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Enhancing Midwifery Students' Knowledge and Skills Through Augmented Reality Learning Media

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ABSTRACT

Objective: Improving the Knowledge and Skills of Midwifery Students through Augmented Reality-Based Learning

Method: This research method is a literature review approach that is taken based on national and international scientific journals related to the use of Augmented Reality Technology in improving midwifery student skills. Retrieval of literature reviews sorted from several databases, namely Pub Med, , Sci lit Science-direct, Google Scholar, and Semantic Scholar databases published between 2018-2024. This review was compiled through searching scientific articles with the keywords 'Learning, Skills, Knowledge, Augmented Reality, Midwifery Students'. After filtering for publication years 2018-2024, 110 articles were found. 52 articles were selected based on abstract, full text, open access, and duplication. Then the final process the author reads and sorts the articles. Based on the criteria set, 30 relevant articles were obtained.

Results: Augmented Reality learning media makes learning more interactive and interesting so that students can access additional information, 3D visualizations, or live simulations that increase understanding and retention of information.

Conclusion: The application of Augmented Reality (AR) technology has a positive effect on students by combining digital elements with the real world so as to increase student knowledge and skills.

Keywords: *Learning, Knowledge, Skills, Augmented Reality, Midwifery Students*

1. INTRODUCTION

Education is the most important part of the effort to improve the quality of education. However, not only lecturers but learners have an important role in achieving learning objectives1. In the 21st century, conceptual frameworks called learning models are used to design and implement, organize learning experiences to achieve objectives and competencies, which serve as guidelines in the learning process as they incorporate systematic steps..[2]

Health education requires a variety of educational information materials such as graphic health , physical, and factual, whereas traditional education involves the use of texts, lectures, pictures, and manuals. Recent research shows the effects of using methods traditional learning are limited to short-termmemory, and in particular, long-term , an example of this lecture method is a presentation that lasts more than 20 minutes, only 20-30% of the lesson content/material can be captured by learners immediately after the presentation, this knowledge will decrease and after two weeks post-learning, 90% of the knowledge has been lost, therefore, learning media is needed that can help learners understand the learning content well [(3)].

Currently, learning methods, media and content can be accessed through various media including electronic media. The Indonesian Internet Service Providers Association announced that the number of Indonesian internet users in 2024 will reach 221,563,,,479 out of a total population of 278696200 Indonesians in 2023. The data shows that most Indonesians have smartphones and use internet services, therefore, this can be used as a potential for development in various fields, especially in terms of education and increasing learner motivation. Mobile learning seems to be fun and not limited by space, time, place, and cost. [4]

All fields of technology are developing so quickly, education and health technology are also developing to improve people's lives. . Learning media used to support the process of learning activities, especially regarding health, still use books and

props as media which causes an unsupported atmosphere during the learning process which will reduce understanding and mastery of the material Learning with the use of learning media such as smartphones can now be easily bridged with technology Augmented Reality (AR). Augmented Reality (AR) is a technology that combines two-dimensional or three-dimensional virtual objects into a real environment and then projects these virtual objects in real time. AR technology can be used to visualize the shape of objects that become learning materials and can provide a more enjoyable explanation. [5] .Currently, learning media derived from AR technology can be used in the health sector to provide information about the use of medical devices, and modelling medical movements such as injections, massages, and others. [6]

In the process of teaching midwifery students, they need learning media that can help them concentrate on improving skills. Many students are less enthusiastic in learning and do not want to learn further [7] . In this study, the use of Augmented Reality Technology is as a learning medium accompanied by animation and explanation to facilitate students' understanding of how student skills. The purpose of this study was to analyse the learning model that uses the lecture method and that uses augmentation reality-based methods.

2. METHODS

This research method is a literature review approach taken based on national and international scientific journals related to the use of Augmented Reality Technology in improving midwifery student skills. The literature review was sorted from several databases namely databases,*PubMed, Scilit, ScienceDirect, Google Scholar, and Semantic Scholar* published between 2018-2024. This review was compiled through searching scientific articles with the keywords "Learning, Augmented Reality, Skills". After filtering for the publication year 2018-2024, 110 articles were obtained, then of the 110 articles found 52 articles relevant, selected based on abstracts, full text, open access, and duplication. Then the final process the author reads and sorts articles that match the theme of this literature review. Based on the criteria set, 30 relevant articles. Articles were sorted based on the criteria:were obtained

Inclusion criteria

The article discusses the Methods Learning in Improving Auqmented Reality-Based Skills

Publication year 2018-2024

International and National Publications

National journals have ISSN

Articles in English and Indonesian

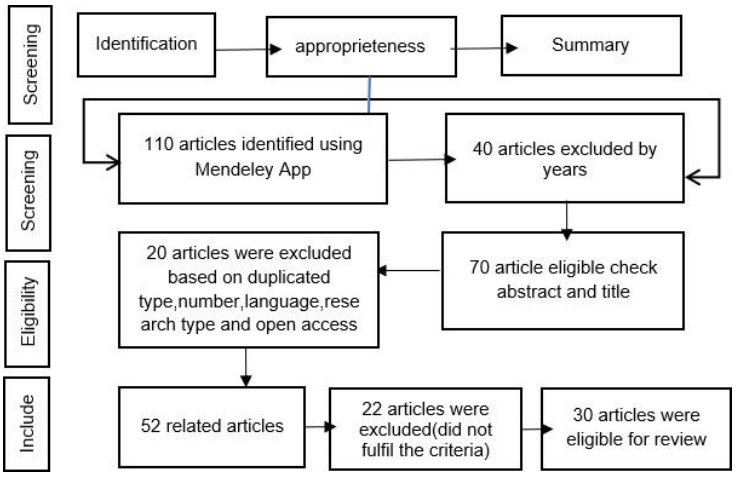
Original article, abstract, full text and open access

Exclusion Criteria

Non-English articles

Type of research literature review

The can be article search strategy seen in Figure 1.



3. FIGURE 1. FLOW CHART OF ARTICLE RESEARCH

RESULTS

Similar extracted data were grouped according to the outcomes measured to achieve the objectives in this literature review synthesis. Abstracts of research journals were entered into the table using the form mentioned above. The abstracts and full text of the reviews were read and reviewed to clarify the analysis. Next, the evaluation summaries were analyses based on the material contained in the research objectives and the results and findings obtained from the research. The purpose of this study was to determine the benefits of using AR technology in improving the skills and knowledge of midwifery students

Table 1. Article Synthesis of AR Technology Utilization

No.	Author/Year	Title	Journal	Results
	Sri Nurlaily Za, 2021 [8]	The effectiveness of Augmented Reality (AR) based learning media towards improving the physical examination system of the duct system pregnant woman's bladder	Gaceta Sanitaria	Both control and intervention groups showed an increase in skills, with a statistical significance of P < 0.001 (P < 0.05). The results showed that the intervention group given AR learning media showed a greater percentage increase in skills in the first week of the study (72.6%) compared to the control group given AR learning media lecture and demonstration (36.7%). Therefore, the learning produced for the intervention group showed an increase in skill
	Irwan Wijaya Arianto, 2023 [9]	Development of Android-based Augmented Reality Application of Hearing System Material in Humans	Juwara Jurnal Wawasan dan Aksara	The AR implementation has been successfully created and runs well, with AR features that are able to display 3D objects in the form of ear organ shapes that greatly help users in understanding the structure of ear organs.
	Kartika Dwi Ningrum, /2022 [10]	Electronic Comic Media Integrated Augmented Reality in Learning Human Blood Circulation System in Elementary School	Basicedu Journal	Normality testing using the Kolmogorov Smirnov test, resulting in electronic comic media Circulatory system integrated augmented reality can increase student interest in learning.
	Rico Fiyan Hady, /2020 [11]	The Effect of Using Augmented Reality on Learning the Channel System Respiratory and Digestive Systems in the human body	Master of Information Technology Integrated Institute of Science and Technology Surabaya	The results of ANOVA (Analysis Of Variance) show that this application successfully helps students learn the respiratory system and the digestive system in the human body using Augmented Reality (AR) technology
	Luther Ananda Sitompul, et al 2020 [12]	Implementation of Augmented Reality-based	Education	Augmented reality media based on android can improve understanding and prevent misconceptions from two-dimensional-based practicum. It can be concluded that practical

		human muscle learning (AR) as misconception prevention for Biology Education students of Samudra University.		media in the form of Augmented reality based on android human muscles can be developed and effective for laboratory learning.
	Hikmandayani, Ahmad M, et al 2021 [13]	Augmented reality (AR)-based learning media increases physical examination skills of the integument system of pregnant women in midwifery student	Gaceta Sanitaria	Mc.Nemar test and Cochran test resulted that augmented reality-based learning is very important to improve students' understanding and skills about the integument system of pregnant women.
	Mislan, Sigit Mulyono [14] et al 2022	The Potential of 3D Printing as Educational Media in Nursing Education	Scientific Horizons Journal	3D printing technology can be one of the solutions in an effort to provide educational media that provides convenience and effectiveness in the transfer of knowledge through simulation for both academic and professional learners.
	Sanriomi Sintaro, [15] et al 2020	Futsalm Basic Techniques Learning Application using Android-based Augmented Reality	TELEFORTECH: Journal of Telematics and Information Technology	Alpha and beta testing using the acceptance method to respondents resulted in a value of 83% of respondents interested in using the 3D AR Futsal Basic Techniques Learning Application.
	Dinda Lutfiyah, [6] et al 2021	Development of Learning Media about the Heart Organ Using Android-Based Augmented Reality Technology	Journal of Information Engineering	3D interactive learning media application using this Android-based Augmented Reality technology for its simulation is designed and developed using The 3D software is Blender 2.91.2 and the supporting software for Augmented Reality is Unity 2017.
	Hussain, Zain Ng, [16] et al 2021	Effectiveness of virtual and augmented reality for improving medical students' knowledge and skills: Protocol for a systematic review	BMJ Open	Outcomes from educational practices include improving the delivery of digital education and ensuring that investments in digital technologies, such as virtual reality (VR) and augmented reality (AR), for medical schools, are justified. When evaluating such devices, institutions will be better informed. They can

				also ensure that the devices are customized and tested to meet student needs.
	Yogi Septiawan Nauko, [17] et al 2021	Introduction to Body Anatomy Using Android-based Augmented Reality Technology	Jambura Journal of Informatics	The augmented reality learning media can visualise abstract concepts for understanding and structure of an object model and allows augmented reality as a more effective media in accordance with the objectives of the learning media.
	Fettiana Gianadevi, [18] et al 2022	Augmented Reality-based Human Body Anatomy Learning Media	Tambusai Journal of Education	Displaying human body anatomy objects from the respiratory system, digestive system and body skeleton in the form of attractive 3D virtual objects in real-time well to help smooth learning of human body anatomy.
	Mochammad Machlul Alamin, [19] et al 2023	Development of Learning Applications for Logic Gates and Circuits Utilising AugmentedReality	Upgris Informatics Journal	The response results showed that students responded positively on mobile learning media augmented reality-based logic circuits. From the responses, 80% respond to agree on each part that is responded to, and 85% get scores above the minimum completeness criteria so that the use of applications learning logic circuits using augmented reality is in the effective category
	Imam Ahmad [20] et al 2022	Application of Augmented Reality on Human Body Anatomy To Support Cupping Point Learning Alternative Medicine	Teknoinfo Journal	Testing the quality of human functional suitability aspects can perform 100% of its functions correctly. Quality testing of usability aspects carried out obtained an overall value of 93.23%. quality testing of portability aspects on several devices with operating system versions of android 10, Lollipop, Marshmallow, Oreo so the portability aspect value reaches 100%.
	Nur Wachid Adi Prasetya, et al 2023 [21]	Augmented Reality Technology for Massage Therapy for Facial Pregnant Women with Pre-eclampsia	Infotekmesin	Black box testing on 10 scenarios resulted in a score of 100% which means the application can run well. In addition, usability testing with the System Usability Scale (SUS) method shows a value of 69.5 which means the application has "good" criteria and can be accepted by users.

	Ta-Ko Huang, Chi-Hsun Yang, [22] et al 2018	Augmented reality (AR) and virtual reality (VR) applied in dentistry	Kaohsiung Journal of Medical Sciences	VR and AR simultaneously affect learning skills and navigation systems. Broadly speaking, VR and AR are not only applied in dental and surgical training lessons, but also improve all areas of our lives.
	Wahyu Nur Hidayat, [5] et al 2020	Development of Mobile Learning Application Based on Augmented Reality with Index Card Match Method	4th International Conference on Vocational Education and Training, ICOVET 2020	Based on the expert judgement assessment, 84.4 per cent of the media value is included in the valid category. Notes from the application include revisions to navigation and material display. Future development is carried out on teaching resources other than AR that can be used by students such as text and video in the hope of having more learning resource options.
	Lintang Ardi Avdillah [23] et al 2023	Android-based Human Internal Organ Anatomy Learning Application with Augmented Reality Technology	CLICK: Scientific Studies in Informatics and Computing	This research concludes that in order to facilitate learning by students to recognizes the visualization of every part of the organs in the human body in 3D. By continuing to explore innovations in the integration of AR, we can enhance students' understanding of human anatomical structures in an unprecedented way.
	Hanum Salsabila Zakiyah, [24] at al 2023	Scientific Review of Informatics and Computer Applications of Human Skeletal System for Biology Learning Based on Augmented Reality	Online Media	The human skeletal system uses augmented reality technology to display 3D objects in real time. The application display that is easy to understand and attractive can make students more interested in learning the human skeletal system by using applications on android smartphones.
	E M Maili, M Akbar [25] et al 2023	Design of Augmented Reality Application for Learning Biology of Human Growth with Markerless Method	Convergence of Technology and Information Systems	Reality learning biology growth in humans can run well, all AR objects can be projected into the real world. With the use of the marker-less method makes it easier for users to use this application.
	Aswadul Fitri Saiful Rahman, [26] et al 2022	Arduino Learning Media Through Android-Based Augmented Reality with Marker-Based Method	Journal of Electrical Engineering Uniba (JTE UNIBA)	Making a 3D arduino uno model using a 3D editing application, namely blender 3D, then making an android application using the unity application with the addition of vuforia for augmented reality. In this application there are several features besides augmented reality such as 3D

				viewer arduino module and narration. With this application, users can more easily understand the parts of the arduino module in detail without having to have the module directly.
	Rahmi Faradisya Ekapti, [27] et al 2023	Indonesian and Malaysian Students' Perception on the Application of Augmented Reality in Learning: A Preliminary Study	Jurnal Tadris IPA Indonesia	This research was conducted on student representatives in two countries, Indonesia and Malaysia. The results show that students are very interested when the learning process uses digital media such as augmented reality with a percentage of more than 50%.
	Poshmaal Dhar, [28] et al 2021	Augmented reality in medical education: students' experiences and learning outcomes	Medical Education Online	The field of AR offers educators in medical education the opportunity to create a rich and engaging curriculum, offering students the chance to not only learn but also experience the learning content. The disruption to traditional classroom teaching due to COVID-19 has led to the rapid adaptation of teaching tools. digital globally, this highlights the importance of digital technologies, including AR to ensure student learning is not hindered.
	Muridah Wiriyanti, [29] et al 2020	The Effect of WEB-based Learning Media on Improving the Practical Skills of Period II Labour Care for Midwifery DIII Students	Muhammadiyah Nursing Journal	There was a difference in measurement results. measurement I and measurement II of labour care skills in the control group ($p<0.05$) and contributed 46.3%. In the intervention group, there was a difference in before and after the provision of web-based learning media ($p<0.05$) and a contribution of 91.7%, in improving the skills of D-III Midwifery students in even semester. about the second stage of labour

	Sri Nurlaily Z, [8] et al 2021	Effectiveness of Augmented Reality (AR) based learning media on increasing the physical examination system of pregnant women urinary system.	Gaceta Sanitaria	Learning outcomes in the intervention group given AR media had a higher percentage of skill improvement (72.6%) when compared to the control group given the lecture method and demonstration method (36.7%). Similarly, the average skill improvement in the second week of learning in the intervention group had a higher percentage of skill improvement (91.9%) compared to the control group given the lecture and demonstration method (66.7%), although in the third week all respondents in the control group and intervention group became skilled in performing a physical examination of the urinary system of pregnant women.
	Devi Mulia Saria, [30] et al 2022	Design of Augmented Reality Spot in Aceh Polytechnic Information Technology Programme Based on Android	Inotera Journal	This application makes it easy for guests to know the shape of the room, know the contents of the room and explain videos about the Information Technology study programme using a smartphone. Making this application using Blender software is used to create a three-dimensional room model, while Unity software is used to create applications.
	Aldryan Hernandaa, [31] et al 2024	Utilization of Augmented Reality Application for Human Organ Learning	Journal of Business Information Technology and Systems	The use of AR application increases students' interest and understanding of human organ anatomy. And showed a high level of engagement and gave a positive response to the use of AR technology in their learning.
	Yogita Bahuguna, [32] et al 2018	Smart learning based on augmented reality with android platform and its applicability	Proceedings - 2018 3rd International Conference on Internet of Things: Smart Innovation and Usages, IoT-SIU 2018	An important advantage of augmented reality android apps is that even a basic Android-enabled device with a good camera can run the app. The app also facilitates the recognition of multiple targets
	Muhammad Hapizd, [33] et al 2023	Development of android-based augmented reality learning material on human digestive organs and their functions	COLLASE (Creative of Learning Students Elementary Education)	Human Digestive, is very helpful for students in the learning process of science material on human digestive organs and their functions anywhere and anytime, opening teachers' insights as an innovation in

				presenting a fun learning for students.
	Yuli Cahyaningsih [34] et al 2020	Augmented Reality Technology on Android-based Promotion	Journal of Computer Science and Engineering (JCSE)	From the Alpha Test results the developed system avoids defects or failures of use. Meanwhile, from the results of the Beta Test, 91.2% of respondents answered strongly agree, this shows that the Augmented Reality application as a promotional medium on the Android-based Honda Genio brochure is very interesting and acceptable to users.

4. DISCUSSION

Education is one of the important things in human life without education humans will not progress, the development of the era, education also developed and the human perspective also developed towards the science of education. [35] Augmented Reality (AR) is a combination of virtual reality and word reality that runs interactively and has functions between objects in 2D and 3D, so that 2D and 3D virtual objects will look real. [36] [37] As a learning media, Augmented Reality (AR) has many benefits. One of them is to enable interactive learning experiences by combining digital elements with the real world, which encourages students to be motivated to learn and better understand learning and make learning more interesting. By applying Android-based Augmented Reality technology, it is hoped that the information presented can look attractive and informative and can make it easier for students to get information directly [15] AR learning is assistance provided by educators so that the process of acquiring knowledge, mastering skills and habits, and forming attitudes and confidence in students can occur [38] [9]

The pre and post-test results showed that students rated their abilities significantly better after the survey compared to before the survey (p=0.05). Simulation influences students' self-assessment of professional knowledge, confidence, and practical skills in emergency situations. It improves students' procedural knowledge and practical skills in complex contexts, broadens their knowledge of the subject, and fosters self-confidence. The use of AR in learning for students midwifery covers midwifery care in pregnant women, labouring women, postpartum women, infants and contraceptive administration, emergencies .obstetric and their management

The application of teaching methods will make learning more interesting for students because the meaning will be easier and clearer. Learning media will also allow a more varied learning approach than verbal communication by educators, so that students are not bored and educators do not run out of energy. [39] Educational media is anything that can be used to convey messages to the person receiving it with the aim of encouraging students' thoughts, feelings, attention, and interest in learning. [40] . Educational media has many kinds of models, for example, such as video, games, virtual reality (VR), Augmented Reality (AR) and so on.

In addition, skills can be defined as activities that require practice or can be interpreted as the implication of activities. In addition, skills can be defined as activities that require practice or can be interpreted as the implications of activities [41] stages in achieving skills, namely each clinical skill has a level of ability that must be achieved at the end of education, according to the miller pyramid, which consists of knows, knows how, shows and does. The good news about skills is that the more we practice the better we get. [42] Skills are defined as the application of knowledge so that the level of skill correlates with the level of knowledge.Knowledge must be scientific, systematic, logical, and can be accounted for because knowledge is a human thought process to find facts and truths based on science. [42]

Augmented reality (AR) has 2 forms that are suitable for use in education, namely:

Based on location, location-aware augmented reality (AR) presents digital media to students as they move through the physical area via GPS-enabled smartphones or mobile devices. Media such as text, graphics, video, audio, and 3D models can provide additional views of the physical environment along with narration, navigation, and location-related information.

Vision-based. Augmented reality (AR) displays digital media to students after they point their mobile phone camera at an object or trigger. [43] [44]

The use of augmented reality (AR) technology has brought a very significant impact in its application Today, AR users cover many fields, such as health, entertainment, machine design, game industry, social media developers, and other applications that priorities visual functions. This is because AR users are highly informative and engaging. Various electronic devices, such as smartphones, cameras, screens, webcams, special glasses, and others that have the ability to display AR. Augmented reality (AR) functions as an output device, this device can display information such as images, animations, videos, and 3D

models. [46 45 (37) 46 47 48 49]

To build an Augmented reality (AR) application, a system development method is needed. In the development of Augmented reality (AR) applications will certainly involve multimedia elements such as text, audio, visual, and animation, therefore the development system that can be used in this method is MDLC (Multimedia Development Life Cycle) is a system development approach for multimedia applications which is a combination of image, sound, video, animation and other media. MDLC method in application development has six stages namely: ,*concept, design, material collecting, assembly, testing* and *distribution*.

By using Augmented Reality, learning can be done anywhere and anytime. This is because the nature of educational media is to assist students in the learning process, allowing them to think critically about everyday problems and events The function of Augmented Reality (AR) in midwifery student learning media is to increase student knowledge and learning skills in ways that are more interactive, in-depth, and effective [(50) (51) 52 54 (55) 56 17 58]

5. CONCLUSIONS

From several studies that have been reviewed, it is concluded that in the field of health, the application of Augmented Reality (AR) technology has been shown to have a positive effect, allowing students to get an interactive learning experience by combining digital elements with the real world. The creation of 3D animations can be used as a substitute for teaching aids, with an attractive appearance that is helpful enough to explain and encourage students to be motivated to learn and understand learning.

REFERENCES

[1] Suganda SA, Rifki MS, Alnedral A, Ikhsan N. The Effect of Learning Methods and Motor Skills on Students' Physical Education Sports and Health Learning Outcomes. *J Stamina*. 2022;5(7):295-309. doi:10.24036/jst.v5i7.1136

[2] 2. Mawardi M. Designing the Implementation of Model and Instructional Media. *Sch J Educator and Kebud*. 2018;8(1):26-40. doi:10.24246/j.js.2018.v8.i1.p26-40

[3] 3. Duarte ML, Santos LR, Guimarães Júnior JB, Peccin MS. Learning anatomy by virtual reality and augmented reality. A scope review. *Morphologie*. 2020;104(347):254-266. doi:10.1016/j.morpho.2020.08.004

[4] 4. APJII. Penetration & Behavioural Profile of Indonesian Internet Users in 2024. online. Published 2024. www.apjii.or.id

[5] 5. Nur Hidayat W, Akhsan Hakiki M, Fajar Nashrullah M, Elmunsyah H, Atmadji Sutikno T. Development of Mobile Learning Application Based on Augmented Reality with Index Card Match Method. *4th Int Conf Vocat Educ Training, ICOVET 2020*. Published online 2020:304-309. doi:10.1109/ICOVET50258.2020.9229914

[6] 6. Lutfiyah D, Utomo AN, Studi P, et al. Machine Translated by Google JANTUNG USING ANDROID-BASED AUGMENTED REALITY TECHNOLOGY ANDROID-BASED AUGMENTED REALITY TECHNOLOGY Machine Translated by Google. 2021;10(2):129-135.

[7] 7. Mignot S, Berthome AC, Andre M, et al. Development and validation of a performance assessment checklist for insertion of an intra-uterine device (IUD). *Gynaecol Pol*. 2023;94(11):874-882. doi:10.5603/GP.a2023.0016

[8] 8. Z SN, Ahmad M, Syarif S, Budu, Idris I, Stang. Effectiveness of Augmented Reality (AR) based learning media on increasing the physical examination of pregnant women urinary system. *Gac Sanit*. 2021;35:S221-S223. doi:10.1016/j.gaceta.2021.10.025

[9] 9. Arianto IW, Hidayati A, Pratama A. Development of Android-based Augmented Reality Applications for the Hearing System in Humans. *Juwara J Wawasan dan Aksara*. 2023;3(2):134-143. doi:10.58740/juwara.v3i2.69

[10] Ningrum KD, Utomo E, Marini A, Setiawan B. Electronic Comic Media Integrated with Augmented Reality in Learning Human Blood Circulatory System in Elementary School. *J Basicedu*. 2022;6(1):1297-1310. doi:10.31004/basicedu.v6i1.2289

[11] Hady RF, Armanto H. The Effect of Using Augmented Reality on Learning the Respiratory System and the Digestive Tract at Sebaung Ii Probolinggo State Elementary School. *Master of Inf Technol Inst Sains dan Teknol Terpadu Surabaya*. 2020;53(9):1689-1699. http://publications.lib.chalmers.se/records/fulltext/245180/245180.pdf%0Ahttps://hdl.handle.net/20.500.12380/245180%0Ahttp://dx.doi.org/10.1016/j.jsames.2011.03.003%0Ahttps://doi.org/10.1016/j.gr.2017.08.001%0Ahttp://dx.doi.org/10.1016/j.precamres.2014.12

[12] Sitompul LA, Auliana A, Aritonang JL, ... Augmented Reality (AR)-based Human Muscle Learning as

Misconception Prevention for Biology Education Students of Samudra University *Educator*. 2020;1:208-211. http://publikasi.fkip-unsam.org/index.php/semnas2019/article/view/50

[13] Hikmandayani, Ahmad M, Syarif S, Budu, Idris I, Stang. Learning media based on augmented reality (AR) increased the skill of physical examination of the integumentary system of pregnant women in midwifery students. *Gac Sanit*. 2021;35:S302-S305. doi:10.1016/j.gaceta.2021.10.040

[14] Mislan SM. THE POTENTIAL OF 3D PRINTING AS AN EDUCATIONAL MEDIUM IN NURSING EDUCATION. *J Cakrawala Ilm*. 2022;2(1):69-76.

[15] Sintaro S, Surahman A, Khairandi N. Futsal Basic Technique Learning Application Using Android-Based Augmented Reality. *TELEFORTECH J Telemat Inf Technol*. 2020;1(1):22-31. doi:10.33365/tft.v1i1.860

[16] Hussain Z, Ng DM, Alnafisee N, et al. Effectiveness of virtual and augmented reality for improving knowledge and skills in medical students: Protocol for a systematic review. *BMJ Open*. 2021;11(8):1-6. doi:10.1136/bmjopen-2020-047004

[17] Nauko YS, Amali LN. Introduction to Body Anatomy Using Android-based Augmented Reality Technology. *Jambura J Informatics*. 2021;3(2):66-76. doi:10.37905/jji.v3i2.11720

[18] Gianadevi F, Elviana, Napitupulu R. Augmented Reality Based Human Body Anatomy Learning Media. *J Tambusai Educator*. 2022;6:8497-8507.

[19] Alamin MM, Pramana AL. Development of Learning Applications for Logic Gates and Circuits Utilising Augmented Reality for Vocational Students. *J Inform Upgris*. 2023;9(1):43-48. doi:10.26877/jiu.v9i1.15599

[20] Ahmad I, Samsugi S, Irawan Y. Application of Augmented Reality on Human Body Anatomy to Support Learning of Alternative Medicine Cupping Points. *J Teknoinfo*. 2022;16(1):46. doi:10.33365/jti.v16i1.1521

[21] Prasetya NWA, Linda Perdana Wanti, Lina Puspitasari. Augmented Reality Technology for Facial Massage Therapy for Pregnant Women with Preeclampsia. *Infotekmesin*. 2023;14(1):35-42. doi:10.35970/infotekmesin.v14i1.1635

[22] Huang TK, Yang CH, Hsieh YH, Wang JC, Hung CC. Augmented reality (AR) and virtual reality (VR) applied in dentistry. *Kaohsiung J Med Sci*. 2018;34(4):243-248. doi:10.1016/j.kjms.2018.01.009

[23] Avdillah LA, Suhendar A. Android-based Human Internal Organ Anatomy Learning Application with Augmented Reality Technology. *KLIK Kaji Ilm Inform dan ....* 2023;4(3):1747-1757. doi:10.30865/klik.v4i3.1368

[24] Zakiyah HS, Utami WS. CLICK: Scientific Review of Informatics and Computer Applications of Human Skeletal System for Biology Learning Based on Augmented Reality. *Online Media*. 2023;4(3):1323-1331. doi:10.30865/klik.v4i3.1438

[25] Maili EA, Akbar M. Design of Augmented Reality Application for Learning Biology of Human Growth with Markerless Method. *KONSTELASI Konvergensi Teknol dan Sist Inf.* 2023;3(2):256-263. doi:10.24002/konstelasi.v3i2.7065.

[26] Rahman AFS, Nugraha MS, Kasrani MW. Arduino Learning Media Through Android-Based Augmented Reality with Marker-Based Method. *J Tek Elektro Uniba (JTE UNIBA)*. 2022;7(1):276-283. doi:10.36277/jteuniba.v7i1.196

[27] Ekapti RF, Mokhtar MM. Indonesian and Malaysian Students' Perception on the Application of Augmented Reality in Learning: A Preliminary Study. *J Tadris IPA Indones*. 2023;3(3):327-335. doi:10.21154/jtii.v3i3.2610

[28] 28. Dhar P, Rocks T, Samarasinghe RM, Stephenson G, Smith C. Augmented reality in medical education: students' experiences and learning outcomes. *Med Educ Online*. 2021;26(1). doi:10.1080/10872981.2021.1953953

[29] Wiriyanti M, Syarif S, Ahmad M, Prihartini SD, ... The Effect of WEB-based Learning Media on the Improvement of Practical Skills for Care of Period II of Labour for DIII Midwifery Students. *J Nursing Muhammadiyah*. 2020;5(2):77-81. http://103.114.35.30/index.php/JKM/article/view/4085

[30] Mulia Sari D, Safwan, Ramadhani, Ambri. Design of Augmented Reality Spot in Aceh Polytechnic Information Technology Programme Based on Android. *J Inotera*. 2022;7(2):163-169. doi:10.31572/inotera.vol7.iss2.2022.id185

[31] Hernanda A, Aji AS. Utilisation of Augmented Reality Applications for Learning Human Body Organs in Elementary Schools. *J Teknol Dan Sist Inf Bisnis*. 2024;6(1):245-251. doi:10.47233/jteksis.v6i1.1166

[32] Bahuguna Y, Verma A, Raj K. Smart learning based on augmented reality with android platform and its applicability. *Proc - 2018 3rd Int Conf Internet Things Smart Innov Usages, IoT-SIU 2018*. Published online 2018:1-5. doi:10.1109/IoT-SIU.2018.8519853

[33] Hapizd M, Safitri C. Development of augmented reality based on android learning material on human digestive organs and their functions in Class V Elementary School. *COLLASE (Creative Learn Students Elem Educ*. 2023;6(1):137-145. doi:10.22460/collase.v1i1.13857

[34] Cahyaningsih Y. Augmented reality technology in Android-based promotion. *J Comput Sci Eng*. 2020;1(2):90-115. doi:10.36596/jcse.v1i2.60

[35] Mirdad J, Pd MI. Learning Models (Four Families of Learning Models). 2020;2(1):14-23.

[36] Saifulloh MA. Application of Augmented Reality (AR) Media in the Engineering Learning Process. *JKPTB*. 2020;6(2):10-17.

[37] Sholeh M, Triyono J, Haryani P, Fatkhiyah E. Use and Development of Augmanted Reality Based Applications. *Jmm*. 2021;5(5):2524-2536. http://journal.ummat.ac.id/index.php/jmm

[38] Moh Suardi. *Learning and Learning*. ed. 1 cet.1. Deepublish; 2018. https://books.google.co.id/books?hl=id&lr=&id=kQ1SDwAAQBAJ&oi=fnd&pg=PA1&dq=apa+that+learning&ots=d-oGuTfqbQ&sig=PiAzV8qK5z5vbbNidurC_9E0YxE&redir_esc=y#v=onepage&q=what is learning&f=false

[39] Hartono R. Application of Macromedia Flash in Improving Creativity, Learning Outcomes, and Learning Effectiveness of Class XII Students at SMK Negeri 1 Kaliorang. *Diglosia J Kaji Bahasa, Sastra, dan Pengajarannya*. 2020;3(2):221-228. doi:10.30872/diglosia.v3i2.48

[40] Tafonao T. The Role of Learning Media in Increasing Student Learning Interest. *J Komun Pendidik*. 2018;2(2):103. doi:10.32585/jkp.v2i2.113

[41] Sulistyowati E. Improving Indonesian Language Learning Skills and Outcomes About Writing Official Letters Through Contextual Teaching And Learning (CTL) in Class VI Students of SD 6 Getassrabi. *INOPENDAS J Science of Education*. 2019;2(1):2-9. doi:10.24176/jino.v2i1.3436

[42] Nurbianto DA, Septimar ZM, Winarni LM. Relationship between knowledge and skills of nurses in the implementation of triage at the Tangerang City Hospital. *J Heal Sains*. 2021;2(1):44-55. doi:10.46799/jhs.v2i1.75

[43] Nurul'ain Fitri N, Azim A, Isa M, Yahya H, Zhafri Bin M, Nazmi M. AR-Learn Model: Augmented Reality (AR)-Based Learning Application Development Model. *Sultan Alauddin Sulaiman Shah J*. 2022;9(1):31-43.

[44] Ali DF, Yahya SS, Omar M. The Use of Augmented Reality Application in Basic Electronic Circuit Topic Augmented Reality in Education. 2020;3(2):1-7.

[45] Hapsari TPRN, Wulandari A. Feasibility Analysis of Augmented Reality (AR)-Based Millennial Textbook as a Learning Media for Procedure Text in Magelang. *Diglosia J Review of Language, Literature, and Teaching*. 2020;3(4):351-364. doi:10.30872/diglosia.v3i4.125

[46] Rizaludin M, Fikriah FK, Hidayat H. Introduction of Augmented Reality (AR) as Learning Media at SMK NU Kesesi. *J Pengabdi Masy TEKNO*. 2022;3(2):77-83. http://jurnal.iaii.or.id/index.php/JAMTEKNO

[47] Mohamad Hanif. *AUGMENTED REALITY INTRODUCTION TO INDONESIAN CULTURE BASED ON ANDROID*. Widyatama University; 2019. https://repository.widyatama.ac.id/items/03d84b8d-1ce9-4487-b85d-20da13d3e745

[48] Syakir AA. C# Programming Language Based Windows Application Using SharpDevelop 4 Editor. 4 (Simple Calculator Programme). *PGRI College of Computing*. 2018;4:1-12.

[49] Andis Indrawan IW, Saputra KO, Linawati L. Augmented Reality as Interactive Education Media in Covid-19 Pandemic. *Maj Ilm Teknol Elektro*. 2021;20(1):61. doi:10.24843/mite.2021.v20i01.p07

[50] Tohir A. Development of Augmented Reality Applications to Introduce Tangible Cultural Heritage at Lampung Museum Using the Development Life Cycle .... *J Data Portal*. 2022;2(7):1-15. http://portaldata.org/index.php/portaldata/article/view/192%0Ahttp://portaldata.org/index.php/portaldata/article/download/192/184

[51] Gunawan G, Faiza IM, Santoso NA, Kurniawan RD. Application of MDLC Method on Science Learning Media in Elementary School. *Sustain J Kaji Mutu Educator*. 2022;5(1):201-210. doi:10.32923/kjmp.v5i1.3100

[52] Baihaiki M. IMPLEMENTATION OF A DECSTOP-BASED INDONESIA CULTURE EDUCATION GAME

WITH MDLC METHODS AT SDS HARAPAN JAYA JAKARTA BARAT. *J Sos and Technol*. 2021;1(7):653-660.

[53] Mulyana YA, Setiawan IR, Lelah L. Design of Augmented Reality Learning Media to Know Degung Musical Instruments. *J Tek Inform and Sist Inf*. 2020;6(2):342-353. doi:10.28932/jutisi.v6i2.2699.

[54] Agus Kurniasari A, Trismayanti Dwi Puspitasari, Argista Dwi Septya Mutiara. Application of the Multimedia Development Life Cycle (Mdlc) Method to a Magical Augmented Reality Book Based on Android. *Antivirus J Ilm Tek Inform*. 2023;17(1):19-32. doi:10.35457/antivirus.v17i1.2801

[55] Effendi B. Multimedia Development Life Cycle (MDLC) Method in Building Android-Based Covid-19 Educational Applications MULTIMEDIA DEVELOPMENT LIFE CYCLE (MDLC) METHOD IN BUILDING COVID-19 EDUCATIONAL APPLICATIONS ANDROID BASED. *Teknomatika*. 2020;10(02):1-5.

[56] Borman RI, Purwanto Y. Implementation of Multimedia Development Life Cycle in Educational Game Development. *J Edukasi dan Penelit Inform*. 2019;5(2):119-124.

[57] Dyah A, Mandiri A, Aryuti S, Martini N. Utilisation of Augmented Reality Technology as a Pregnancy Education Media: Alpha Testing Utilisation of Augmented Reality as a Health Education Media for Pregnant Women: Alpha Testing Pregnancy is a physiological process AuRil (Augmented Reality Pregnant Women). 2023;2(2):27-33.

[58] Wiguna E, Rachman I, Sulistyono. Application of Introduction to Animal Names and Types Using Android-Based Augmented Reality Technology. *ProTekInfo (Development of Ris and Obs Tek Inform*. 2020;7(2003):17-21. doi:10.30656/protekinfo.v7i.5054

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