DEVELOPMENT OF AN AUGMENTED REALITY (ARDent) APPLICATION AS AN EFFECTIVE LEARNING MEDIUM IN INCREASING KNOWLEDGE OF DENTAL THERAPY STUDENTS IN OPERATING ROOM LEARNING

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Info Article	Abstract
  	Background: Augmented Reality is a technology that combines two-dimensional or three-dimensional computer-generated objects into the real environment around the user in real-time. In the health sector, ARDent has developed rapidly based on previous scientific studies. Multimedia technology can help create a quality learning environment for dental students by combining various medium and technology, such as text, graphics, sound and animation, including ARDent. The addition of existing Augmented Reality technology, ARDent as a learning medium will attract the attention of dental therapy students because it can provide an interactive, three-dimensional virtual presentation in the introduction and use of oral surgical dentistry tools. **Purpose:** This research aims to assess the effectiveness of developing the ARDent application as a medium for increasing the knowledge of Dental Therapy students in learning oral surgery. **Method:** The research method used is Research and Development (R&D), namely Information Collection, Design, Expert Validation, Product Testing, and Analysis of the product results. **Results:** The expert validation results revealed that the third expert's score averaged 88.6%, with a p-value of 0.039. The variables of software engineering, visual communication, and functionality, both pre and post-test scores on the ARDent application for applied bachelor dental therapy students, demonstrated a significance score of >0.001 for all three aspects (Paired T-Test). **Conclusion:** ARDent is effective in the aspects of software engineering, visual communication, and functionality, serving as an effective learning medium to enhance the knowledge of applied dental therapy students in learning oral surgery.

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Introduction

Augmented Reality (AR) is a technology that incorporates two-dimensional or three-dimensional computer-generated objects into the real environment around the user in real-time (Ismayani, 2020). In the field of health, AR has rapidly developed based on previous scientific research. One application of AR in health promotion is educational games for dental health aimed at children, facilitating the conveyance of information about dental health to them. Interesting visualizations and simulation games simplify the process of understanding information about dental health for children. Additionally, this approach makes it more convenient for dental health workers to provide education on dental and oral health for children (Hapsari, G., Mutiara, G., Chaidir, 2022). Recently, generations Y and Z have become familiar with multimedia learning environments and expect certain technologies to be integrated into the curriculum (Guazzaroni, G., Pillai, 2020). Therefore,

it will be easier for them to understand if we use AR that is appropriate to the subjects being studied.

AR has been used to improve the delivery of education and the quality of training in oral and maxillofacial surgery by creating a virtual environment for surgical procedures, enhancing manual dexterity, and improving clinical training. Sondang *et al.* (2015) reported that, without using AR during the study, 90% of students did not use the bain correctly, 83% did not use the sonde correctly, and 63% did not use mouth mirrors properly. In the process, students were provided with materials, a practicum introduction, and guidance on the use of tools. However, one of the obstacles was the limited practice or repetition of material by students due to the limited learning time on campus (Sondang, S., Siregar, 2015).

The benefits of AR in health education are evident. AR facilitates various learning procedures and activities that can be conducted without direct supervision, enhancing knowledge and skills among

students and reducing concerns when operating the planned service. Besides that, it provides access to quality interactions, educational resources, and cost-effective training overall. Several programs are being developed to facilitate the seamless integration of technology into simulation and practice, aiding students in their transition (Haji, Z., Arif, A., Jamal, S., Ghafoor, 2021).Virtual technology appears to improve educational outcomes for dentistry students (Moussa, R., Alghazaly, A., Althagafi, N., Eshky, R., Borzangy, 2022). The recently developed AR tool, medical teeth, focuses specifically on the introduction to medical teeth, with a particular emphasis on the conservation of medical teeth. An innovation in oral surgery known as ARDent has been introduced. In this study, we believe that technological developments, coupled with the community's demand for comprehensive health services, will assist prospective dental and oral therapists in acquiring competencies aligned with scientific developments, especially in the field of oral surgery.

Methods in AR can be categorized into two types: marker-based tracking and markerless augmented reality (Riady, S.C., Sentinuwo, S., Karouw, 2016). In this study, the researcher developed an AR marker (marker-based tracking) with the usage flow outline in Figure 1 (Riskiono, S.D., Susanto, T., 2020)
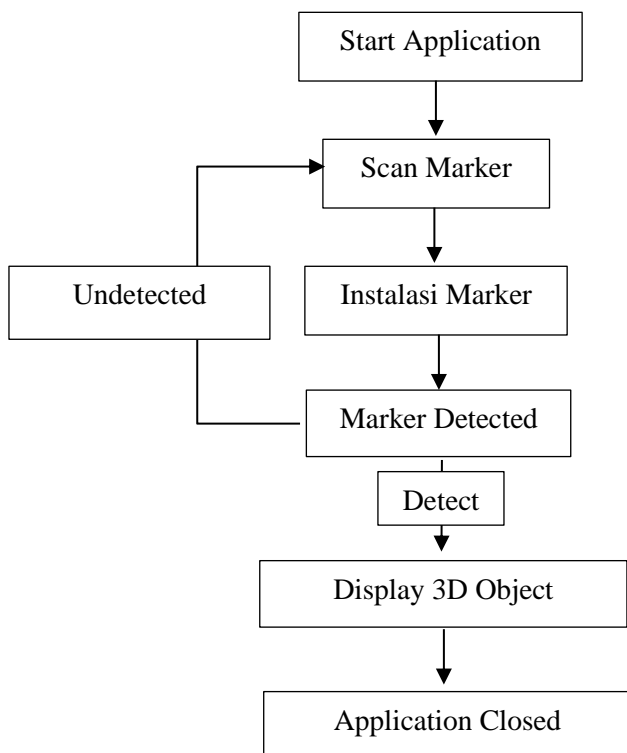
Figure 1. View workflow usage

The image above explains the stages of using ARDent from opening the application, using the marker, then scanning by the user and the application will install the marker, if it is not detected, it will be scanned again. After the 3D illustration appears, the user can use and study the shape of the detected tool

The learning media for dental therapy students within the scope of their competence is the introduction and use of oral surgical dentistry tools. In this case, ARDent is expected to help students imagine and illustrate tools and how to use them, so with the addition of existing Augmented Reality technology it will help attract the attention of dental therapy students because it can provide interactive three-dimensional virtual presentations regarding the introduction and use of oral surgical dentistry tools. delivered so that students can better understand the material provided. It is hoped that the use of AR technology as an educational medium can attract the target's attention and make education an interesting thing to follow.

Method

This study used the Research and Development (R&D) method, building upon existing studies (Sugiyono, 2016). In the initial stage, the collection of information was essential for creating the ARDent application. After collecting the information, the next step involved designing ARDent. At this stage, the IT team played a crucial role in developing *ARDent* as an introductory tool for medical tooth room surgery based on the previously collected information. The expert validation of ARDent was conducted through purposive *sampling, involving experts in dentistry,* oral surgery, dental health education, and IT fields, using a questionnaire instrument (Yuniar *et al.*, 2021).

The product test for ARDent was conducted using *purposive sampling, with* inclusion criteria consisting of students from the Dental Therapy FKG at Hasanuddin University (UNHAS), Class of 2021, and exclusions were applied to those who did not meet the inclusion criteria. The research design used a p*re-experimental design* with a one-group *pre-post-test* design due to the absence of an existing control group. The results of the ARDent product formed an android application and markers. This study obtained ethical approval from KEPK RSGMP UNHAS on December 12, 2022, with the reference number 0145/PL.09/KEPK FKG-RSGM UNHAS/2022.

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Result

Initial data were collected through interviews and observations conducted by related dental specialists, dental therapists, and mouth educators, who also studied literature to gather information before the IT team developed *AR* in the introductory tool for medical tooth room surgery for dental therapy students (Sumantri, Murodi, Ekayanti, no date). ARDent expert validation was performed by experts in dental specialists oral surgeon, dental health education expert, and field IT experts, with the results shown in Table 1.

Table 1. Expert Validation

Variable	N	score	F (%)	Means	p-values
Dentist Specialists Oral Surgeon	10	45	90		
Dental Health Education Expert	10	45	90	88.6%	0.039
IT expert	10	43	86		

The conclusion drawn from the expert validation results showed a score of 88.6% with a *p-value* of 0.039, indicating that ARDent is worthy as an effective learning medium for enhancing the knowledge of oral surgery among applied bachelor dental therapy students. This finding suggests that surgery is clinically based on mature education, and AR also affects lesson skills. In general, AR is not only applied in dental and vocational training courses but also improves all areas of our lives (Huang, T.-K., Yang, C.-H., Hsieh, Y.-H., Wang, J.-C., Hung, C.-C., 2018).

ARDent product trials were carried out using the pre-experiment method with a one-group pre-post test design (Muri, 2014).This study took place from August to December 2022, with the results presented in Table 2.

Table 2. Normality Test

Variable	Sig.*
Engineering Pre	0.116
Post Software Engineering	0.015
Visual Communication Pre	0.036
Post Visual Communication	0.249
Pre functionality	0.270
Post functionality	0.125

A data normality test was performed to determine whether the data group or variables used were normally distributed or not. The results of the data normality test were used to determine which statistical test was to be conducted next. If the data were normally distributed, parametric analysis could be used, and if the data were not normally distributed, non-parametric analysis was used.

Table 3. Paired T-Test

Variable	Means	std. Deviation	Sig.*
Engineering Pre - Software Engineering Post	2.267	1.856	0.001
Communication Pre - Visual Communication Post	3.400	3.568	0.001
Pre functionality - Post functionality	8.667	7.450	0.001

From the paired t-test results in Table 3, it is evident that there was a change in pre and post-test values with the application of ARDent to applied bachelor dental therapy students, with a significance score of >0.001. This indicates that ARDent has proven to be an effective learning medium in the aspects of software engineering, visual communication, and functionality as a learning media, effectively enhancing the knowledge of applied bachelor dental therapy students in learning oral surgery. This finding highlights that the better the physical facilities and responsiveness, the higher the student satisfaction (Ayoub, A., Pulijala, 2019).

Figure 2. View of the tool on ARDent

Discussion

The study's findings indicate that ARDent is effective as a learning medium in increasing the knowledge of applied bachelor students, particularly in dental therapy learning oral surgery. The expert validation results presented in Table 1 demonstrate a mean value of 88.6%, indicating that ARDent is a worthwhile and effective learning tool for knowledge enhancement. This is in line with the research conducted. (Rahmadani, 2021), which reported that the use of AR has a significant impact on users, improving memory retention, motivation, learning achievement, and reducing anxiety.

AR is a beneficial tool for clinical practice in the field of oral maxillofacial surgery (Fahim, S., Maqsood, A., Das, G., Ahmed, N., Saquib, S., Lal, A., Khan, A.A.G., Alam, 2022). Table 3 shows significant values from three variables, with a significance score of 0.001, indicating that ARDent is highly effective for use in applied bachelor dental therapy students, specifically in learning oral surgery. ARDent could be used as an alternative to increase knowledge and skills among students, reducing anxiety during their practical procedures. Besides that, ARDent also provides access to quality interactions, educational resources, and cost-effective training in a comprehensive manner (Haji, Z., Arif, A., Jamal, S., Ghafoor, 2021).

The utilization of packaged learning media using technology shaped like *AR* has been proven to increase users' knowledge in identifying objects, even when only projected virtually. (Tullah and Santoso, 2022). This is supported by research conducted on the utilization of the D-Pare Model in maintaining behavior change for oral health among adolescents, revealing a significant difference in knowledge scores with a p-value < 0.05, specifically *p-value* (0.001). This demonstrates a noticeable change in knowledge levels before and after the use of the D-Pare Model, with a score change of $\Delta=5.33$. These findings show that the implementation of *AR*-based educational media has a positive impact on enhancing respondents' knowledge (Pitts *et al.*, 2017).

Technology is, of course, a flexible medium for use in various applications, especially in the educational process (Haleem, A., Javaid, M., Qadri, M.A., Suman, 2022). The result of the study is in line with research conducted on the utilization of the Syif'AR tool for medical teeth, which focuses on the learning introduction tool for medical teeth, specifically emphasizing the conservation of medical teeth. In contrast to the focus of this study, the researcher focuses on the recognition tool for medical teeth in room surgery. The research findings are also supported by the improvement in skills among respondents in identifying the tool, with a *p-value* of 0.001, indicating a significant difference before and after the use of the Syif'AR media in respondents. (Asy-syifa, 2022)

Indeed, there are several aspects in which AR can be particularly helpful, for example, in providing augmented visual communication cues.(Patkar, N., Merino, L., Nierstrasz, 202AD) Paired tests on software engineering, visual communication, and functionality in pre and post-treatment research obtained results with *p-value*< 0.05, all significant at 0.001. This demonstrates a significant difference in the knowledge level of the treatment group before and after applying ARDent. In other research, interaction testing and test automation were identified to have great potential in software engineering.(Jiménez, E.J. de A.S., Aguilar Vera, R.A., López, J.L., Gómez, O.S., 2021) The utilization of an AR mobile application's functionality increased the learning motivation of students.(Khan, T., Johnston, K., Ophoff, J., 2019)

It is anticipated that ARDent could enhance knowledge not only for applied bachelor dental

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therapy students but also for all individuals who require education on oral surgery. This is because, in addition to the use of AR media in the learning process, performing oral surgery on applied bachelor dental therapy students impacts anxiety and increases overall training costs.(Monterubbianesi, R., Tosco, V., Vitiello, F., Orilisi, G., Fraccastoro, F., Putignano, A., Orsini, 2022) Through simulation, the aim is to minimize existing risks, as dental officer and oral therapist gain an initial understanding of the patient's oral cavity.(Suciliyana, Y., Rahman, 2020)

Conclusions and Suggestions

After conducting tests and analyzing the ARDent application, we can conclude that ARDent is a worthy and effective learning tool for increasing the knowledge of applied bachelor dental therapy student's in learning oral surgery, as assessed by expert validators. ARDent is effective in aspects of software engineering, visual communication, and functionality as a learning medium that enhances the knowledge of applied bachelor dental therapy students in learning oral surgery. A limitation of this study is the high cost associated with developing this application. To address this, we make sure to increase this study to be a good application with research funding assistance. Based on the conclusions drawn from the results above, the researcher hopes that this study will continue to develop, specifically contributing to dental and oral therapy education in Indonesia.

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