International Journal of Learning, Teaching and Educational Research
Vol. 24, No. 5, pp. 679-705, May 2025
https://doi.org/10.26803/ijlter.24.5.35
Received Mar 29, 2025; Revised May 16, 2025; Accepted May 19, 2025

Creating AR Application for Advanced ESP Vocabulary Teaching in Indonesia

Putri Amalia Rizkina
Universitas Muhammadiyah Purwokerto
Central Java, Indonesia

Tono Suwartono
Universitas Muhammadiyah Purwokerto
Central Java, Indonesia

Sri Nurhayati
IKIP Siliwangi
West Java, Indonesia

Okto Wijayanti
Universitas Muhammadiyah Purwokerto
Central Java, Indonesia

Fahmy Ferdian Dalimarta
Universitas Muhammadiyah Tegal
Central Java, Indonesia

Abstract. Recent virtual and online education has led to the invention and popularisation of many online tools, including 3D models and AR, for visualising medical tool architectures. The present study aimed to assess the need for augmented reality (AR) application specially dedicated to medical tools vocabulary teaching to anaesthesiology nursing students, create the application prototype, assess its quality, and evaluate its effectiveness when put into action. The study adopted McGriff's research and development model. Data was collected utilizing multiple techniques. To obtain information on the students' and teacher's needs, a questionnaire was administered and an interview was conducted, respectively. To ascertain the quality of the application, expert judgement was carried out and a students' voice questionnaire was administered. To evaluate the effectiveness of the application, pre- and post-tests were administered. Data gathered from questionnaires was analysed using descriptive statistics. Data elicited through interviews was analysed qualitatively. Data on students' performance before and after the software use was analysed using T-test statistical tool. The need survey revealed

that all students need AR application to support their medical tools vocabulary learning. Initial interview with the lecturer demonstrated enthusiasm in an application use for instructional media. The developed software was deemed valid through the expert judgment and was considered excellent as per student voice survey. In addition, the statistical analysis indicated that the developed application improves students' learning outcome. One implication is that the AR application could serve as a significant resource in the realm of medical vocabulary acquisition.

Keywords: augmented reality; application; ESP; vocabulary; teaching

1. Introduction

Vocabulary is the core element of second/foreign language learning. Engaging students in vocabulary learning has become a more important area of research. Over the past few decades, there has been a spike in studies aiming at fostering and facilitating student language acquisition and use with the help of technology. However, there is still a lack of studies that promote the incorporation of technology within vocabulary teaching and/or learning (Bostanci, 2022; Hasan et al., 2022). More specifically, in the field of English for Specific Purposes (ESP), there are some problems encountered by both teachers and students regarding technical vocabulary teaching and learning in vocational courses (Irawan et al., 2023; Havwini et al., 2024). This indicates a need to help teachers and students with ESP vocabulary instructional media.

ESP offers English for Medical Purposes (EMP) for surgeons, cardiologists, nurses, and midwives. EMP's English for Nursing Purposes (ENP) addresses nurses' clinical and educational communication demands (Chetsadanuwat, 2024). ENP addresses medical terminology, patient-focused communication, professional teamwork, and cultural awareness (Brooks et al., 2019; Ličen & Prosen, 2023). These research have helped us comprehend nurses' communication styles. This finding inspired a framework to characterise nurses' English use in different circumstances. The contexts include (a) reading course handouts, textbooks, journals, and nursing resources; (b) analysing medical information (medical tables, graphs, and charts); (c) facilitating electronic communication (reading and writing emails to physicians and patients, both native and foreign); and (d) providing patient care. Many studies have examined the English language demands of nurses and nursing students, but few have examined the needs of nursing English learning media.

A small-scale classroom survey with students of Anaesthesiology Nursing Department confirmed the idea above, where 96.2 percent of the students wanted media to support their English learning, including a tech-based app for both indoor and outdoor learning, suggesting the need to learn English for their professional sphere with the help of technology in an autonomous way of learning. An initial interview with the ESP lecturer revealed that the students were mostly dull and exhausted due to packed schedule. The existing media seemed to be old-fashioned to these gen-z students. Despite the use of various

existing media and varied activities for teaching English, such as Quizizz, Kahoot, flashcards, power point, videos, lectures, and group work, students continue to face difficulties in learning the language. They were reluctant to use English in the classroom and were passively interactive during the class.

Regarding the aforementioned status quo, augmented reality (henceforth abbreviated as AR) has emerged as the latest trend in English language teaching. One obvious strength of this technology deals with its capacity to create student-centered learning (Chen et al., 2016; Aniuranti et al., 2024). Having considered the results of the students and teacher' need assessment as well as the fact that students have smartphones which enable AR apps to be run within the classroom and beyond, the current study was conducted. Specifically, this study seeks the answer to the following questions.

1. How is the Anaesthesiology Nursing students' and English teacher's need for AR technology in their English vocabulary instruction?
2. How is the validity of the developed AR app based on expert judgement?
3. How is the performance of the AR app according to the students?
4. How does the AR app affect the students' learning outcome?

2. Literature Review

2.1 Recent Development of AR Application in Education

In modern education, technology is becoming more and more integrated, changing both learner engagement and pedagogical approaches. Among new tools, AR has drawn interest as a game-changing tool with enormous educational potential (Redondo et al., 2020). The development of AR environments necessitates the integration of diverse technologies, as evidenced by prior studies (Kipper & Rampolla, 2012). These technologies encompass devices capable of capturing environmental imagery, such as computer screens, smartphones, webcams, or gaming consoles; display systems that integrate real-world and virtual imagery, utilizing the aforementioned devices; computational units, including computers, mobile devices, and gaming consoles, which process real-world data and generate the requisite virtual components; specialized software tailored for AR development; activators or markers, including QR codes, physical objects, or GPS signals; and content servers that store virtual data to be overlaid onto the real-world environment.

The nature of AR activation determines its classification into marker-based, geolocation-based, or QR code-based AR, as articulated by Cabero and Barroso (2016). Marker-based AR employs printed markers to associate 3D images, videos, or animations through specialized software (Na et al., 2025). When a marker is scanned by a webcam, its embedded virtual elements are activated, facilitating real-time perspective shifts that unveil the three-dimensional nature of the augmented content.

Through the overlay of interactive, computer-generated 3D objects, AR improves the physical world and enables users to interact with digital content via mobile displays (Lee et al., 2017). Real-time feedback, experiential learning, and spatial cognition are all supported by this multimodal learning experience that combines

virtual and real-world components. Through visualization and interaction, AR shows a special ability to connect abstract and concrete knowledge, even though its adoption in formal education systems is still in its infancy (Mohamed & Razali, 2019). Nevertheless, careful instructional design, access to suitable infrastructure, and teacher preparation are necessary for its pedagogical value. Even though the technology has potential, more empirical research is needed to determine how it affects learning outcomes and differentiate between novelty effects and long-term cognitive gains.

Christopoulos et al. (2021) pointed out that a considerable amount of literature has explored the potential of AR in education; however, there is limited understanding of the impact of AR-supported instruction within tertiary-level Medical Education (ME). Karacan and Akoglu (2021) examined research on foreign language instruction using augmented reality technologies. According to the results, augmented reality presents many chances and advantages for learning foreign languages; but, its whole integration into foreign language classrooms is not yet achievable.

According to O'Connor and Mahony (2023), AR has similar effects on student behavior, changing the dynamics of participation and involvement. Students are drawn to AR applications because of their dynamic and gamified features, which encourage participation and teamwork in group projects. Additionally, by enabling contextual and experiential learning, augmented reality transforms teaching approaches (Malaquias & Malaquias, 2021). Teachers use augmented reality to craft captivating lessons that give students real-world applications of their academic learning. As a result, teaching strategies that emphasize student participation and inquiry are replacing traditional teaching techniques.

2.2 The Potential of AR Application in Language Vocabulary Teaching

According to Huang et al. (2016), technological advancements in educational settings have facilitated the development of complementary methods, subjects, and learning objectives through interdisciplinary collaboration. Al-Khattabi (2017) postulates that AR can significantly contribute to education, enabling students to collaborate on AR projects, engage in language-related challenges, and communicate in English within shared spaces, fostering both teamwork and communication skills. Similarly, Akçayır and Akçayır (2017) assert that AR allows users to view virtual objects within real-world contexts, enhancing the sense of authenticity. Al-Ansi (2023) identifies three fundamental aspects of AR: the blending of real and virtual environments, real-time interactivity, and 3D integration and rendering. Furthermore, AR promotes an engaging learning experience, contextual learning, vocabulary expansion, grammar visualization, cultural immersion, personalized instruction, and collaborative learning, making the process both motivating and enjoyable. Empirical evidence suggests that AR has the potential to enhance learning efficiency and knowledge retention when compared to traditional 2D desktop interfaces. By providing immersive visual and interactive experiences that integrate the real world as the "primary world" with virtual components, AR facilitates the comprehension of complex phenomena. In essence, AR represents the real-time merging of digital and physical data through technological tools, wherein virtual elements are

superimposed onto the real world to enrich the user experience (García et al., 2010; Muñoz, 2013).

AR enables users to interact with both the physical and virtual environments simultaneously (Cantero at al., 2015). It overlays real-world images and videos with computer-generated 3D text and objects. Cuendet et al. (2015) describe AR as a "technology that projects digital materials onto real-world objects" (p. 554), effectively bridging the gap between real and virtual domains. Billinghurst et al. (2021) perceive AR as a tool for object manipulation that fosters dynamic educational experiences. Cabero and Barosso (2016) characterize AR as the "real-time mixing of digital and physical information via various technological devices" (p. 44), emphasizing its potential in creating immersive learning environments. Beyond its application in general education, AR is particularly beneficial for language learning, as it facilitates the visualization of grammatical structures, provides cultural immersion by virtually transporting learners to an English-speaking environment, and offers tailored instructional content that adapts to individual learning styles and proficiency levels. By integrating AR into language education, students receive personalized feedback, self-paced exercises, and content aligned with their linguistic development. Akçayır and Akçayır (2017) affirm that AR seamlessly incorporates virtual elements into real-world settings, demonstrating its transformative potential in English language education by modernizing conventional teaching methods and making language learning more effective, engaging, and relevant in the digital era.

As highlighted earlier, one of the challenges in language education is to ensure that students grasp the material effectively, particularly given the time constraints of English classes and the potential decline in student motivation. AR presents a viable solution for both educators and learners by offering an interactive and engaging approach to content delivery. One could argue that the primary purpose of augmented reality is to enhance existing knowledge by supplementing real-world information with digital content. In this way, AR functions not as a replacement for traditional learning materials but rather as an amplifier of educational content, creating an enriched learning experience.

With the rapid advancement of digital technology, mobile AR has become an increasingly prevalent tool in education, fostering theoretical exploration, knowledge acquisition, curiosity, and enjoyment (Chen et al., 2020; Yoon et al., 2021). Numerous studies have investigated the use of mobile AR-based learning activities to improve student engagement through multimedia learning principles (Goff et al., 2018; Wu et al., 2013). Clark and Dünser (2012) found that AR-based educational materials, such as interactive books, enhance learner engagement and comprehension by increasing interactivity and improving content retention. Furthermore, AR applications have been shown to enhance fine motor skills, communication abilities, and fundamental cognitive skills (Drigas et al., 2016). Several researchers have explored AR applications in specialized learning contexts. Bai (2012) utilized AR as an assistive learning tool for autistic children, while Brandão et al. (2015) developed "An Augmented Reality Game-Book" to support children with autism spectrum disorder. Similarly, Markouzis and

Fessakis (2015) investigated the potential of interactive storytelling through AR for learning and entertainment, and Ivanova (2014) examined the role of AR-enhanced textbooks in future blended education. In a broader cultural context, Franza et al. (2016) developed a Balinese dance AR application, while Yılmaz (2021) found that AR fosters high student engagement in interactive learning environments in Turkey. A study conducted in Malaysia further corroborated these findings, demonstrating that AR applications help sustain student motivation and participation in classroom activities (Rasalingam et al., 2021).

The role of mobile applications in English language learning—particularly in vocabulary acquisition—has been widely studied. Farrah and Abu-Dawood (2018) examined the efficacy of mobile applications in language instruction, revealing that students actively sought additional apps to complement their learning (Rizkina & Suwartono, 2023). Elfeky and Masadeh (2016) assessed the impact of mobile-assisted learning on students' academic performance and conversational proficiency, concluding that such interventions significantly enhance both linguistic competencies. Developing a new supportive medium for learning English is anticipated to enhance reliability for students (Nurhayati et al, 2020). Additionally, several studies have found that integrating mobile applications in classroom instruction increases student attention, engagement, and motivation (Pérez-Fuentes et al, 2011; Tomi & Rambli, 2013; Di Serio et al., 2013).

A major pedagogical challenge in vocabulary instruction is the lack of meaningful contextualization. Wu (2014) reports that Cyclical Repetition Technique (CRT) helps Chinese college students memorize English vocabulary quickly, effectively, and perpetually. Cents-Boonstra (2020) observes inspiring teachers starting their lessons by activating their students by freeing them to experiment in well-planned activities and assignments. Conversely, teachers in lowly engaging lessons tend to waste time with demotivating teaching behavior at the start of the lessons.

Given the increasing role of English as a global lingua franca, proficiency in the language has become essential across multiple disciplines, including medicine, where precise communication is critical for research, education, and clinical practice. Creswell (2013) highlights that scientific, technological, and academic information is predominantly conveyed in English, reinforcing the necessity of English language proficiency for medical professionals. Wahyuni (2021) stresses the importance of motivating medical students and professionals to study English, while Heming and Nandagopal (2012) note that English serves as the "official language" of international medicine.

Beyond academic research and information retrieval, language proficiency in medical contexts plays a direct role in patient care and clinical communication (Ibrahim, 2010). Given the growing demand for English proficiency in specialized domains, there is a pressing need to prioritize medical vocabulary instruction through innovative approaches.

As discussed, the development of AR applications for vocabulary instruction in

medical education is both feasible and desirable. AR-based applications have the potential to increase learner autonomy, enhance engagement, and provide interactive learning opportunities. By transforming abstract concepts into tangible experiences, AR applications facilitate hands-on training without the necessity of physical learning materials. The present study contributes to this evolving research discourse. Employing McGriff's ADDIE model as a rigorous theoretical framework within an R&D paradigm, this study aims to develop an AR application for medical vocabulary instruction. The findings of this research will offer valuable insights into the integration of technology in education, contributing to ongoing scholarly discussions on pedagogical innovation and digital transformation in language learning.

3. Method

3.1 Research Design

In our attempt to create an AR application for learning medical tools vocabulary, we employed McGriff's ADDIE model of research and development. We chose McGriff's ADDIE model because it provides an iterative, flexible, clear framework fit for creating and assessing classroom or instructional aids. ADDIE is perfect for technology-based innovations and education as it permits constant feedback and improvement compared to stricter R&D models. This model covers five stages: analysis, design, development, implementation, and evaluation (McGriff, 2000), as illustrated in Figure 1.

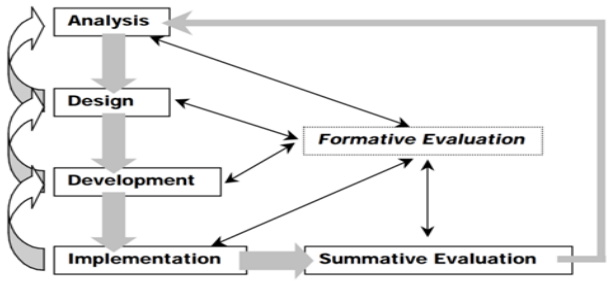

Figure 1: ADDIE model of research and development

The study involved a needs analysis using surveys to identify students' unique learning needs for AR to acquire and use medical tool vocabulary. The design phase involved selecting appropriate software, compiling content, setting objectives, creating a quiz, and establishing assessment criteria. Various software, including Unity 3D, Vuforia SDK, SketchUp Pro 2022, and Canva, were used to create visual representations of medical tools, test within the application, and design the application's cover and first page.

The Development phase builds on Analyse and Design phases, involving identifying reliable AR maker engines, selecting easy-to-use AR applications, developing instruction, media, and supporting documentation. Unity 3D Engine, Vuforia Engine SDK, Canva, and SketchUp Pro 2022 were chosen for AR model development, image processing, layout creation, and vocabulary drawing. Details on the hardware needed are listed in Table 1.

Table 1: The hardware specification

No	Item	Specification
1	Processor	Apple M1 and later, Intel Core i7 4500u
2	RAM	8 GB
3	Graphic Card	NVIDIA GeForce 750M
4	HDD	1 TB HDD with 100 GB of free space
5	Operating System	macOS, Windows 10
6	Camera	48 MP

While the types of software needed for designing the AR app are mentioned in Table 2.

Table 2: The software specification

No	Item	Specification
1	Unity 3D	Unity Hub 2.0.1
2	Vuforia SDK	Vuforia Engine 10.15
3	SketchUp	SketchUp Pro 2022
4	Canva	Canva 2023

The developed application had an output, which was an AR based medical tools application. This app could run as native application on mobile devices, and this developed application would run on android platform only because this has become the most used mobile platform among the students. Sample of the app research and development process in the current study is illustrated in Figure 2.

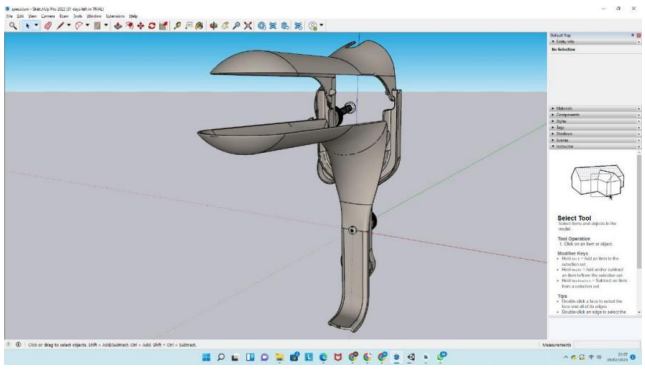

Figure 2: The 3D asset (vaginal speculum) utilizing SketchUp Pro 2022

Overall app research and development process is displayed in Figure 3.

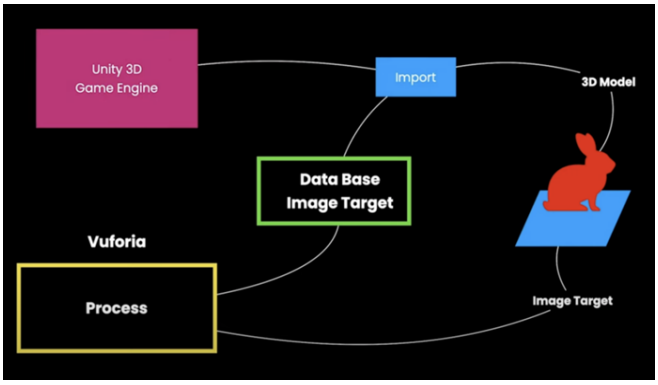

Figure 3: Stages of the AR app research and development

The initial image target was created using SketchUp Pro 2022 and imported to Vuforia SDK and integrated into AR app prototype by using Unity 3D Engine. Examples include those given in Figure 4.

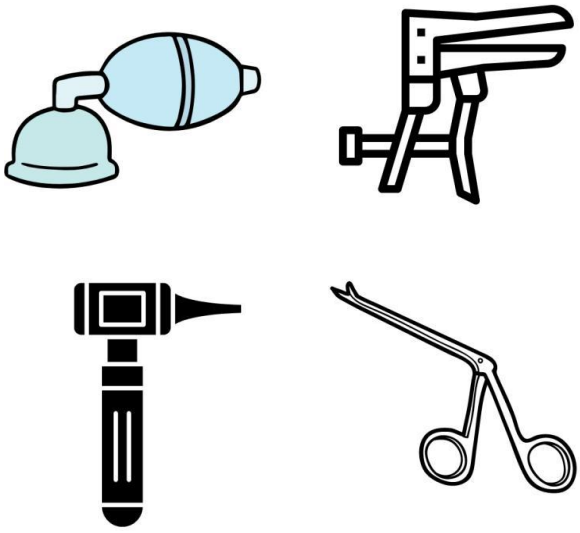

Figure 4: Sample of images to be included in the AR app

The app was then run on the Android platform, allowing students to easily navigate between medical tools 1 and 10. The app also included a test to assess students' mastery of the vocabulary. The implementation stage involved implementing the app in the teaching process to assess its performance and effectiveness. The application was incorporated into Advanced English for Anaesthesiology Nursing teaching guidelines.

The final stage was evaluation. An initial evaluation was conducted through expert judgements, covering content, language use, and media courseware judgements and a quiz as pre-test administration. Further evaluation was a crucial step in assessing the performance and effectiveness of the developed AR app. It covered a quiz as post-test administration, a G-form questionnaire, and the second expert evaluation.

3.2 Participants

The study involved 53 out of 66 students majoring in Anaesthesiology Nursing and 1 lecturer who taught them "Advanced English for Anaesthesiology Nursing" Course at Universitas Harapan Bangsa, Indonesia. Informed consent and anonymity were provided for academic purposes and clear research objectives (Sindhuri & Dongre, 2023). The students, who attended the course, and their lecturer volunteered themselves to be part of the research.

3.3 Data Collection

Questionnaires were administered (completed by 53 students) and interviews with the lecturer were conducted to gather data on students' needs and lecturer's perspective of this matter. Regarding the expert judgment, we provided the evaluators with assessment sheets to validate the developed AR app content, language use, and media courseware. Twenty items were evaluated on relevancy, suitability with learning objectives, grammar use, motivation, attractiveness, validity, graphic quality, depth, student interaction, accuracy, references, examples, intellectual development, content appropriateness, attractiveness, 3D representative models, validity, functionality, 3D images proportionality, and layout.

The assessment component related to language appropriateness included 10 components using a 1-to-5 rating scale. These components include: (1) spelling and punctuation accuracy, (2) editorial clarity and readability, (3) accuracy of examples and illustrations, (4) suitability of language style for the target students, (5) grammatical accuracy, (6) accuracy of word choice, (7) clarity of language instruction, (8) proper use of language, (9) cohesion, and (10) coherence.

The assessment component related to the effectiveness and practicality of instructional media included 14 components using a 1-to-5 rating scale. These components included: (1) visibility of system status, (2) user control and freedom, (3) satisfaction, (4) aesthetic and minimalist design, (5) help and documentation, (6) match between system and the real world, (7) consistency and standard, (8) error prevention, (9) recognition rather than recall, (10) flexibility and efficiency of use, (11) help users recognize, diagnose, and recover from errors, (12) environment configuration, (13) accuracy, and (14) alignment with learning objectives.

To obtain data on student voices, a questionnaire was administered. The students' voice evaluation aimed to capture: (1) alignment of the provided material with the learning objectives, (2) adequacy of information in the AR app about the provided material, (3) adequacy of examples discussed in the AR app, and (4) fit between the material and the AR app. The full version of questionnaires is given in the Appendix.

To collect data on student learning outcome (vocabulary mastery) as impact of the developed AR trial, a quiz was administered. The students were asked to do multiple-choice questions twice: before (pre-test) and after (post-test) being introduced to the AR app.

3.4 Data Analysis

Descriptive statistics was used to analyse the data obtained from questionnaires and expert judgements. The resulting percentage score was then categorized on the basis of assessment criteria (Suwartono et al., 2024) as presented in Table 3.

Table 3. Categories of assessment result

1-5 Rating Scale Score	Percentage Score	Category
AR > 4,2 - 5	1 - 20%	Excellent/Very Effective
AR > 3,4 - 4,2	21 - 40%	Above Average/ Effective
AR > 2,6 - 3,4	41 - 60%	Average/Fairly Effective
AR > 1,8 - 2,6	61 - 80%	Below Average/Slightly Effective
AR > 1 - 1,8	81 - 100%	Very poor/Not Effective

Interview data was analysed using content analysis. Data collected through pre- and post-tests was analysed using an inferential statistical tool of paired sample T-test with the help of the SPSS 22 statistical analysis software.

4. Results and Discussion

4.1 Students' Need for AR App

The following table summarizes results of the students' need survey data analysis.

Table 4. Result of students' need survey

Items	Yes	No
1 Q1	41,5%	58,5%
2 Q2	96,2%	3,8%
3 Q3	94,3%	5,7%
4 Q4	100%	0 %
5 Q5	96,2%	3,8%
6 Q6	79,2%	20,8%
7 Q7	32,1%	67,9%
8 Q8	84,9%	15,1%
9 Q9	94,3%	5,7%
10 Q10	100%	0 %
11 Q11	64,2%	35,8%
12 Q12	52,8%	47,2%
13 Q13	50,9%	49,1%
14 Q14	50,9%	49,1%
15 Q15	90,6%	9,4%

Responses to Q1, 7, 12, 13, and 14 seem unexpected. Q1 asks about the English class's hospital communication goals. Over 58% of the students replied no, indicating they were irrelevant. Students may not immediately connect their English language abilities to medical communication needs. They may think it is common English, not knowing medical terminology, patient engagement, or interprofessional communication. Higher student motivation may be achieved by engaging with all relevant variables in their field of competence (Spalević et al., 2018).

Q7 asks about students' prior knowledge about the AR technology. Nearly 68% of the respondents replied no, indicating this AR technology was novel in their English learning environment. Although numerous students are considered digital natives (Çelik & Ersanlı, 2022), it is mistaken to assume that all possess an identical level of technological familiarity. Some students may have insufficient access to essential devices or possess limited experience with comparable technologies, resulting in a digital divide in the classroom.

Q12 asks whether pupils use IOS. The results indicated 52.8% of they responded yes and 47.2% said no, virtually balanced. Platform-agnostic programming is essential given OS preference's near-even split. Focusing on iOS alone may exclude many pupils (Hinze et al., 2022). Cross-platform apps are more accessible and effective.

Q13 asks if respondents always use smartphone when learning English. More than half (50.9%) of them believed that English in anaesthesiology nursing consistently incorporates smartphones, whereas 49.1% disagreed, highlighting a significant division in perceptions. This division highlights the intricacies involved in the integration of mobile technology within clinical practice.

Recent research underscores the opportunities and obstacles associated with smartphone utilization in healthcare environments. A survey of anaesthesiologists indicated that 50.9% perceived smartphone use as beneficial to patient care, whereas 43% viewed it negatively, highlighting distractions as a significant concern (Ambasta et al., 2022). Nursing students have indicated that smartphones can facilitate clinical decision-making and enhance patient care; however, they may also jeopardize patient safety and the quality of communication (Gutiérrez-Puertas et al., 2021).

The findings indicate that the adoption of smartphones in anaesthesiology nursing is not universally embraced and may be influenced by factors including individual attitudes, institutional policies, and contextual usage. Consequently, additional research is required to establish guidelines that reconcile the advantages of mobile technology with the necessity of ensuring patient safety and care quality. Overall result of students' need assessment was used to develop the AR app.

4.2 Lecturer's Need for AR App

The lecturer expressed considerable enthusiasm regarding the application of AR in educational settings. The initial response simply recognizes AR as a new educational tool, without providing additional detail or clarification regarding its comprehension. Given the class compaction this semester, the students experienced boredom, leading her to consider the incorporation of new, fresh, and engaging media. The English instructor explained as follows:

> "*Actually, if there is no tight timetable, English could be fun for the students because we use a lot of teaching media such as flash cards, quiz and soon. English is like their escape from the heavy materials of*

> *Anaesthesiology Nursing. Unfortunately, due to this status quo, the students seem so exhausted and bored during the class,"*

Also, EL clarified that

> *"They need something that can attract their attention, to boost their motivation in learning English. Plus, they need such a thing to help understand especially general medical tools they do not see in the field of anaesthesiology."*

The statements confirm studies by Al-Gerafi et al. (2023) and Al-Musawi et al. (2025), who characterized AR as a groundbreaking technology that creates computer-generated simulations of environments and facilitates real-time interaction for users. This insight emphasizes the potential of AR to revolutionize education by offering innovative and captivating learning experiences. Sharma (2021) and Al-Sinani and Al-Taher (2023) agree that AR provides a unique learning experience that boosts student motivation and enjoyment. Enhancing image targets in this context transcends the simple introduction of new technology; it involves a strategic application of its capabilities to improve and optimize the learning experience. Through the effective integration of AR, educators can develop more engaging, interactive, and comprehensive learning environments that address various learning styles, ultimately enhancing the understanding and retention of academic concepts for anaesthesiology students.

4.3 What Experts Say about the Developed AR App

The following chart displays results of the expert evaluation regarding the validity of the developed AR app.

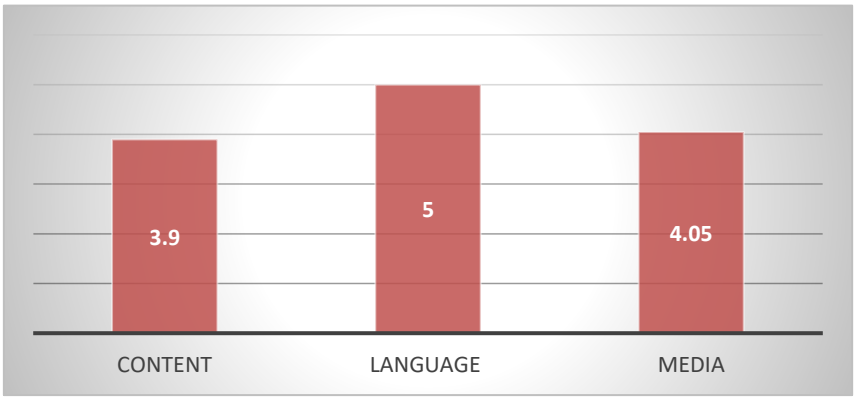

Figure 5: Results of expert evaluation

The average content validation score was 3.9. Relevance was the most important of 20 assessment components, followed by suitability of the material with learning objectives, grammar in use, motivation, and attractiveness (3D pictures), validity of material substances, appropriateness of graphics, depth of the material, student motivation, suitability of the app with student interaction, accuracy of references, examples and explanations, and intellectual development. The evaluators

encouraged the use of more 3D medical instruments and more unique ones. This is in line with previous studies by Bilous et al. (2020) and Iatsyshyn et al. (2020).
The expert in language use validated an application designed for English language proficiency, evaluating aspects such as spelling accuracy, punctuation, editorial clarity, relevant examples, stylistic appropriateness, grammatical correctness, word selection, clarity of instructions, language appropriateness, cohesion, and coherence. The application achieved a remarkable average score of 5.00, with the expert endorsing it as an engaging learning tool and suggesting the addition of content to encompass a broader range of English language education subjects, somewhat compatible with studies by Kiv et al. (2020) and Chen et al. (2020).

The evaluations from app development expert indicated that 22 assessment components, such as visibility of system status, user control and freedom, satisfaction, aesthetic design, help and documentation, interaction solution, alignment between system and real world, consistency, error prevention, recognition, flexibility and efficiency of use, assistance in recognizing, diagnosing, and recovering from errors, environment configuration, and accuracy, all garnered scores between 3 and 5. The overall score reached 89, resulting in an average score of 4.05. The specialist in app development offered the subsequent observation, i.e. the application was aligned well with the established learning objectives. Additionally, it is essential to incorporate more tools into the app's content as well as a timer for each item on the multiple-choice questions in the quiz.

4.4 The Developed AR App (Prototype)
The outcome of the developed AR application includes a homepage, 10 AR representations of medical tools along with their definitions, and a quiz. The two-dimensional image was reproduced on the paper. The 2D image was identical to the one created in SketchUp Pro prior to its incorporation into AR. The students directed the camera at the image using the app, and the image would automatically augment.

Figure 6: The homepage menu of the AR app

The initial interface presented itself upon launching the application. As observed on the page, there were two buttons labelled "start" and "quiz." Upon clicking the initial button labelled "START," the sequence of 10 augmented reality images would be displayed individually. The individual had the ability to directly position the camera towards the printed marker, resulting in the augmented reality version of the image appearing. The image was designed to rotate 360 degrees, facilitating a better understanding of its visualization for the students. Every AR image is accompanied by a description of the medical tool's function in the bubble below.

Figure 7: The first AR picture (Ambu bag) appearing in the AR app

The Ambu bag was displayed on screen, emerging in 3D and rotating a full 360 degrees. The students may have the opportunity to observe the image from various angles. The title of the image was displayed in the upper left corner. The white bubble beneath the object was illustrated alongside an explanation of the tool's function, presented in a verb-ing construction. This finding is consistent with Vakaliuk and Pochtoviuk (2021).

Upon clicking the second button labeled "QUIZ," a series of 10 multiple-choice questions will be displayed. The quiz featured a single bubble at the top containing the question, while four alternative bubbles were positioned below it. This idea compliments Vakaliuk and Pochtoviuk (2021), mentioning that one of the best features on Vuforia SDK is also "text and environmental recognition." The students may select the most suitable answer from the provided options, and the outcome will be displayed immediately. Figure 8 exhibits how the initial page of the quiz looks like.

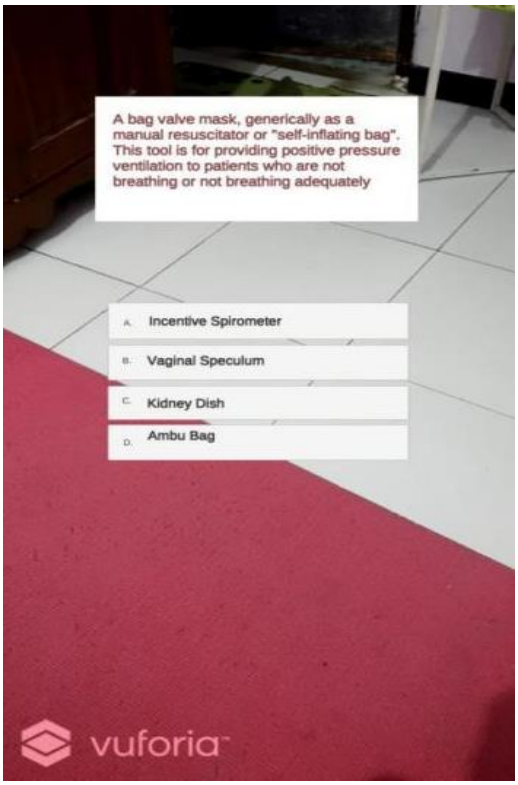

Figure 8: The quiz

The quiz comprised a single question positioned in the upper bubble, accompanied by four alternative responses located in the bubble beneath. Users are required to select the best answer based on their comprehension in response to the question. The application would detect whether users provide either a correct or incorrect response. Figure 9 shows how a wrong answer notification appears on the screen.

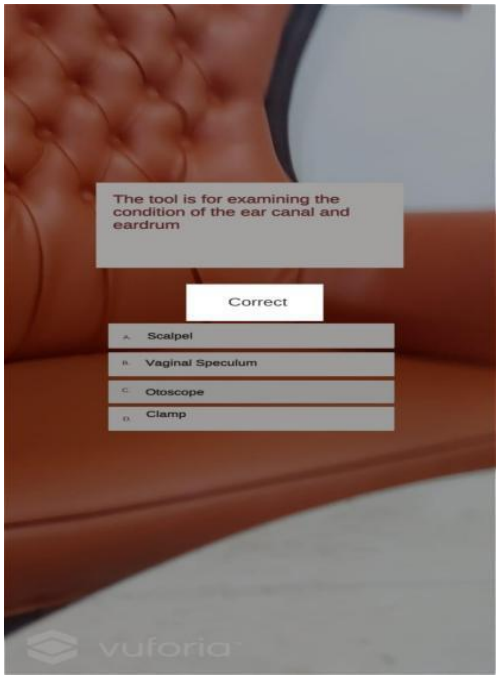

Figure 9: The correct answer

Upon selecting the optimal answer, which is confirmed as correct, students will be seamlessly directed to the subsequent question. Figure 10 exemplifies how the application is in operation during a class time.

Figure 10: The developed AR app in action

From the result presented above, it is possible that Indonesian teachers of English face problems in its implementational level. Teachers' most significant challenge is their lack of skills and experience in implementing this IT-based learning media and their inability to operate this software, even if they have poor digital literacy.

The need for facilities and technological training presents challenges for institutions (Rasimin et al., 2024).

4.5 Students' Learning Outcome Post-AR App Utilization

The findings from the field testing aimed at assessing the effectiveness of the AR app have revealed the following information: the maximum score achieved on the pre-test was 100, whereas the highest score recorded on the post-test was likewise 100. The pre- and post-tests data was presented briefly in Table 5.

Table 5. Summary of pre- and post-tests results

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Post-test	100.0000	53	.00000	.00000
	Pre-test	96.0377	53	4.93793	.67828

The pre-test yielded an average score of 84.8, whereas the post-test reached an average score of 88.3. This shows a rise of 3.9 points in the average score of the post-test. The standard deviation from the pre-test was 4.93, whereas the standard deviation from the post-test was 0. This indicates that there was an increase in the students' vocabulary mastery following the implementation of the AR application. The pre-test scores exhibited a wider range of variation in contrast to the post-test scores, suggesting that the students' performance on the post-test was more homogenous. This is most probably attributable to the enhanced vocabulary proficiency of the students regarding medical instruments. This finding is line with research by Al-Khresheh et al. (2024) and Al-Khresheh & Al-Ruwaili (2020).

Using the SPSS software to measure significance of difference between the pre- and post-tests data, we obtained the following result.

Table 6. Summary of the paired sample t-test

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Post-test - Pre-test	3.96226	4.93793	.67828	2.60120	5.32333	5.842	52	.000

Table 6 shows that the AR application created for "Advanced English for Anaesthesiology Nursing" Course significantly improved students' medical instruments vocabulary at 4.93 standard deviation. As a textbook supplement, the app helped teach Advanced English. The AR app's success depends on its medical features and user-friendly design. This finding confirms previous studies (Khan

et al., 2019; Lopez-Belmonte et al., 2020; Lopez-Bouzas; del Moral Perez, 2020; Lv et al., 2021).

Three-dimensional augmented medical tools, descriptions of their functions, and quizzes on accurate and wrong information included in the AR app. Student scores are available immediately after testing. The app helps pupils understand tools and their purposes. The test's MCQ style is organized for clarity and patient participation. The app works without a lecturer. The 3D augmented reality of medical tools is detailed, clear, and structured in simple language. The app's vocabulary acquisition research shows its importance in predicting vocabulary competency. This outcome is consistent with previous research (Binhomran & Altalhab, 2021; Busra et al., 2021; Kellems et al., 2020; Sadikin & Martyani, 2020).

4.6 Students' Voice of the Developed AR App

The questionnaire results showed that 66.7% of students agreed that the AR application's content was aligned with learning objectives, and 58.3% felt there was sufficient vocabulary input. Overall, 66.7% of students found the app excellent, with an average score of 63.9%. The app's good performance was made possible by its easy-to-understand material, medical tool vocabulary, and targeted grammar, as assessed with the rubric. The app effectively made the material readable and easy to understand, with students being able to assess their mastery on their own. However, the students suggested more tools, as the app prototype includes only 10. More medical tools could enhance learning experience. This fact underscores the role of AR in promoting social interaction, student-cantered activities, and leaner autonomy, thereby transforming the educational process into a more dynamic and inclusive experience. This corroborates a study by Al-Khresheh et al. (2024).

5. Conclusion

This study provides empirical evidence supporting the integration of marker-based AR applications in medical English vocabulary instruction, demonstrating significant gains in learner engagement and vocabulary acquisition. In response to this finding, the institutions should be ready with technology literate human resource for effective implementation. Curriculum developers and policy makers need to consider the educational implication of the present research finding for other possible courses and practices across departments. Regarding the current research small sample, future studies may explore the adaptation of this AR model in other ESP contexts such as engineering or legal English to examine its transferability. Furthermore, a follow-up longitudinal study is recommended to assess the long-term retention impact of AR-integrated learning environments across different healthcare disciplines.

Conflict of Interest

We, this paper's authors, hereby declare that there is no conflict of interest among us.

Author Contributions

PAR conducted the research, wrote the paper manuscript, and made revisions as suggested by all co-authors; TS supervised the research, proofread the paper, gave

feedback, finalized the manuscript, made submission to target journal, and made correspondence with target journal; SN proofread the manuscript, gave feedback, and helped to make revisions; OW proofread the manuscript, gave feedback, and helped to make revisions; proofread the paper, gave feedback, and helped to make revisions.

Acknowledgment

A big thanks goes to all students at Universitas Harapan Bangsa, Indonesia, who participated voluntarily in the study when it was underway. We, the authors, are also indebted to the dean of related faculty at the newly labelled "university" institution, who gave permit for the study to us. Finally, we would like to express our greatest appreciation to Mrs. Dinar Primasiwi, the lecturer of "English for Advanced Anaesthesiology Nursing" Course in the faculty for her invaluable time and who gave continued support throughout the research.

6. References

Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*, *20*, 1–11. https://doi.org/10.1016/j.edurev.2016.11.002

Al-Ansi, A. M., Jaboob, M., Garad, A., & Al-Ansi, A. (2023). Analysing augmented reality (AR) and virtual reality (VR) recent development in education. *Social Sciences and Humanities Open*, *8*(1), 1-10. https://doi.org/10.1016/j.ssaho.2023.100532

Al-Gerafi, M. A., Zhou, Y., Oubibi, M., & Wijaya, T. T. (2023). Unlocking the potential: A comprehensive evaluation of augmented reality and virtual reality in education. *Electronics, 12*(18). https://doi.org/10.3390/electronics12183953

Al-Khattabi, M. (2017). Augmented reality as e-learning tool in primary schools' education: Barriers to teachers' adoption. *International Journal of Emerging Technologies in Learning, 12*(2), 91-100. https://doi.org/10.3991/ijet.v12i02.6158

Al-Khresheh, M. A., Mohamed, A. M., & Shaaban, T. S. (2024). A quasi-experimental study on the effectiveness of augmented reality technology on English vocabulary learning among early childhood pupils with learning disabilities. *Innoeduca*: *International Journal of Technology and Educational Innovation*, *10*(2), 5-26. https://doi.org/10.24310/ijtei.102.2024.17823

Al-Khresheh, M. H., &. Al-Ruwaili, S. F. (2021). Understanding teachers' belief about effective vocabulary instruction in the Saudi tertiary EFL context. *Journal of the North for Humanities, Northen Broader University*, *8*(1), 345-356. http: //doi.org/10.12816/0061410

Al-Musawi, A. S., Al-Suhi, A., & Al-Mamari, Z. (2025). Exploring EFL teachers' perceptions of using virtual reality in education. *Contemporary Educational Technology, 17*(2), ep562. https://doi.org/10.30935/cedtech/15835

Al-Sinani, Y., & Al-Taher, M. (2023). Enhancing teaching skill of physical education teachers in the Sultanate of Oman through augmented reality strategies: A comprehensive feedback-based analysis. *Cogent Social Science*, *9*(2), Article 2266253. http://doi.org/10.1080/23311886.2023.2266253

Ambasta, S., Kannaujia, A. K., Shamshery, C., Shrivastava, D., Mishra, P., & Mahapatra, S. (2022). Smartphone use among anaesthesiologists during work hours. *Anaesthesia Essays and Researches*, *16*(1), 22–30. https://doi.org/10.4103/aer.aer_15_22

Aniuranti, A., Naeli, R., & Suwartono, T. (2024). Designing local folktales based English grammar instructional materials with the PACE model procedure. *Educational Process: International Journal*, *14*(e2025036), 1-21. https://doi.org/10.22521/edupij.2025.14.36

Bai, Z. (2012). Augmenting imagination for children with autism. *Proceedings of the 11th International Conference on Interaction Design and Children*. https://doi.org/10.1145/2307096.2307159

Billinghurst, M. (2021). Grand challenges for augmented reality. *Frontiers in Virtual Reality, 2*, Article 578080. https://doi.org/10.3389/frvir.2021.578080

Bilous, V. V., Proshkin, V. V., & Lytvyn, O. S. (2020). Development of AR-applications as a promising area of research for students. In *CEUR Workshop Proceedings 2731,* 205–216. http: //ceur-ws.org/Vol-2731/paper11.pdf.

Binhomran, K., & Altalhab, S. (2021). The impact of implementing augmented reality to enhance the vocabulary of young EFL learners. *The JALT CALL Journal , 17*(1), 23-44. https://doi.org/10.29140/jaltcall.v17n1.304B

Bostanci, H. B. (2022). The impact of subtitled films on English as a second language students' vocabulary retention. *Journal for Educators, Teachers and Trainers*, *13*(1), 101-109. https://doi.org/10.47750/jett.2022.13.01.012

Brandao, J., Cunha, P., Vasconcelos, J., Carvalho, V., & Soares, F. (2015). An augmented reality gamebook for children with autism spectrum disorders [Seminar Paper]. *International Conference on E-Learning in the Workplace 2015*.

Brooks, L. A., Manias, E., & Bloomer, M. J. (2019). Culturally sensitive communication in healthcare: A concept analysis. *Collegian*, *26*(3), 383-391. https://doi.org/10.1016/j.colegn.2018.09.007

Busra. Y., Funda, E., & Samed, Y. (2021). Augmented reality for learning in special education: A systematic literature review. *Interactive Learning Environments*, *8*(1), 1–17. https://doi.org/10.1080/10494820.2021.1976802

Cabero, J. J., & Barroso, J. (2016). The educational possibilities of augmented reality. *New Approaches in Educational Research*, *5*(1), 44-50. https://doi.org/10.7821/naer.2016.1.140

Cantero, J. D. L., Martin-Dorta, N., Pérez, J. L. S., Carrera, C. C., & González, M. C. (2015). Ubiquitous learning environment with augmented reality and tablets to stimulate comprehension of the tridimensionality space. *RED: Revista de Educación a Distancia, 37*, 1-17. https://revistas.um.es/red/article/view/234041

Çelik, F., & Ersanlı, C. Y. (2022). The use of augmented reality in a gamified CLIL lesson and students' achievements and attitudes: a quasi-experimental study. *Smart Learning Environments*, *9*(1). https://doi.org/10.1186/s40561-022-00211-z

Cents-Boonstra, M., Lichtwarck-Aschoff, A., Denessen, E., Aelterman, N., & Haerens, L. (2020). Fostering student engagement with motivating teaching: an observation study of teacher and student behaviours. *Research Papers in Education*, *36*(6), 754–779. https://doi.org/10.1080/02671522.2020.1767184

Chen, C. H., Chou, Y. Y., & Huang, C. Y. (2016). An augmented-reality-based concept map to support mobile learning for science. *Asia-Pacific Edu Res*, *25*, 567–578. https://doi.org/10.1007/s40299-016-0284-3

Chen, H. C., Yang, C. K., Huang, K., & Yao, K. C. (2020). Augmented reality and competition in robotics education: Effects on 21st century competencies, group collaboration and learning motivation. *Journal of Computer Assisted Learning, 36*(6), 1052–1062. https://doi.org/10.1111/jcal.12469

Chetsadanuwat, K. (2024). Needs of English-nursing communicative skills, functions and content for nursing students in a Thai program: Perspectives of nursing lecturers at a university in northern Thailand. *LEARN Journal: Language Education and Acquisition Research Network*, *17*(2), 711-744. https://doi.org/10.70730/pcah8109

Christopoulos, A., Pellas, N., Kurczaba, J., & Macredie, R. (2021). The effects of augmented reality-supported instruction in tertiary-level medical education. *British Journal of Educational Technology*, *53*(2), 307–325. https://doi.org/10.1111/bjet.13167

Clark, A., & Dunser, A. (2012). An interactive augmented reality coloring book [Seminar Paper]. *IEEE Symposium on 3D User Interfaces 2012*. https://doi.org//10.1109/3DUI.2012.6184168

Creswell, J. W. (2018). Qualitative inquiry & research design (4th Edition). SAGE Publications, Inc., California.

Cuendet, S., Bonnard, Q., Do-Lenh, S., & Dillenbourg, P. (2013). Designing augmented reality for the classroom. *Computers & Education, 68*, 557-569. https://doi.org/10.1016/j.compedu.2013.02.015

Di Serio, Á., Ibáñez, M. B., & Delgado, K. C. (2013). Impact of an augmented reality system on students' motivation for a visual art course. *Computers & Education, 68*, 586–596. https://doi.org/10.1016/j.compedu.2012.03.002

Drigas, G., Kokkalia, A., & Economou, A. (2016). Mobile learning for preschool education. *International Journal of Interactive Mobile Technologies, 10*(2), 57-64. https://doi.org/10.3991/ijim.v10i4.6021

Elfeky, A. I. M., & Masadeh, T. S. Y. (2016). The effect of mobile learning on students' achievement and conversational skills. *International Journal of Higher Education, 5*(3), 20–31. https://doi.org/10.5430/ijhe.v5n3p20

Farrah, M. A. H., & Abu-Dawood, A. K. (2018). Using mobile phone applications in teaching and learning process. *International Journal of Research in English Education, 3*(2). https://doi.org/10.29252/ijree.3.2.48

Franza, N. P. S., Sudana, O., & Wibawa, K.S. (2016). Application of basic balinese dance using augmented reality on android. *Journal of Theoretical and Applied Information Technology, 90*(1). https://www.jatit.org/volumes/Vol90No1/7Vol90No1.pdf

García, I., Peña-López, I., Johnson, L., Smith, R., Levine, A., & Haywood, K. (2010). Informe horizon: Edición iberoamericana 2010. The New Media Consortium, Texas.

Goff, E. E., Mulvey, K. L., Irvin, M. J., & Hartstone-Rose, A. (2018). Applications of augmented reality in informal science learning sites: A review. *Journal of Science Education and Technology, 27*(5), 433–447. https://doi.org/10.1007/s10956-018-9734-4

Gutiérrez-Puertas, V., Gutiérrez-Puertas, L., Aguilera-Manrique, G., Rodríguez-García, M. C., & Márquez-Hernández, V. V. (2021). Nursing students' perceptions of smartphone use in the clinical care and safety of hospitalised patients. *International Journal of Environmental Research and Public Health*, *18*(3), 1307. https://doi.org/10.3390/ijerph18031307

Hasan, M. K., Fakih, A. H., Seraj, P. M. I., & Hasmirati. (2022). The effect of technology-assisted language programme on vocabulary learning among EFL students at the tertiary level. *Heliyon. 8*(8), 1-6. https://doi.org/10.1016/j.heliyon.2022.e10313

Havwini, T., Ratnasari, D., Fadilah, N., Feby, F., & Firdaus, F. (2024). English vocabulary mastery in vocational higher education: An analysis of challenges and feasible strategies. *Journal on Education*, *6*(4), 19110-19118. https://doi.org/10.31004/joe.v6i4.5796

Heming, T. A., & Nandagopal, S. (2012). Comparative difficulties with non-scientific general vocabulary and scientific/medical terminology in English as a second language (ESL) medical student. *Sultan Qaboos University Medical Journal, 12*(4), 485-492. https://doi.org//10.12816/0003175

Hinze, A., Vanderschantz, N., Timpany, C., Cunningham, S. J., Saravani, S., & Wilkinson, C. (2022). A study of mobile app use for teaching and research in higher education. *Technology Knowledge and Learning*, *28*(3), 1271–1299. https://doi.org/10.1007/s10758-022-09599-6

Huang, W., Sun, M., & Li, S. (2016). A 3D GIS-based interactive registration mechanism for outdoor augmented reality system. *Expert Systems with Applications, 55*, 48–58. https://doi.org/10.1016/j.eswa.2016.01.037

Iatsyshyn, A. V., Kovach, V. O., Lyubchak, V. O., Zuban, Y. O., Piven, A. G., Sokolyuk, O. M., Iatsyshyn, A. V., Popov, O. O., Artemchuk, V. O. & Shyshkina, M. P. (2020). Application of augmented reality technologies for education projects preparation. *CTE Workshop Proceedings*, *7*, 134–160. https://doi.org/10.55056/cte.318

Ibrahim, A. M. (2010). ESP at the tertiary level: Current situation, application, and expectation. *English Language Teaching*, *3*(1), 200-204. https://doi.org/10.5539/elt.v3n1p200

Irawan, S., Ciptaningrum, D. S., & Faizal, A. A. (2023). Vocabulary learning strategies in vocational school for English specific purposes. *International Journal of Contemporary Studies in Education (IJ-CSE)*, *2*(1). https://doi.org/10.56855/ijcse.v2i1.256

Ivanova, G., Aliev, Y., & Ivanov, A. (2014). Augmented reality textbook for future blended education [Seminar Paper]. *International Conference on e-Learning*, 4, 130–136.

Karacan, C. G., & Akoglu, K. (2021). Educational augmented reality technology for language learning and teaching: A comprehensive review. *Shanlax International Journal of Education, 9*(2), 68–79. https://doi.org/10.34293/education.v9i2.3715

Kellems, R., Eichelberger, C., Cacciatore, G., Jensen, M., Frazier, B., Simons, K., & Zaru, M. (2020). Using video-based instruction via augmented reality to teach mathematics to middle school pupils with learning disabilities. *Journal of Learning Disabilities, 53*(4), 277-291. https://doi.org/10.1177/0022219420906452

Kipper, G., & Rampolla, J. (2012). *Augmented reality*. Syngress/Elsevier, Amsterdam.

Kiv, A. E., Shyshkina, M. P., Semerikov, S. O., Striuk, A. M., & Yechkalo, Y. V. (2020). How augmented reality transforms to augmented learning. *CEUR Workshop Proceedings 2547*, 1–12. http://ceur-ws.org/Vol-2547/paper00.pdf

Lee, L. K., Chau, C. H., Chau, C. H., & Ng, C. T. (2017). Using augmented reality to teach kindergarten students English vocabulary. *Proceedings of the 2017 International Symposium on Educational Technology*. https://doi.org/10.1109/ISET.2017.20

Ličen, S. & Prosen, M. (2023). The development of cultural competences in nursing students and their significance in shaping the future work environment: A pilot study. *BMC Med Educ*, *23*, 819. https://doi.org/10.1186/s12909-023-04800-5

López-Belmonte, J., Moreno-Guerrero, A. J., López-Núñez, J. A., & Hinojo-Lucena, F. J. (2020). Augmented reality in education: A scientific mapping in Web of Science. *Interactive Learning Environments, 31*(4), 1860-1874. https://doi.org/10.1080/10494820.2020.1859546

López-Bouzas, N., & del Moral Pérez, M. E. (2022). Instrument supported by digital applications to diagnose the communicative competence of students with ASD: Design and validation. *Innoeduca: International Journal of Technology and Educational Innovation, 8*(2), 83-96. https://doi.org/10.24310/innoeduca.2022.v8i2.14264

Lv, Z., Lloret, J., & Song, H. (2021). Real-time image processing for augmented reality on mobile devices. *Journal of Real-Time Image Processing*, *18*(1), 1-14. https://doi.org/10.1007/s11554-021-01097-9

Malaquias, R. F., & Malaquias, F. F. D. O. (2021). A literature review on the benefits of serious games to the literacy process of children with disabilities and learning difficulties. *Technology and Disability, 33*(4), 273– 282. https://doi.org/10.3233/TAD-210339

Markouzis, D., & Fessakis, G. (2015). Interactive storytelling and mobile augmented reality applications for learning and entertainment – A rapid prototyping perspective [Conference Paper]. *The 9th International Conference on Interactive Mobile Communication, Technologies, and Learning (IMCL2015)*. https://doi.org/10.1109/IMCTL.2015.7359544

McGriff, S. J. (2000). *Instructional System Design (ISD): ADDIE Model instructional systems*. College of Education: Penn State University, Pennsylvania.

Mohamed, M. H., & Razali, A. B. (2019). Augmented reality in teaching and learning English reading: Realities, possibilities, and limitations. *International Journal of Academic Research in Progressive Education and Development*, *8*(4), 724–737. https://doi.org/10.6007/IJARPED/v8-i4/6696

Muñoz, J. M. (2013). Realidad Aumentada, realidad disruptiva en las aulas. *Boletín SCOPEO, 82.* http://scopeo.usal.es/realidad-aumentada-realidad-disruptiva-en-las-aulas/

Na, H., Willet, K. B. S., & Kim, C. (2025). Investigating the impact of AR technologies on geometric learning in primary school: A comparison between marker- based and markerless AR. *British Journal of Educational Technology*, 1-20. https://doi.org/10.1111/bjet.13584

Nurhayati, Suwartono, T., Saripudin, A., & Juwita, N. (2022). Applying web-based technology in developing student worksheets on writing local culture content drama script. *Theory and Practice in Language Studies, 12*(2), 263-273. https://doi.org/10.17507/tpls.1202.07

O'Connor, Y., & Mahony, C. (2023). Exploring the impact of augmented reality on student academic self-efficacy in higher education. *Computers in Human Behavior*, *149*, 107963. https://doi.org/10.1016/j.chb.2023.107963

Pérez-Fuentes, M. C., Álvarez-Bermejo, J. A., Molero, Mª; Gázquez, J. J., & López, M. A. (2011). Violencia escolar y rendimiento académico (VERA): Aplicación de realidad aumentada. *European Journal of Investigation in Health, Education and Psychology,1*(2), 71-84. https://doi.org/10.1989/ejihpe.v1i2.6

Rasalingam, R. R., Muniandy, B., & Rasalingam, R. R. (2021). Exploring the application of augmented reality technology in early childhood classroom in Malaysia. *IOSR Journal of Research & Method in Education (IOSR-JRME), 4*(5), 33-40. https://doi.org/10.9790/7388-04543340

Rasimin, Semma, A. B., Zakiyuddin, Ali, M., & Helmy, M. I. (2024). Multi-dimensional challenges in the Indonesian social science information technology-based learning: A systematic literature review. *Heliyon*, *10*(7), 1-11. https://doi.org/10.1016/j.heliyon.2024.e28706

Rizkina, P. A., & Suwartono, T. (2023). ICT-based learning during Covid 19 outbreak: Students' responses, benefits, and challenges. *Proceedings of the 2nd International Conference on Social Sciences (ICONES)*. http://dx.doi.org/10.4108/eai.22-7-2023.2335410

Sadikin, I. S., & Martyani, E. (2020). Integrating augmented reality (AR) in EFL class for teaching vocabulary. *Professional Journal of English Education, 3*(2), 161-167. https://doi.org/10.22460/project.v3i2.p161-167

Sharma, A., Mehtab, R., Mohan, S., & Shah, M. K. M. (2021). Augmented reality - an important aspect of Industry 4.0. Industrial Robot. *The International Journal of Robotics Research and Application*, *49*(3). http://doi.org//10.1108/IR-09-2021-0204

Sindhuri, R., & Dongre, A. R. (2023). Challenges in obtaining informed consent in qualitative research and suggestions to improve it: A descriptive qualitative study. *National Journal Community Medicine, 14*(6), 386-390. https://doi.org/10.55489/njcm.140620232874

Spalević, M., Milosavljević, N., & Spalević, M. (2018). The underlying concept of motivation in medical English teaching. *Acta Medica Medianae*, *57*(2), 40-44. https://doi.org/doi:10.5633/amm.2018.0207

Suwartono, T., Nurhayati, S., & Junaid, R. (2024). Assessing the need for technology-enhanced tools to release the sufferings of Cinderella in language teaching (pronunciation). *Edelweiss Applied Science and Technology*. *8*(6), 9756-9765. https://orcid.org/0000-0002-9615-2257

Tomi, A., B., & Rambli, D., R., A. (2013). An interactive mobile augmented reality magical playbook: Learning number with the thirsty crow. *Procedia Computer Science*, *25*, 123-130. https://doi.org/10.1016/j.procs.2013.11.015

Vakaliuk, T., A., & Pochtoviuk, S. I. (2021). Analysis of tools for the development of augmented reality technologies [Seminar Paper]. *AREdu 2021: 4th International Workshop on Augmented Reality in Education*. https://doi.org/10.31812/123456789%2F4625

Wahyuni, S. (2021). English language needs for medical students: A link and match of academic and professional career. *English Franca: Academic Journal of English Language and Education*, *5*(1), 169–184. https://doi.org/10.29240/ef.v5i1.2146

Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & Education*, *62*, 41-49. https://doi.org/10.1016/j.compedu.2012.10.024

Wu, Q. (2014). A rote strategy in memorizing vocabulary for ESL learners. *Procedia – Social and Behavioral Sciences*, *143*, 294-301. https://doi.org/10.1016/j.sbspro.2014.07.408

Yilmaz, Z., A., & Batdi, V. (2021). Meta-analysis of the use of augmented reality application in science teaching. *Journal of Science Learning,* *4*(3), 267-274. https://doi.org/10.17509/jsl.v4i3.30570

Yoon, J. C., & Kang, H. Y. (2021). Interactive learning in the classroom: A mobile augmented reality assistance application for learning. *Computer Animation and Virtual Worlds*, *32*(5). https://doi.org/10.1002/cav.1989

Research Survey

Name: _____

Directions: Chek Yes if you agree; check No if you do not agree.
Give your thoughtful and honest response.
Your information is kept confidential.
Thank you for your participation

No.	Questions	Yes	No
1	Are you struggling to comprehend new terminology related to medical instruments in English language instruction during lectures?		
2	Are you seeking diverse media, such as a learning application for English in Anaesthesia Nursing?		
3	Are you inspired to acquire proficiency in English for anesthesia nursing with the accessible educational resources?		
4	Is internet access and numerous apps necessary for English language acquisition in anesthesia nursing?		
5	Do you find the availability of English learning material enhanced by 21st-century technology, such as quizzes, Kahoot, Zoom, and Google Meet, beneficial?		
6	Does the lecturer consistently elucidate the content, facilitate conversations for inquiries and responses, and consistently provide feedback?		
7	Are you familiar with Augmented Reality (AR) technology?		
8	Are you interested in using an Augmented Reality (AR) application for learning English in Anaesthesia Nursing?		
9	Do you like studying in a group (group discussion)?		
10	Do you feel comfortable using AR applications in the classroom?		
11	Do you use an Android-based smartphone?		
12	Do you use an IOS-based smartphone?		
13	Is learning English for Anaesthesia Nursing always done using a smartphone?		
14	Do you feel satisfied with the media used to study the English for Anaesthesia Nursing course?		
15	Do you feel satisfied with the media used to study the English for Anaesthesia Nursing course?		