Applied the knowledge of traditional Sundanese food in the area of nutrition education. Another topic

covered was character building, in which an attempt was made to strengthen pupils' critical thinking skills. AR was also used in mathematics and geometry to build 3D forms and space objects. There were also studies on ecology and global warming. Finally, it was used in physics to study the kinetics of gasses. Because of its adaptability and dynamism, augmented reality may be applied to any sort of learning and language subject, including English, because it promotes communicative and multicultural methods, which are critical in learning and teaching a new language.

With the advancement of technology and its use as a result of the covid-19 pandemic, teaching practice will have to seek and build tools that are adaptable to various situations, tools that at all times help students in general to appropriate knowledge from a new perspective, from their vision, which can no longer be separated from technology.

5. Conclusion

AR has many applications in diverse areas of education while providing students in Indonesia with a more engaging learning experience. The ease with which mobile phones and tablets can be used, as well as their rising accessibility among students, is allowing for growth in education opportunities. AR benefits the learners in many ways, including knowledge retention, and making studying easier and more enjoyable. Teachers have begun to embrace this type of technology by implementing it into their classes for the benefits stated in this study, among other reasons.

The development of technology has had a very good impact on education in Indonesia. One of them is AR, with a myriad of interesting applications that have begun to be applied in learning. The use of AR can improve the quality of learning, can be accessed easily, and present more interesting material to help students achieve learning outcomes. Learning through AR offers to be deemed of good quality and adequate medium for its use in learning physics for students. The AR-based application on the topic of Global Warming can be used in a variety of strategies, giving a positive impact on the implementation of digital technology-based learning.

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