International Journal Linguistics of Sumatra and Malay (IJLSM)
Journal homepage: https://talenta.usu.ac.id/lsm

Enhancing Augmented Reality (AR) Technology to Improve Medical English Literacy

Haida Umiera Hashim [1*], Erikson Saragih [2], Mahriyuni [3], Abdul Gapur[4]
[1] *Academy of Language Studies, Universiti Teknologi Mara (UiTM), Selangor, Malaysia*
[2,3] *Department of Linguistics, Faculty of Cultural Sciences, Universitas Sumatera Utara, Medan, Indonesia*
[4]*Faculty of Language & Communication, Universitas Harapan Medan, Medan, Indonesia.*
[*]Corresponding Author: eriksonsaragih@usu.ac.id

ARTICLE INFO

Article history:
Received 12 January 2024
Revised 29 March 2024
Accepted 29 June 2024
Available online 30 June 2024

ISSN: 2986-3848

How to cite:
Hashim, H.U., Saragih, E., Mahriyuni, & Gapur, A. (2024). Enhancing Augmented Reality (AR) Technology to Improve Medical English Literacy. *International Journal Linguistics of Sumatra and Malay (IJLSM)*, 3(1), 13-19.

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http://doi.org/10.32734/ijlsm.v2i2.17082

ABSTRACT

Since the paradigm for teaching reading has shifted from traditional literacy to multimodal literacy, prior research has demonstrated that augmented reality (AR) technology can successfully improve conventional literacy in general language learning. Only a few research, particularly in English for Nurse courses, have examined the potential of Augmented Reality (AR) technology to improve multimodal literacy in ESP learning. The purpose of this study was to determine how AR technology affects nursing students' multimodal literacy in ESP learning and how they communicate with others through a variety of multimodal modalities to improve their multimodal literacy in medical English. Fifty nursing students enrolled in English for Nursing courses participated in the study to share their experiences using this multimodal ESP learning survey to improve their medical English literacy. In the auditory mode, background music and sound effects were used to elicit strong emotions and improve immersive experiences. The results also showed a significant improvement in nursing students' multimodal English literacy skills when the material was created for a location-based augmented reality application. The findings revealed that nursing students used three modes in AR (visual, imaging, and animations). The three modes were used to help viewers comprehend complex material, give them specific ideas, and encourage participation.

Keywords: Augmented Reality, Nursing Students, Multimodal Literacy, Medical English

1. Introduction

Over the years, new learning opportunities have often been made possible by recent technological advancements (Crompton et al., 2020; Chen et al., 2020). For example, research spanning decades has shown that the use of computers in the classroom, as opposed to instruction conducted without such resources, may improve student achievement and teaching and learning. Augmented reality (AR) is one of the newest technologies being used in education. It allows the seamless merging of the digital and physical environments. It has already started to show promise in terms of helping students learn more effectively and enhancing information retention when compared to traditional 2D desktop interactions (Davis et al., 2019).

Scholars have demonstrated that augmented reality (AR) technology has become a standard instrument in higher education during the past ten years (Elmqaddem, 2019; Finch et al., 2020). Its popularity among academics can be attributed to its ability to blend a virtual environment with text, images, videos, 3D mode, and animations. Furthermore, location-based and marker-based designs identify an object or an image within the frame of a camera to start augmented reality activities, including showing the object in three dimensions. Furthermore, augmented reality requires users to locate a landmark and a particular area of interest using their phones. Once there, visitors can engage with virtual elements like images, films, and three-dimensional animations.

Numerous studies have looked at the use of augmented reality in the field of education to ascertain how it is currently being used and analyse which uses are most beneficial (Challenor & Ma, 2019). Research on the various uses of augmented reality and how well it supports learning has been done in classroom environments.

According to Billinghurst & Dunser (2012), augmented reality (AR) helps students understand complicated phenomena by providing them with unique interactive visual experiences that combine virtual and real-world data. Creators can use augmented reality (AR) to superimpose virtual images on real objects, giving viewers the ability to physically alter digital content. This improves the illustration of the contextual relationships between real and virtual items as well as the concepts of space and time. Students can understand the general location of a planet about the sun, for example, by reading about and viewing a 2D representation of that position; yet, they can better understand the details of that position by visualising a 3D solar system (López-Belmonte et al., 2020). While dynamic processes are turned into animated objects, direct tactile contact provides a natural way to interact with the digital content. The ultimate result is a deeper comprehension of temporal and spatial concepts as well as the contextual relationships between real and virtual objects.

AR can also facilitate new kinds of cooperative learning, both online and offline (Cheng et al., 2019). Learning becomes essentially a social activity when several users can interact with 3D things and share their perspectives while seeing them from different viewpoints. These skills can serve as the foundation for some innovative learning experiences. The rise in smartphone usage in recent years has led to a spike in interest in mobile augmented reality apps (Ariano et al., 2023). The ideal devices for AR (augmented reality) experiences, both indoors and outside, are modern smartphones and tablets with built-in sensors (camera, GPS, compass, accelerometers), a large touchscreen, fast CPUs, and graphics capability. Academics and commercial developers have used these platforms to create educational apps that provide novel learning experiences.

Certain research studies have also demonstrated the efficacy of Augmented Reality in the context of language instruction. According to Larchen Costuchen et al. (2021), augmented reality (AR) has proven to be a useful tool that could support the creation of creative materials for second-language instruction as well as immersive educational technologies. This study's most ground-breaking discovery was that incorporating immersive augmented reality (AR) experiences into a user's comfortable physical surroundings enhanced a sample group of twenty-first-century college students attempting to learn a second language's performance on the vocabulary retrieval exam. Furthermore, students demonstrated a high motivation to learn via contextualized AR-enhanced learning, according to Chen et al. (2022). Skilled learners showed higher motivation about self-efficacy, proactive learning, and learning value.

The effectiveness of using augmented reality (AR) technology in learning has been studied in the past (Parmaxi & Demetriou, 2020; Lin et al., 2022; M. P. Chen et al., 2022). However, there has never been research done in an ESP learning context in Indonesia that specifically applies this technology to improve nursing English literacy skills. The research team investigated the use of this technology in learning English for Specific Purposes, particularly in English for Nursing courses, given its efficacy in the learning process. The effects of technology on medical English literacy among nursing students are the particular focus of this study.

It is believed that the study's findings will enable nursing students to get experience in medical English literacy, which is undoubtedly highly beneficial for enhancing their multimodal literacy abilities in ESP learning. Furthermore, it is envisaged that the findings of this study will contribute to the body of knowledge regarding the use of augmented reality technology to enhance literacy in learning foreign languages, particularly English for particular uses in the nursing context. In summary, the purpose of this study is to investigate how nursing students are utilizing Augmented Reality (AR) technology to enhance their multimodal literacy in English, as well as the effects of AR use on medical English multimodal literacy.

2. Methods

2.1. Subjects

Sixty nursing students who were enrolled in the Nursing Department's mandatory Medical English course in Indonesia participated in the study. Students in this course had to create material for an augmented reality app that introduced hospital departments and medical equipment in local health communities. According to their school entry exams, the students' English ability was at an intermediate level, and none of them had any prior experience with augmented reality. Everyone was told that the information they provided would be utilized for the study.

The study employed project-based learning (PBL) as a framework for instruction to help students improve their multimodal literacy. Asking students to create artefacts through peer collaboration is the main goal of the PBL approach. The final product was an augmented reality (AR) programme that let users utilise their phones to identify and engage with specific locations of interest, all while in a location-based healthcare setting. Since the students would be creating the material for the location-based augmented reality app, they would use

several multimedia formats to produce virtual representations of the hospital locations in Medan, Indonesia. Consequently, the hospital AR app user can have a deeper comprehension of hospital departments and equipment.

The study took eighteen weeks to complete. The students were split into 11 groups and given a survey to complete in weeks one through two to determine their multimodal literacy levels before starting the AR project. A teaching assistant was appointed to each group to oversee the AR project's development and provide technical support. In week three, the students chose a tourist destination that showcased local people, buildings, food, entertainment venues, and culture to explain medical equipment. The students built digital components of the tourist destination they had chosen between weeks 4 and 17. The AR app users could interact with virtual materials at various tourist places, such as images, written descriptions, graphics, audio, or video. to the world of reality.

As a result, the students would have the chance to talk about how to combine and work with various multimedia (text, photos, audio, and videos) to produce engaging and educational messages that describe the hospital locations. Through the processes of ideation, design, and product creation using the augmented reality app, the students were able to practise multimodal literacy in written, spoken, and visual formats. After participating in the AR project, the students shared their work in the app and completed a post-survey in week 18 to assess how their multimodal literacy levels had changed. After the AR app project was completed, they also submitted reflection essays.

2.2. Data Collection and Analysis

The information gathered included students' reflection essays, their use of several video formats to represent hospital regions in the location-based augmented reality app, and (c) the pre- and post-administration of a multimodal literacy survey. To find out how students employed different multimedia modes to create successful multimodal communication, researchers collected data on students' use of these modes as well as their reflection essays (RQ1). Through the use of a location-based augmented reality app called Hospital Spots, which allows users to interact with the locations through textual and multimedia modes (such as photographs, sounds, and videos), the students' use of multimedia modes was collected. When the augmented reality (AR) project came to a close, the reflective essays were assembled by asking every group member how they used different digital modalities to develop effective multimodal interaction. The content analysis method was used to examine the research data. The students' use of various multimedia modalities and reflective essays was examined using the four phases of content analysis: coding, categorization, description, and interpretation. The researchers developed the main components of the app by going through its various media types during the coding phase. During the classification step, the students' use of different multimedia modes was categorised using the systemic functional technique. The two researchers found supportive remarks for the groups from the students' reflection writings during the description process. The researchers concentrated on elucidating findings, constructing conclusions, formulating inferences, and tying together interpretations throughout the interpretation phase. Between-assessment reliability was 0.85.

Before and after the students finished their hospital communication assignments using the AR tool, a range of multimodal literacy surveys were given to them in order to evaluate the impact of creating AR content for an app on users' multimodal literacy (RQ2). The 17-item multimodal literacy scale served as the foundation for the multimodal literacy survey. There are three multimodal proficiency scales in this survey: (a) self-expression using multimodal structures; (b) multimodal structure interpretation; and (c) choosing a multimodal structure to signify multimodal literacy. A paired-sample t-test was used to compare the outcomes of the multimodal literacy surveys conducted before and after.

3. Results and Discussion

3.1. Results

RQ1. What modes are used by nursing students to Improve ESP Multimodal Literacy using AR?

The study used a systemic functional approach to investigate the modes that students used within the location-based AR. To show how the students successfully created multimodal representations, this method can be used to pinpoint the fundamental shapes and purposes of various modes.

Table 1. Features and Function of Visual Literacy Made by Nursing Students

Mode Forms	Features and Descriptions	Functions
Visual Effects	Integrate Footage of Live action and image	To catch the attention and interest of viewers

Imaging	Pictures in Footage	Provide concrete descriptions of ideas
Animation	Series of Images that simulate movements	To promote and increase viewers' engagement

The table above summarises the findings of nursing students' presentations on the application of multimodal to enhance their medical English literacy. The two types of modalities used by students were separated: visual and audio. The functions that the visual and aural modalities play are as follows: nursing students used the visual mode to demonstrate medical equipment made with augmented reality. Smaller elements such as animations, graphics, and visual effects comprised the visual forms. The students combined real-world film with visual effects to highlight important content and pique viewers' interest.

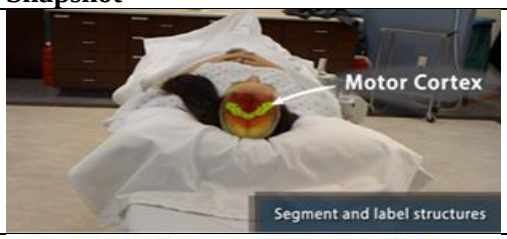
A few of the visual effects were ink spilling and popping up. The words "orange" appeared in the centre of the video when set A presented a set of foods high in vitamin C, as Table 2 illustrates. This was done by the students to draw viewers' attention to the content's central point.

Table 2. Nursing Student Use of Visual Effects in AR

Mode Forms	Features and Descriptions	Snapshot
Visual Effects	Students applied textual effects to enlarge the text that helps viewers concentrate on the main theme of the video	

Students made extensive use of photographs in addition to visual effects. The image's primary purpose was to convey abstract ideas. Group D, for instance, used pictures to present a variety of meals that contain vitamin B9. They said that the pictures were the best multimodal medium for showcasing each piece of gear. Additionally, the students represented difficult information visually by creating infographics using photographs.

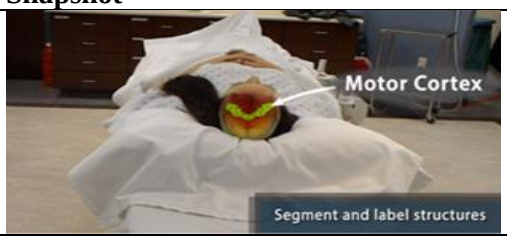
Table 3. The Use of Images in AR

Image Functions	**Features and Descriptions**	**Snapshot**
Abstract concepts	Students use image and textual effects to enlarge the text to enable viewers to concentrate on the object and focus on the image.	
Information Load	Students used infographics and textual effects to help viewers concentrate on the various names of the object in the video.	

3.1.1. Animations

Animations were the final multimedia format the students utilised with augmented reality technology to produce multimodal communication. By using cartoons, the students hoped to persuade viewers to use augmented reality technology. Group B was concerned that when listeners heard oral explanations of medical conditions, they might become uninterested, as Table 4 illustrates. Consequently, Group B produced animations to aid viewers in visualising and appreciating the narratives. They also added text to the clip, which did not hold the attention of the audience. They used eye-catching, cartoon-like digital visuals to create an animation that introduced the core values.

Table 4. Animations in AR Practice

Image Functions	Features and Descriptions	Snapshot
Abstract concepts	Students use image and textual effects to enlarge the text to enable viewers to concentrate on the object and focus on the image.	

3.1.2. Auditory Tools

The nursing students also introduced various hospital regions using AR technology in the auditory mode. Included in the auditory mode were sound effects and background music. The students used these two audio formats to enhance immersive experiences and evoke powerful emotions. Various background music genres were used to create different emotions that complimented the hospital environments.

Table 5. Background Music in AR

Forms	Features and Descriptions	Functions
Background Music	Students used background music in all parts of the video	Background Music function to attract viewers' interest in content delivered in AR. It also functions to create a relaxed and engaged situation.
Sound Effects	Students used various sound effects on the various content of AR	Sound Effects function to attract viewers' interest in the content delivered in AR. It also aimed at enabling viewers to become immersed in the content of the AR.

To improve immersive experiences, the second audio format included non-musical sound effects that matched the material, like chirping, doors opening and closing, and other town and city noises. To improve the users' vicarious sense of their service to the nation, Group D, for example, incorporated national noises from Indonesia into their video scene featuring paramedics in the operation room. In a similar vein, Group E entered the hospital building to mimic the spirit sound effect of a nurse who is prepared to provide care.

RQ2: The effect of creating AR content on students' multimodal literacy

To show how AR affects multimodal literacy in ESP learning, a paired-sample t-test was used both before and after research participation. The mean and standard deviations for the multimodal literacy measures taken by the students are shown in Table 6.

Table 6. Pre-and Post-Test on Multimodal Literacy on ESP Learning

Scales on Multimodal Literacy	Pre-test		Post Test				
	M	SD	M	SD	t	df	Sig
The use of Modes to express content	3.85	.48	4.02	.52	-2.05	52	.046
Interpret video content visually and textually	3.86	.36	4.06	.53	-2.53	52	0.25
Multimodal structures preferred for communication contents	3.26	.85	3.53	.56	-2.27	52	0.26

The results show that there were significant differences between the pre- and post-scores of the three multimodal literacy measures, indicating that students' multimodal literacy was significantly improved by creating an augmented reality app employing a range of multimodal media.

3.2. Discussions

The study's findings show that nursing students use three different AR modes—visual, image, and animations—to increase their ESP literacy and that using AR affects their multimodal literacy abilities. Furthermore, based on this research, AR environments and systems may help students learn skills and

knowledge that they can more successfully acquire in other technologically sophisticated learning contexts (Garzón et., 2020; Wu et al., 2013; Garzón, 2021). The results of this study corroborate past research on the effectiveness of augmented reality in the language learning process. The aforementioned scenario boosts material knowledge and learning motivation, encourages situated and collaborative learning, and helps students recognize complex spatial linkages and abstract ideas in the presence of virtual goods and real locations (Wedyan et al., 2022). Even though the study's findings are similar to those of previous research (Yang & Mei, 2018; Che Dalim et al., 2020), this study's results particularly show how augmented reality (AR) technology can greatly increase multimodal literacy when learning English for Specific Purposes (ESP), especially English for Nurses.

However, in addition to the advantages of using this technology in the classroom, there are pedagogical considerations that must be made while deploying AR systems (Alalwan et al., 2020; Che Dalim et al., 2020). As with many other educational innovations in the past, the use of augmented reality in the classroom may first encounter opposition from teachers and school policies. Modern methods such as interactive simulations and studio-based pedagogy are frequently used in augmented reality-related learning activities (Garzón et al., 2020b; Akçayır & Akçayır, 2017). The emphasis on traditional teaching methods, which is teacher-centred and delivery-based, is fundamentally different from the nature of these instructional approaches. Institutional limitations, such as the requirement to cover a certain amount of content in a set amount of time, may also make it difficult to implement innovations. When creating learning activities and augmented reality systems, the primary obstacle facing academics is how information should be communicated and moved between two worlds and across multiple devices.

4. Conclusion

The research has been investigating how multimodal literacy in ESP learning can be developed through augmented reality (AR). To give nursing students an interactive experience, computer-generated perceptual data is added to real-world hospital artefacts in this technology application practice. For nurses using augmented reality for ESP learning, this study offers helpful information. Above all, the findings offer useful data to those responsible for teaching ESP and augmented reality (AR) to nursing students. Consequently, educators are afforded greater possibilities to assist children in need with their education. The study also highlights the significance of offering a suitable learning environment, especially when augmented reality is involved. In this sense, simply having teaching aids or materials is insufficient; they also need to be customized for the setting in which they will be used. Thirdly, learning and teaching need to be engaging and innovative, made possible by modern educational tools. Policymakers should concentrate on incorporating innovative pedagogical methods, such as augmented reality, into various teaching and learning processes to improve the communication abilities of nursing students. However, several evidential validity and design issues with these empirical studies require further research to resolve.

5. Acknowledgement

The team of authors would like to thank the research centre of Akademi Pengajian Bahasa, Universiti Teknologi Mara (UiTM) Malaysia and Lembaga Penelitian (LP) of Universitas Sumatera Utara for providing funding for this research. The authors also thank the team editors and team reviewers who provided corrections and suggestions for improving this paper.

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