The Design and Development of Augmented Reality (AR) Application for Internet Evolution Learning Topics

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Abstract—The education field has seen numerous revolutions and innovations that have altered the teaching and learning process through the emergence of Information and Communications Technology (ICT) which provides numerous benefits to both educators and students. However, there is concern that students' focus in the classroom becomes less due to the lack of pleasurable during the teaching and learning sessions. Thus, the existence of learning using Augmented Reality (AR) applications seems to help students improve their thinking skills in terms of cognitive as well as behaviorism. Therefore, this study proposed the Design and Development of an Augmented Reality (AR) Application for Internet Evolution Learning Topics known as AREvo. The methodology used in this study was based on design and development research (DDR) and ADDIE Model was used for designing and developing AREvo. Several platforms and software were used to develop AREvo. Several experts in the Creative Multimedia field from higher education were appointed to evaluate the AREvo in terms of its functionality, content design, interaction design, and presentation. The data analyze and obtained is in the form of frequency and feedback. Results revealed that the AREvo application can be used as additional material for instructors as well as students who are taking basic ICT courses. In addition, AREvo is expected to provide a positive impact in terms of functionality and usability of this AR application in the present and the future.

Keywords—Augmented Reality (AR), ADDIE model, ICT course

1 Introduction

The use of computer technology has resulted in numerous revolutions and innovations in the field of education today. The teaching and learning process should be carried out following current technological development and technological trends, as teaching and learning methods have changed as a result of technological advance-

ment. As a result, mastering technology has become a requirement for both teachers and students, as it offers numerous benefits to both [1]. Multimedia technology is used in teaching and learning methods, as the incorporation of elements such as video, audio, text, and graphics is a current trend that has been shown to attract attention and interest, as well as stimulate students' vision and hearing [2].

Students with exceptional technological skills should be considered by educators. One of the important factors to consider in today's learning environment, according to Dewi, Pahriah, and Purmadi [3], is that students of the Y and Z generations have a strong technological background and literacy. Many students are disinterested in their current learning environment, according to Malahito and Quimbo [4]. It is because the current learning method only uses a whiteboard with chalk and talk from their teachers to transfer information. Furthermore, Kamalruzzaman et al. [5] found that students' focus in the classroom is declining due to a lack of enjoyment during learning and teaching sessions.

The teacher is the most active participant in the process of learning in conventional learning, and students are only required to hear and follow what the teacher says [6]. Traditional learning is teacher-centered learning in which the teacher controls the majority of the presentation of learning, also known as the lecture method. The emphasis of teaching and learning activities is on outcomes rather than processes. The traditional approach to education entails outlining specific learning objectives, providing students with logical justifications, and having students share their own preclinical or clinical experiences. Traditional education has flaws such as reliance on the teacher's expertise, judgment, and interpersonal and communication skills.

According to Mitra and Gupta [7], traditional teaching techniques based on chalk, conversation, and natural talent will not produce students with creative, critical, and imaginative thinking, so they cannot solve problems better. Furthermore, when teachers use traditional methods of instruction, which can be tedious and primarily teacher-centered [8], students are unmotivated to learn. Thus, Sharoff [9] agrees that in the age of information and communication technology (ICT), teachers must be creative and innovative to educate students. Teachers, on the other hand, are hesitant to incorporate digital or technological tools into teaching and learning due to a lack of technological knowledge, skills, and experiences [10]. As a result, teachers must adapt pedagogical aspects as well as technology in the teaching and learning process for students [11].

Augmented Reality (AR) is one of the alternative tools that can be used in teaching and learning for fun learning. AR refers to a computer-generated visual that creates an object that is then added to a real-world scene. AR is a variation of the Virtual Environment (VE), or Virtual Reality, and is defined as a virtual environment that combines real and virtual objects in a single interface [12]. It has helped students improve their cognitive and behavioral thinking abilities.

AR is also used to supplement reality rather than completely replace it [13]. The result will be displayed on the screen as if the object existed in the real world. AR, as a multimedia element and a new technology in Malaysian education, can provide additional information to learning students [14]. AR technology is a real-world combination in which images appear on a mobile device display when directed to a specif-

ic object, which can help students learn and teach more effectively and enjoyably. According to Saputro & Saputra [15], the use of AR technology can transform boring learning methods by making users eager to learn more about a topic under study. It can also help educators create information technology-based teaching materials for the twenty-first century. According to Billinghurst, Clark, and Lee [16], the use of AR in education provides a variety of benefits, including the ability to support the smooth interaction between real and virtual environments in the context of education, which can help students learn visually.

Additionally, according to the findings of a study conducted by Jesionkowska, Wild, and Deval [17], the use of AR applications in learning and teaching can increase student motivation. The use of new approaches that combine the virtual and real worlds has a positive impact on learning quality. This augmented reality application can also assist the education sector in conducting more effective learning and teaching sessions. Aside from that, AR is one of the technologies that has altered the location and timing of education and training [16].

Due to the benefits of using AR in teaching and learning, there is a high potential for using AR in learning internet evolution. According to a Darby [18] study, students can't see things that aren't real unless they use a specific device, and this app exists to help students see what they are thinking. Students learning of the topic of internet evolution is not visually visualized, and this learning is referred to through textbook writing. Students struggle to remember the dates and changes that occur in this topic. Thus, the goal of this research is to design and develop an augmented reality (AR) application for internet evolution learning topics known as AREvo. The AREvo application will be evaluated by experts based on its functionality. AREvo was created to assist students in learning about internet evolution and WWW topics. Furthermore, AREvo could contribute to increasing students' interest and creativity in learning about the evolution of the internet and WWW topics.

2 Methodology

This study employed to design and development research (DDR) to design and develop AREvo. The approach formulated is based on DDR empirically [19]. The design of this AREvo application was based on the DDR form proposed by Brown and Collin in the 1990s and ADDIE Model. This model was selected because each phase in this model is compatible with the development process of this AR application. ADDIE Model includes five phases: analysis, design, development, implementation, and evaluation. It is also one of the most common methods used in research to test theory and validate its practicality. According to the DDR approach, there are three main phases, as illustrated in Table 1.

Table 1. Implementation of DDR Phase

Phase	Type of Development
Phase 1: Requirement Analysis	Literature Review
Phase 2: Design and Development	Development of AR Application
Phase 3: Functionality	Quantitative Method (Questionnaire)

2.1 Sampling

A purposive sampling method that has been used is in a form of non-probability sampling in which researchers rely on their judgment when choosing members of the population to participate in their surveys [20]. The respondents of this study involved three experts and they were asked to evaluate the AREvo in terms of functionality via questionnaire. The criteria of the selected experts are (i) lecturers from the field of Creative Multimedia, (ii) lecturers teaching in several institutions of higher learning, and (iii) lecturers who have extensive knowledge and experience in the field of study.

2.2 Instrument

The questionnaire was given to the three lecturers in the field of Creative Multimedia from several higher learning institutions who have extensive knowledge and experience in their field of study. In the questionnaire, Part B consists of items (8 items) for application design in AREvo and Part C consists of items (12 items) for application functionality in AREvo. The level of agreement was based on the Likert Scale with five rating scale choices which score values ranging from Strongly Disagree (1), Disagree (2), Partially Disagree (3), Agree (4), and Strongly Agree (5). The researchers opted to use this scale as it was easier to collect data and would provide an accurate assessment in explaining respondents' feedback.

2.3 Data analysis

In this study, the data were collected and analyzed by using percentages based on the questionnaire that has been distributed. To facilitate data analysis, each item was classified and recorded as percentages. By using Microsoft Excel, the percentage used to obtain the reading of agreement level regarding the AREvo application and classifies into different determinant levels. The data then analyzed by using descriptive statistics that been used to see the percentage score of experts' level of agreement throughout the questions given.

2.4 The design and development of AREvo

In addition, Merrill's Principles of Instruction Model also will be used as guidance to design the AREvo. Merrill's Principles of Instruction Model consists of task-centered, integration, activation, application, and demonstration. In the task or problem-centered phase, students learn when instruction is centered on a real-world prob-

lem or task and this goes from simple to complex while in the activation phase, students learn when they are asked to recall previous knowledge, remember a structure to organize that knowledge or are given a structure to organize new knowledge. The demonstration phase allows students to learn new skills and knowledge when those skills or knowledge are shown to them in the context of a real-world problem or task and the applications phase help students learn when they perform tasks in the real world. Lastly, in the integration phase, students learn when they integrate new knowledge into their daily lives. Although Merrill's [21] principles are very general for reporting actual practices in classrooms, the feasibility of using this framework for designing classrooms is emphasized [22]. Figure 1 shows Merrill's Principles of Instruction Model that has been embedded within the ADDIE Model for the design of the AREvo application.

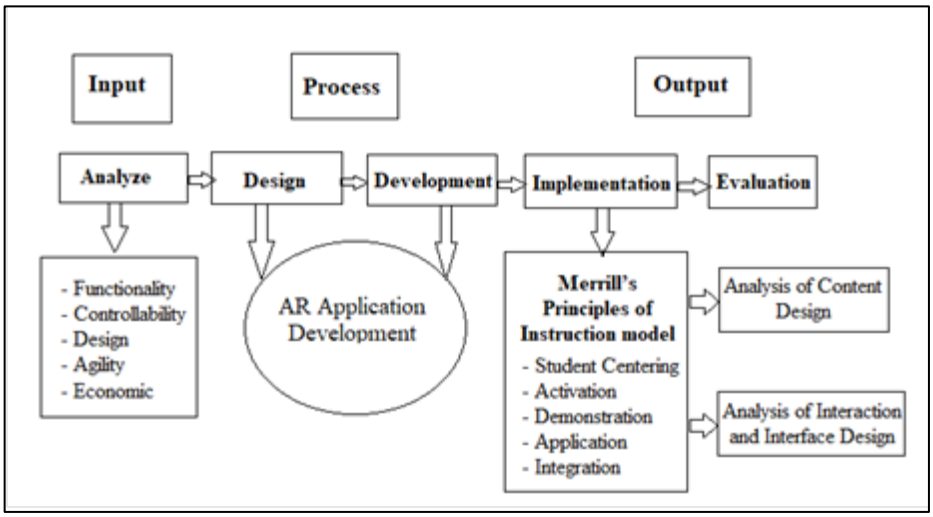


Fig. 1. Merrill's Principles of Instruction Model Implementation [23]

Merrill's Principles of Instruction Model is an educational theory that takes into account a variety of teaching theories and models. It consists of a series of interconnected principles such as task or problem-centered, activation, demonstration, application, and integration. These guidelines can assist instructional designers in creating teaching materials that improve the teaching and learning process. It's a task-centered educational theory, therefore it emphasizes the utilization of real-world challenges or tasks in the learning process, which is ideal for AREvo. This AREvo application was created using the ADDIE model instructional design as part of the design and development process. The ADDIE model provided users with a method of instructional design that included an iterative process that included all of the necessary phases for creating a successful course or program [24]. The ADDIE model method's five key phases were used as a guide for product development in this process:

Analyse Phase. In this stage, the researchers examine the application's content as well as the study's three objectives, which are to design and develop Augmented Real-

ity (AR) applications for the topic of Internet Evolution and to test the applications' functionality in AREvo-style teaching and learning processes. The first level of analysis in the ADDIE model was performed, and the process of determining the target group, existing problems, and steps to solve the problems were performed. At this phase, the research's scope and objectives were also decided. The information gathered will be obtained and evaluated. Table 2 shows the five primary criteria that were reviewed during the evaluation process before developing the AREvo application:

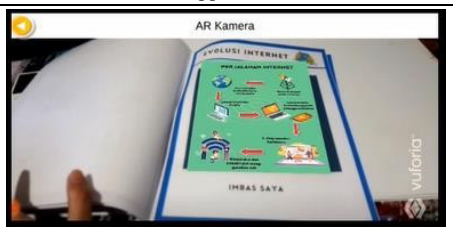
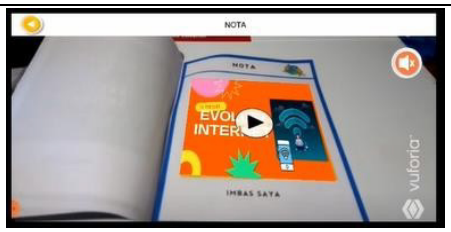
Table 2. Selection of Analysis in Design Criteria

Criteria	Explanation
Functionality	This design should have an operational value where the design developed fits or meets the scope of the study.
Controllability	Consumers need to manage the products that are guided by the manual provided so that the operation of the production system can be shown.
Design	The development of the AR application must be compatible with the functions and operating methods used for teaching and learning purposes.
Agility	The selection of materials for the development of the AR application must be taken into account since it also involves the product's durability and is able of functioning properly.
Economic	The cost, time, and energy of the AR application development are quite high but, in reality, it is affordable with its functionality as an effective tool for teaching and learning purposes.

Design Phase. Content, interaction, and interface design are the three categories of the design described by the researchers. The researchers have gone through the process of creating a storyboard based on the findings of the overall investigation and data collection. The storyboard is a diagram that depicts the information layout, sequence, and detail for the produced AREvo application's presentation display. Furthermore, the researchers have stated that three types of design have been integrated, including content, type of interaction, and type of presentation for multimedia elements that have been placed according to the analysis phase. The storyboard was created using Microsoft Word as a sketching tool because it is simple to use, as well as tidy, and easy to read. Table 3 shows the preparation and planning process for the main components and consumables.

Table 3. Selection of Analysis in Design Criteria

No	Design	Display and description
1.	Content Design	 The content design process is the process of explaining the purpose of the AR application and organizing the content into a design that can help to achieve the purpose of AR application development. The content in this AREvo application includes introductions, user manuals, notes, AR notes, and quizzes.

No	Design	Display and description
2.	Interface Design	 The interface design is the main link to the user in displaying this AREvo application page that has been developed as it creates fewer problems, increases user involvement, perfects functionality, and creates a strong link between this AREvo application.
3.	Interaction Design	 The interaction design is the navigation of this AREvo application that allows full control of the value of a communication service to its users and the quality of experience they have when using it.
4.	Multimedia Element Presentation Design	 In this section, the presentation of multimedia elements that have been used in the AREvo application such as video, text, audio, animation, and graphics have been displayed. Therefore, it is important to provide information and enhance the other media being presented to run smoothly and systematically.

Development Phase. This phase involves the application that has been used to develop this AREvo application that includes the media and technology elements as needed. Researchers use Adobe 3D Max and Unity software in this phase to facilitate the development of this AREvo application. In this phase, the researchers will follow the ICT syllabus which is an introduction to Internet Evolution as a base where the user will learn theoretically. The development phase is implemented after the design phase is completed. This level involves many activities that include interface and content development followed by embedding multimedia elements such as text, graphics, audio, and video. Interface design is very important because it involves an initial overview of the user's application, and the development process should be carefully implemented so that it can adapt to the subject and meet the target users' objectives.

Next, content development will be carried out carefully. The content of this AREvo application must comply with the ICT syllabus which is an introduction to Internet Evolution. This process should be carried out carefully so that the objectives of the study can be achieved. Lastly, it is the development of multimedia elements which is an important element as the application contains many multimedia elements, which can give the user an enjoyable learning session, especially in terms of understanding the passage time of the Internet Evolution. The multimedia elements available in this application include video, graphics, audio, and text as per Table 4. The effective use of quality graphics can boost students' motivation in focusing on this course.

Implementation Phase. At this stage, the teaching materials provided will be used or implemented in real situations. The completed AREvo application will be tested on real users to identify errors during project development. If an error occurs, it will be fixed before handing it over completely to the user. This phase will be implemented after the completion of the development phase. This stage involves the process of testing the effectiveness of the students who use it. Previously, a member verification application was required to determine whether the AREvo application complied with the validity of the course syllabus adopted by students. At this stage, the teaching materials provided will be used or implemented in real situations. If an error occurs, it will be fixed before handing it over completely to the user.

i) Student Centering: First of all, AR is an application that can create visuals and audio with the atmosphere or even a real-world view of the creation with digitally generated sensory input. In the teaching and learning process carried out, student centralization uses a situation where there were instructed to complete tasks by finding information related to this AR application. After that, the instructor will issue instructions to the students by solving a puzzle related to the topic.

ii) Activation: At this stage, students search for information related to AR technology and try to explain all the information based on searches and discussions between them as well as assisted by the instructor. In addition, students can also provide insights on the topic of Internet Evolution from time to time-based on students' existing perceptions and experiences by adapting the use of the internet in their daily lives. In general, instructor guidance is intended to help students relate new experiences to the structures provided during this phase.

iii) Demonstration: In this phase, the instructor explains the AR-related information as well as demonstrates the actual use of the way to operate this AREvo application. In addition, the instructor asked for the student's attention to focus on the demonstration. The instructor shows the right steps to explore into AREvo application on the topic of Internet Evolution. Students will see and try to understand the instructor's description and be prepared to use it. This demonstration phase is very important to show students visually with real movements so that they can remember things that have been described very well. This demonstration process can also increase students' motivation and understanding during the activities.

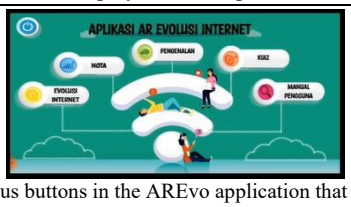
iv) Application: In this application phase, the instructor allows the students to use this AREvo application for the first time and run some of the things that have been demonstrated. In addition, students train themselves by using the application and the instructor needs to ask some questions related to the operation of the AREvo applica-

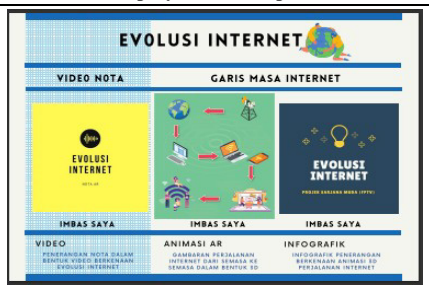
tion to identify the level of understanding and students' responses. In addition, instructors need to ask students to move from time to time so that students can understand and see all the existing content in the situation and environment of the AR. Students will try to explore the AREvo application environment and resolve everything as a process of improvement in terms of their understanding and experience.

v) Integration: In this integration phase, students are required to present and demonstrate the use of the AREvo application in front of other students. This is done to see the level of understanding of students by sharing their new experiences while using this AR technology. In addition, students are also required to make reflections aimed at seeing their level of achievement before and after using this AREvo application. During the reflective writing process, students should be guided to summarize what they have learned and again examine how the new knowledge relates to what they previously knew through a structure that can be remembered or provided.

Evaluation Phase. In this phase, AREvo was evaluated by three (3) experts in terms of its application of design and functionality. The assessment phase is the last phase of the Internet Evolution learning topic in the AREvo application. At this stage, the usability of this application will be evaluated through a questionnaire to elicit feedback on the usefulness and improvement of the AREvo application.

Table 4. AR Application Development

No	Element	Display and description
1.	Home Page Interface Design	 This page has various buttons in the AREvo application that can take the user to the provided page.
2.	Note Page Interface Design	 This page displays a note on Internet Evolution. There are three different notes and the user can select their choice of notes.
3.	Augmented Reality Page Interface Design	 On this page, the user needs to press the "scan" button to activate the device's camera system. After that, the user needs to scan the target image or marker that has been provided. Next, the 3D object will be displayed on the screen of the user's device.

No	Element	Display and description
4.	Target Image Brochure	 The developed AREvo application has user-friendly features. In addition, this part can ensure that users can easily understand how these applications work. For example, each button displayed on each page has a label that is easy for the users to understand.

3 Result and discussion

We discuss the process of analysis that will be carried out to discover all of the information about the product produced in detail. The analysis findings will help to achieve the goals of developing this AREvo application based on expert evaluation of the topic of Internet Evolution. Researchers have implemented phases of testing and evaluation of the AREvo application based on the approval of three experts articulated in their field and expertise. Researchers have measured the functionality and reliability of the AREvo application based on the content, interfaces, and interactions design based on the testing and evaluation process. As a result, experts were provided a checklist form to use during this phase to determine the functional extensions of the AREvo application based on three design elements.

The questionnaire in Part B has eight items to test the AREvo application functionality in terms of content design. In addition, the researchers analyzed the data in the form of percentages. Information is analyzed and carried out using answer options and feedback on selected items. Table 5 shows items, answer options, and feedback for the testing process in terms of content design elements by experts.

As a result of analysis by experts on the content design, items 1, 2, 7, and 8 states that all experts (100%) agreed on the content of the AREvo application was suitable and easy to understand, the content of the AREvo application fulfills the needs of teaching and learning in Internet Evolution topic, the questions in the quizzes provided in AREvo application were based on the provided notes and the language used in this AREvo application is clear and easy to understand. While for items 3 and 6, there are two experts (67%) who that agree the AREvo application help user maintain consistency throughout the course and that the AREvo application content meets the objective that has been set in the course while another expert (33%) strongly agree on it. Next, for item 4 two experts (67%) agreed that the instructions in the AREvo application are clear and easy to understand while another expert disagreed on the same thing. For item 5, two experts (67%) agreed on the 3D model used in the AREvo

application is suitable and interesting while another expert (33%) choose neutral on the matter.

Table 5. Analysis of Content Design

No.	Items	Percentage (%)				
		1	*2*	*3*	*4*	*5*
1	The content of the AREvo application was suitable and easy to understand.	0	0	0	100	0
2.	The content of the AREvo application fulfills the needs of teaching and learning in the Internet Evolution topic.	0	0	0	100	0
3.	The AREvo application help user maintains consistency throughout the course.	0	0	0	67	33
4.	The instructions in the AREvo application are clear and easy to understand	0	33	0	67	0
5.	The 3D model used in the AREvo application is suitable and interesting.	0	0	33	67	0
6.	The AREvo application content meets the objective that has been set in the course.	0	0	0	67	33
7.	The questions in the quizzes provided in the AREvo application were based on the provided notes.	0			100	
8	The language used in this AREvo application is clear and easy to understand.		0		100	

For section C, there are 12 items related to the analysis of interaction and interface design that experts need to evaluate to obtain functional confirmation of this AREvo application as shown in Table 6. Information analysis was carried out and stated by using percentages and feedback of acceptance for testing in terms of interaction and interface design elements by experts. The results indicated that on items 2, 4, 6, 7, 8, 9, and 11, all three experts (100%) agreed on these seven things that are the exit button in the AREvo application helps the user to log out and close the application, the AREvo application allow the user to control, trust and explore, the AREvo application invite interactions through intuitions and interactive media, the AREvo application allows the user to control, trust and explore, the font size used is used in AREvo application is suitable and easy to read, the font type used in this AREvo application is appropriate and interesting and the target image content used in AREvo application is easy to watch and well-matched. Next, for items 1 and 10, two experts (67%) agree on two things on the menu button in the AREvo application work as expected The provided quiz used in the AREvo application is interesting and well functions while another expert (33%) disagrees about it. For item 3, each expert (33%) namely disagree, agree, and strongly agree the buttons/icons used in the AREvo application are suitable and easy to understand. Then for item 12, an expert (33%) agree on the matter of There being no technical issue happened during the use of the AREvo application and two experts (67%) agree on the same thing.

Table 6. Analysis of Interaction and Interface Design

No.	Items	Percentage (%)				
		1	*2*	*3*	*4*	*5*
1	The menu button in the AREvo application works as expected.	0	33	0	67	0
2.	The exit button in the AREvo application helps the user to log out and close the application.	0	0	0	100	0
3.	The buttons/icons used in the AREvo application are suitable and easy to understand.	0	33	0	33	33
4.	The AREvo application have match user experience and expectations.	0	0	0	100	0
5.	The infographic notes used in the AREvo application are attractive and easy to understand.	0	0	33	67	0
6.	The AREvo application invites interactions through intuitions and interactive media.	0	0	0	100	0
7.	The AREvo application allows the user to control, trust and explore.	0	0	0	100	0
8	The font size used is used in the AREvo application is suitable and easy to read.	0	0	0	100	0
9.	The font type used in this AREvo application is appropriate and interesting.	0	0	0	100	0
10.	The provided quiz used in the AREvo application is interesting and well functioned.	0	33	0	67	0
11.	The target image content used in the AREvo application is easy to watch and well-matched.	0	0	0	100	0
12.	There is no technical issue that happened during the use of the AREvo application.	0	0	33	67	0

Based on the result and analysis, the process to design and develop an Augmented Reality (AR) application for the topic of Internet Evolution and test the functionality of these applications in teaching and learning processes known as AREvo seems to be successful. All three experts give positive comments about this AREvo application, and it looks good and is suitable to be used as teaching material for the Internet Evolution topic. The selected ADDIE model proved to be suitable for the AREvo application design and development process as supported by Soraya [25], who stated that this model has proven to be effective in developing teaching modules as it effectively achieves learning goals with a systematic approach of meeting the students' desires and needs.

Aside from that, the AREvo application looks capable of attracting students by knowing and understanding the history of Internet Evolution and the web timeline more clearly due to the interaction and interface design of the AR technology developed which is intriguing. This is because of the use of an AR application to visualize learning content, which is used to entice students to learn interactively. AR can assist users in interacting with real and virtual environments through a tangible interface composed of words, specific information, and 3D models [26]. Users' comprehension will improve as a result, and the learning process will improve as well.

Furthermore, the development of this AREvo application can be used as an alternative reference material for students who is less interested in academic work i.e., read-

ing, and writing through developing interest and passion in them using technology [27]. This assertion is consistent with Bayanova et. al. [28], who claim that technology applications such as electronic textbooks are a great alternative to books because one small tablet can contain all of the manuals and textbooks, and searching for the necessary information in them is simple and quick, not to mention the fact that you don't have to carry many textbooks.

In the future, the developer can add more features and content to benefit students and improve this AREvo application, such as adding more quiz questions to make learning more interesting and motivating. This statement is similar to a study conducted by Zourmpakis Papadakis & Kalogiannakis [29], in which students demonstrated strong interest and motivation in the activities when quiz games were used because they competed with friends which eventually assisted them to understand and remember the learning content. As a result, the AR application should be very intuitive and provide real-time feedback on their learning to encourage perseverance [30], which can be accomplished by implementing quizzes designed to provide students with continuous feedback on their information's apprehension and retention obtained during the information.

As explained by Goipova, Boqiyeva, and Azimova [31], audiences nowadays are more interested in seeing visual elements such as photos, infographics, and illustrations rather than text. In addition, the use of graphics also provides a visual display that can explain something more clearly and is easier to map into the student's memory. In other words, the information conveyed by using one of the multimedia elements, namely graphics, is easier to remember for a long time.

Because of this, most informants think that they can re-explain the content of lessons learned based on the multimedia elements used by the teacher because the instrument is easier to understand than purely descriptive reading as found in textbooks. This is because descriptive reading materials require more time and attention to find important content for a subject, the teachers need to innovate by using the latest methods that are more interesting because, for Garzón et. al. [32], the role of the teacher nowadays is more of a facilitator and not a mere conveyer of information. As a facilitator, teachers need to be prepared to use learning alternatives efficiently and effectively by applying interactive multimedia in the teaching and learning process in this era of globalization and liberalization. Like the research done by Yeop et. al. [33], the analysis of the study has concluded that Information and Communication Technology (ICT) is an important medium nowadays to obtain information and share knowledge. Through the study, the two tried to convey an understanding of the importance of the medium in the teaching and facilitation process in schools to the Malaysian Ministry of Education.

The application of technology is a necessary attention to the readiness of educators and students to implement it in the learning process as described earlier in technology acceptance. This is because teachers with favorable attitudes and perceptions of technology are more likely to use it in their classrooms. Furthermore, high technology acceptance might reduce second-order barriers like rising teachers' beliefs about educational technology and willingness to change teaching practices to incorporate technology [34]. If teachers and students are ready for and accept technology, they can

use this AR technology to carry out deep learning development. Besides, AR applications can be a creative and adaptable emergent response to a specific crisis such as COVID-19, hurricanes, or war [35].

The options for using technology in Augmented Reality visualization are determined by the teacher and student. Teachers require a period to transition from traditional learning methods to new learning technologies. To use abilities, ideas, and interests in the learning process, students and teachers must collaborate in implementing AR technology as a form of visualization learning. Utilizing deep AR technology Internet Evaluation learning topics can adopt various methods that are used and applied in general subjects. There are stages in applying the Internet Evolution topic in learning:

a) Setting up an Augmented Reality Application

As educators, they must be able to determine the media to be used in the teaching and learning process. The thing that needs to be taken into consideration for teachers who teach the topic of Internet Evolution is to determine the accuracy of the media and provide socialization in its use to students. The Augmented Reality application used is adjusted to the achievements of the subjects. For example, look for AR applications that support and are not heavy in accessing 3D images, because not all students have android devices that have high specifications. Schools can work with third parties to prepare AR applications or technology according to the learning implementation plan.

b) Marker identification

Marker is a detection or application that is used to identify objects captured by the media used. 3D objects are displayed by markers which will then produce images as if they were real. In identification, the camera marker will receive the object and acquire the image by refracting light in the reflection of the object through the camera lens. After the acquisition, the image is detected according to the edge of the captured object.

c) Marker Validation

The markers that have been identified will then be matched with the existing marker database. If the matching process is successful, it will immediately render or build an image or video according to the captured object. Rendering in the world of multimedia is a way to combine captured objects with objects that already exist in the database.

d) Displaying 3D Image Objects

If the image or object is valid, it will display objects that are already in the database according to the edge detection of the object which is focused. The displayed image is a 3D image that has been stored in the database markers.

e) View Image Objects

Users will see image objects that have been captured by the camera according to their shape, and usually, the display produced by Augmented Reality technology is like a moving image.

According to Goipova, Boqiyeva, and Azimova [31], the mainstay of interactive multimedia is in teaching situations where students have control over potentially reviewing learning materials in their own space based on their interests, needs, and cognitive processes. In addition, the use of text elements in a multimedia matter is important for conveying clear understanding and information to students [36]. The development of this AREvo application incorporates the concept of the 3D model because it will help stimulate students and increase their motivation to explore the topic [37].

Next, video is a very effective medium for assisting the learning process because it contains a lot of comprehensive information and directly reaches the students. In their study, Agustien, Umamah, and Sumarno [38] state that video can add a new perspective to the learning content because it can show students the information through moving pictures and voices. The ability of video to illustrate material is extremely useful in assisting educators in the preparation of dynamic material. This statement is similar to a study conducted by Rosa [39], applications can attract students with features such as a combination of the virtual and real worlds. It can even provide students with the opportunity to learn and explore something new. As a result of the existence of this application, such learning can, to some extent, encourage students to learn with a new and beneficial experience.

Learning media development is critical in today's teaching and learning process, and AR technology has made it easier for students to understand the information conveyed. The significance of conveying knowledge in the development of Internet Evolution learning is a barometer for a learning process's success in shaping student character. This statement is supported by Lee et. al. [40], who state that technology can develop a more contextual and scientific learning process to shape students' characters with the spirit of scientists and the demands to produce quality students. Thus, the implementation of AR technology as a form of developing media technology is critical. The introduction of forms and functions of Internet Evolution is one of the applications that can be made in development or innovation by utilizing AR technology. AR technology can be used to introduce students to various parts of Internet Evolution functions and forms as well.

The use of AR technology in the development of learning on the Internet Evolution topic makes learning more interesting and can increase students' desire and motivation to learn. This statement is consistent with Campos-Pajuelo et. al. [41], which emphasizes the importance of implementing AR in education because it can improve motivation, comprehension, and involvement with the subject matter. Furthermore, the advancement of learning through AR technology can assist students in thinking critically about a problem, which can be done directly anywhere and at any time [42]. This is because this technology can visualize the concept of shapes and objects through teaching materials, allowing it to become a more effective medium in terms

of learning outcomes and objectives. According to a study [43], AR technology allows for the merging of virtual objects with the view of real objects, allowing both virtual and real objects to coexist and interact in real-time. Plus, through more theoretical modes of presentation, AR technologies enable the integration of theoretical knowledge in real-world contexts.

This AREvo application has also been viewed as a platform that allows students to learn independently, and they can explore it gradually to help them focus and understand the information presented. According to García Botero, Questier, and Zhu [44], students can do independent learning outside of the classroom to increase their motivation. According to Kok et. al. [45], the use of video learning can demonstrate some differences between what can and cannot be seen completely during actual learning sessions conducted by instructors in practice. This could be a perfect solution to the problem raised by Shabiralyani et. al. [46] regarding school learning materials, which still rely on reference books with 2D images to generate student understanding. As AR development creates affordable technology, teachers have greater access to innovative support for their students with disabilities in academic, social, emotional, and behavioral skill development [47].

In conclusion, there needs to be a shift in learning from two-dimensional (2D) to three-dimensional (3D) settings to keep up with the technology that is becoming more prevalent. This can also make history appear more realistic. To assist students in implementing learning process activities, learning materials in the form of news or information must be converted into media aids [48].

4 Conclusion

This study was developed to produce AREvo for Internet Evolution learning topics for students who are taking ICT courses as alternative learning tools. It can help to facilitate students to learn visually and more clearly regarding the history of the internet. This AREvo application can give a positive impact on students in terms of effective and interesting knowledge delivery. Apart from that, AREvo can also provide a new experience to the outside community, where they can see the content of 3D learning. The AREvo application fulfilled the experts' judgment criteria. However, some refinements and improvements need to be done based on experts' suggestions. The improvement process after this is expected to provide a positive impact in terms of functionality and usability of this AREvo application in other fields such as medicine, tourism, design, arts, entertainment, military industry, education, and others.

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