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Manual and Motion Therapy Learning Media Development on Augmented Reality based Shoulder Injuries

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Abstract

Introduction: The rapid development of technology decreases understanding of various theories in the learning process.

Objectives to develop and understand the effectiveness of 'manurak' (manual dan gerak/manual and motion) therapy learning videos on augmented reality (AR)-based shoulder injuries.

Methods: This research and development study applied the ADDIE (Analysis-Design-Develop-Implement-Evaluate) model. The subjects of the research involved two media experts as product validators. Meanwhile, the effectiveness of the product was examined with the help of 30 Sports Science students, Faculty of Sports and Health Sciences, Yogyakarta State University. The data analysis technique in this study involved expert validity tests and the pass rate in AR-based manipulative therapy courses to see the level of effectiveness.

Results: The study found that (1) the average value of total Augmented Reality (AR)-based media used in supporting the learning process was $x^{-} = 4.8$, which meant that this value was valid because $4 \leq x^{-} \leq 5$; (2) the results of the student manipulative therapy course examination showed that the average score of students was 83.6 with the 26 students who obtained scores in the 'complete' category, while those who did not complete were four people. The percentage of completeness obtained by students was 87% (high category). In comparison, the incomplete was 13%, which meant that learning manipulative therapy courses on shoulder injuries using AR-based media was in the high category or very effective.

Conclusions: Based on the results of the study, it can be concluded that AR-based 'Manurak' Therapy Media on Shoulder Injuries was valid and effective for its use.

Keywords: Learning Media, Manurak Therapy, Shoulder Injury, Augmented Reality, Education.

1. Introduction

Many athletes experience shoulder and knee injuries. Many obstacles are faced in providing students with learning or training, including the need for more media when delivering material. Various therapy methods have developed rapidly, one of which is called '*manurak*' (*manual dan gerak*/manual and motion) therapy. This is a therapeutic modality developed by the Manipulative and Rehabilitative Therapy Clinic Health and Sports Center, Faculty of Sports and Health Sciences, Yogyakarta State University, to overcome musculoskeletal disorders, especially in the joints.

The Manipulative and Rehabilitative Therapy Clinic patient data from January to April 2022 showed that the most frequent injury for upper limbs was the shoulder joint, and for the lower limb was the knee joint. Manual therapy emphasising the joints with stroking and friction can relax muscles, reduce pain, and facilitate blood and lymph flow.

Pats can be applied to all muscle surfaces around joints and tendons to strengthen the effects of stroking and friction while reducing pain due to stroking manipulation. With reduced pain and muscle relaxation, the scope of the joint motion (*Range of Motion: ROM*) increases (Sadacharan & Seo, 2021). Motion therapy performed after manual therapy can return the joint to the correct position (*repositioning*) without excessive pain and stiff stretch muscles so that they become more relaxed. Motion therapy involves patients actively so that it is safer because patients perform according to the stiffness and pain felt (Bae & Park, 2013) . Thus, the advantages of *manurak* therapy involve: that it can relax muscles, reduce pain and ROM quickly, safely, and comfortably for patients, and easy and light for therapists.

In general, the pathophysiological process that occurs in a person's body when it is injured begins when cells are damaged. Cells secrete chemical mediators that stimulate inflammation, including histamine, bradykinin, prostaglandins, and leukotriene. Chemical mediators that arise can cause vasodilation of blood vessels and withdrawal of the population of immune cells at the site of injury. Physiologically, the body's response is known as the inflammatory process. Over time, this inflammatory process will then gradually decrease, and regeneration occurs in these cells or tissues.

Based on Van Mechelen (2003) in (Arovah, 2009), the sprains injury is divided into three levels, namely: a) Sprain grade I, where there is a slight hematoma in the ligament and only a few fibres are broken. The injury causes tenderness, swelling, and pain in the area; b) Grade II sprains, where more fibres than the ligament are broken, but more than half of the ligament fibres are intact. Injury causes pain, tenderness, swelling, and effusion (a fluid that comes out) and usually cannot move the joint; and c) Sprain grade III, in this injury, the entire ligament breaks so that the two ends are separated. When the joint concerned feel very painful, there is blood in the joint.

Manurak therapy begins with manipulating the trigger point area (stroking, press, or friction) that accelerates muscle relaxation. *Tapotement* (punch) will perfect the relaxation to reduce pain when moved, and *motion* performed by the patient himself according to the stiffness and pain felt on the therapist's instructions will return the joint to the correct position and relax the muscles that experience stiffness. A *trigger point* is a point that feels pain when pressed due to the presence of hyperirritable areas located in muscle structures or fascia that tighten. According to (Kalichman & David, 2017), suppression of trigger points is believed to activate the autonomic nervous system by stimulating type III and IV interstitial receptors that respond to light touch. Sustained pressure can respond to *Ruffini* in the fascia, decreasing sympathetic tone and increasing gamma motor neuron activity that promotes interfacial muscle cell relaxation. In addition, it is believed that an autonomic nerve system promotes vasodilation and local fluid dynamics that decrease the viscosity of the fascia so that it is more gel-like. Movement is carried out according to the normal range of motion of the joint. Contraction and relaxation of the muscles around the joint will place the bones forming it in their normal position (repositioning). In addition, muscle contractions can also increase circulation to the area of pain so that substances that cause pain can be removed from the tissue.

Augmented reality displays objects more interestingly and uses alternative multimedia visualisation. *Markerless* is an emerging technology and is included in Augmented Reality techniques. This technique has the advantage that users do not have to use particular marker patterns to display digital elements. Augmented reality can properly present information in the real-world using marker detection. The system needs to know where the user is and what the user is looking for. Usually, users explore the environment through a screen that depicts images from the camera and the information raised. So, in this case, the system needs to determine the location and orientation of the camera through camera calibration and then be able to bring up virtual objects right in the right place. In this study, development research conducted a study entitled *Developing Training Media for Shoulder and Knee Injuries Based on Augmented Reality*.

2. Methods

This study applied research and development methods supported by qualitative and quantitative approaches (Edmonds & Kennedy, 2016; Hong et al., 2019; Petrovic et al., 2017) using the ADDIE (Analysis-Design-Develop-Implement-Evaluate) model. The ADDIE model is arranged programmatically in a systematic sequence to solve problems that suit the needs and characteristics of the development of Augmented Reality-based shoulder and knee injury training models. The ADDIE development model has revision stages at each stage, from analysis to evaluation. Revisions are made to improve the development model to be valid, feasible, practical and effective in overcoming this research problem.

The subjects involved in the research were two media experts assigned to validate the developed product in the form of learning videos that demonstrate *manurak* therapy for shoulder and knee injuries based on augmented reality. Meanwhile, this study also used help from 30 students of Sports Science students, Faculty of Sports and Health Sciences, Yogyakarta State University, to test the effectiveness of the product.

Instruments used to test the effectiveness of learning video development were carried out using a questionnaire. The questionnaire contained questions about shoulder injury material, and *manurak* therapy was used to collect data on the student's grades before and after using the developed *manurak* therapy learning videos. The data analysis technique used in this study used two techniques, namely expert validity testing and seeing the pass rate in Manipulative Therapy courses on shoulder injuries using Augmented Reality (AR)-based media to see the effectiveness of Augmented Reality (AR)-based media.

3. Results

3.1 Results of Media Validity Data Analysis Based on Augmented (AR)

Augmented Reality (AR)-based media validation activities began by providing validator assessment sheets. Based on the results of validation by validators on Augmented Reality-based media, the following results were obtained:

Table 1. Average Augmented Reality (AR)-Based Media Validation Results Based on Their Assessment

No	Aspects	Average Scores		Va	Validity
		Va1	Va2		
1	Learning feeds	4.3	5.0	4.7	Valid
2	Content eligibility	4.8	4.8	4.8	Valid
3	Constructivism Paradigm	5.0	5.9	5.0	Highly Valid
4	Design	4.5	5.0	4.8	Valid
5	Validity Aspect	4.6	4.7	4.6	Valid
	Average	4.7	4.9	4.8	Valid

Based on the results of the analysis shown in Table 1 above, the average value of total Augmented Reality (AR)-based media used in supporting the learning process was $\bar{x} = 4.8$, which is included in the *valid* category ($4 \leq \bar{x} \leq 5$) by referring to the criteria. Therefore, based on all criteria, Augmented Reality (AR)-based media that had been developed were declared to meet the validity criteria to be suitable for use.

Augmented Reality (AR)-based media developed was called *AR Manurak Therapy for Shoulder Injury*, with the initial display (interface) after installation on Android as shown below:

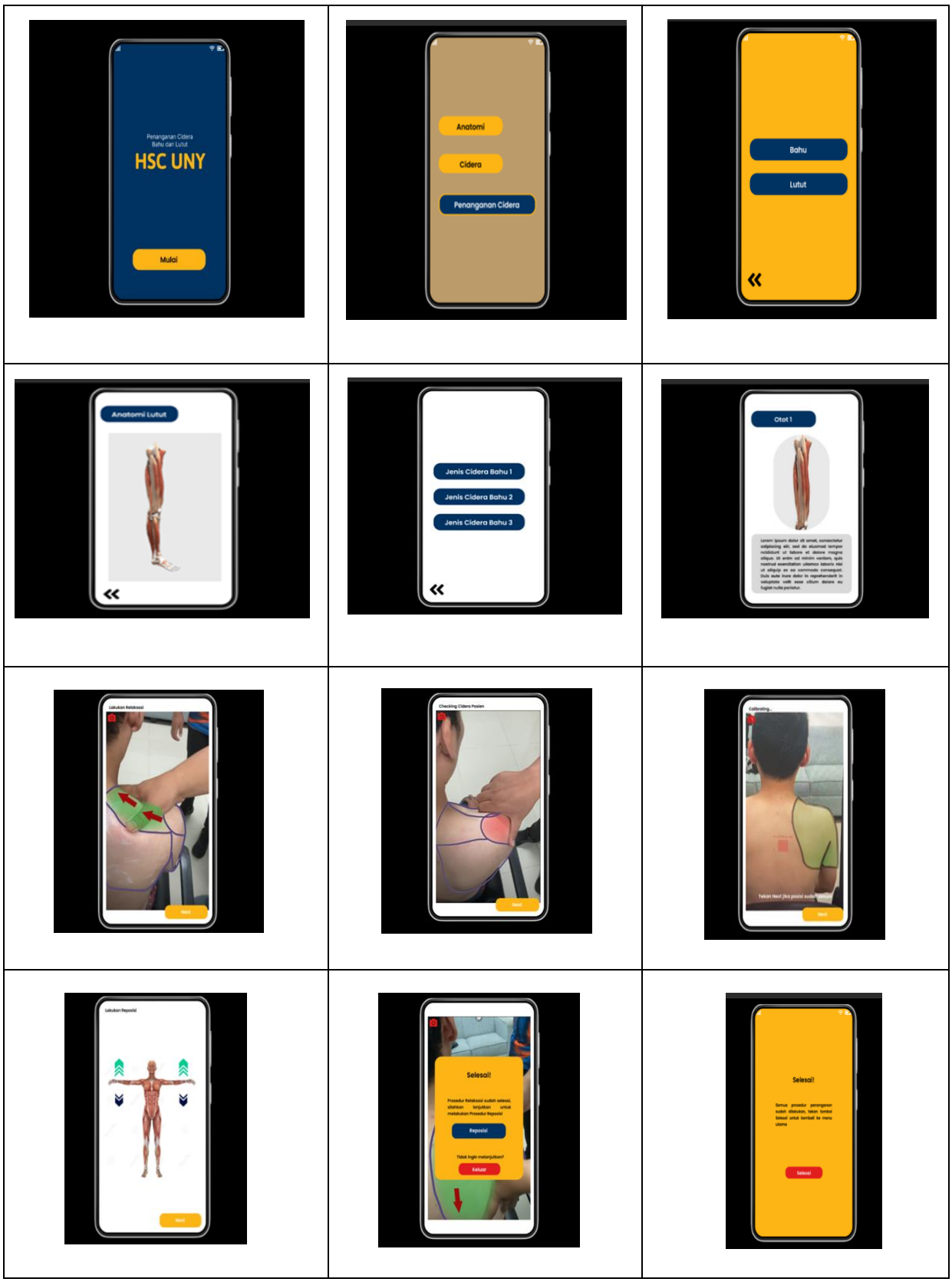

Figure 1. Augmented Reality (AR)-based media developed

3.2 Results of Practicality Data Analysis of Augmented Reality-Based Media (AR)

Based on the data in Table 2, the responses from the lecturers or the validators to the Augmented Reality-based media showed that the average percentage score for each category was in the range of 80% < P ≤ 100%, which was in the *very good* category. In other words, teachers gave a very positive response to Augmented Reality (AR)-based media developed as follows:

Table 2. The Results of the Lecturer's Response Analysis to the Developed Augmented Reality (AR)-based Media

Response Percentage	Category	Number of Respondents in Categories	Percentage (%)
80.1% - 100%	Very Positive	17	100%
60.1% - 80%	Positive	0	0
40.1% - 60%	Positive Enough	0	0
20.1% - 40%	Less Positive	0	0
0% - 20%	Negative	0	0

Table 3. Results of Analysis of Student Responses to Developed Augmented Reality (AR) Based Media

Response Percentage	Category	Number of Respondents in Categories	Percentage (%)
80.1% - 100%	Very Positive	5	16.7
60.1% - 80%	Positive	25	83.3
40.1% - 60%	Positive Enough	0	0
20.1% - 40%	Less Positive	0	0
0% - 20%	Negative	0	0

The data in Table 3 shows the overall student response to the learning media of *Manurak* Therapy in Augmented Reality-based Shoulder Injuries. The average percentage of student response was 83.25%, which was in the range of 80% < P ≤ 100%, which means it is very positive or in the *very practical* category.

3.3 The value of student learning outcomes determines the effectiveness of the product. The results of the data analysis of student learning outcomes can be seen in Table 4.

Table 4. Descriptive Analysis of Manipulative Therapy Subject Exam Results

Data	**Value**
Number of samples	30
Lowest score	36
Highest score	100
Data	**Value**
Average	83.6
The number who passed	26
The number who did not pass	4
Completion percentage	87%
Incompletion percentage	13%
Standard Deviation	19.54

Based on Table 4, the percentage of student manipulative therapy course exam results shows that the average score of students was 83.6, with the number of students who obtained scores in the complete category as many as 26 people, while those who did not complete as many as four people. The percentage of completeness obtained by students was 87% (high category), while incomplete was 13%. This shows that learning the manipulative therapy courses on shoulder injuries using Augmented Reality (AR)-based media was in the high category or very effective.

4. Discussion

Augmented Reality (AR) is a technology created by combining the real and virtual worlds to present objects or digital information in the real world. In this case, the primary purpose of AR technology is to expand or enrich the perception of the actual world (Jorge et al., 2016). Meanwhile, the use of AR in education is still slightly applied. Based on the current developing literature, the effect of using AR on the learning process still raises pros and cons (Rodriguez-Abad et al., 2021; Tang et al., 2020). However, in this study, it is known that the AR-based shoulder injury therapy video developed could effectively improve the learning outcomes of Sports Science students for the 2021/2022 Academic Year.

These findings are undoubtedly caused by various factors, including interactions between the factors involved, or in other words, AR affects the learning process in a multidimensional manner (Rodriguez-Abad et al., 2021). In addition, the findings by (Salar et al., 2020) state that the key to the success of AR can be shown in the advantages provided by AR in the world of education. In the science of pedagogy or the learning process, the technology owned by AR can provide unlimited opportunities and opportunities for users to develop the learning process (Moreno-Guerrero et al., 2020).

AR technology has a high potential for adaptation to different stages of education. AR technology is a versatile tool for developing learning processes considering an extensive student profile because AR technology can be applied to children to adults (Moreno-Guerrero et al., 2020; Sahin & Yilmaz, 2020). In addition, AR can improve educational standards and encourage learner engagement, skills, and competencies so that these methods are considered superior to traditional (conventional) methods (Cardoso et al., 2019). AR in higher education in Health Sciences is known to reduce cognitive load and increase student motivation and satisfaction. Its role as a learning support tool can also improve spatial understanding and promote better autonomous learning (Rodriguez-Abad et al., 2021). AR technology makes learning human therapy more interesting and increases students' curiosity. In line with this, interest or curiosity is the basis, initial capital, or a first step towards the success of the learning process (Vasilevski & Birt, 2020).

Furthermore, to make AR more effective, AR must be built based on instructional design models to ensure that it follows the character needs of the learners and can motivate them in learning (AlNajdi, 2022). The video of *manurak* therapy in AR-based shoulder injuries developed in this study had been prepared and tailored to the needs of Sports science students in understanding *manurak* therapy. AR-based video content in this study could help students understand anatomical concepts in human therapy, mass techniques, and the correct sequence of techniques. Through AR videos, human therapy learning becomes more comprehensive if the videos are presented using AR because it provides a detailed perspective and a clear picture to users (Schneider et al., 2020).

In addition, learning *manurak* therapy using AR media could increase student learning motivation. However, our study was uncertain about how significant the increase in motivation was. Motivation is known to be associated with learning success (Cook & Artino Jr, 2016; Steinmayr et al., 2019). Changes in motivation are often followed by changes in students' level of interest, curiosity, and involvement in the learning process (AlNajdi, 2022; Cohen et al., 2022). Changes to these things can help students to understand human therapy learning better.

AR in higher education in health sciences can improve skills acquisition, providing students with more authentic learning and more personalised learning experiences (Zhu et al., 2014). If further developed, AR can help student practice activities (Rodriguez-Abad et al., 2021). The AR-based video in this study not only assisted with theoretical learning supplements but also provided interesting interaction interactions and can help student practice. Thus, we suggest that the use of AR in the learning process be carried out, considering the various benefits that can be obtained for students.

This study has limitations. Given the inadequate literacy resources regarding AR research in manipulative therapy education, we cannot strengthen or support the results. Although learning using the AR video model in this study could improve the quality of student learning outcomes, it is new in the education field (Wu et al., 2013). Therefore, the development of AR video must continue to be considered and further developed due to rapid technological advancements.

5. Conclusions

The development model used in the Augmented Reality-based *manurak* therapy was learning videos of *manurak* therapy with the following results:

a. The Augmented Reality-based media developed by the researchers have been declared valid based on Likert scale calculations. From the results of the analysis of validity data, it was obtained that the average was in the *valid* category, so it can be concluded that the Augmented Reality-based media developed has met the requirements for the validity value of 4 = Va < 5 and is suitable for use in the learning process. Because all aspects of the media assessment are in the *valid* category, the Augmented Reality (AR)-based learning media that have been developed can be used in the next stage, namely field trials on the learning process.

b. The Augmented Reality-based validation stage, the learning media developed is declared valid if the average validation value is 87.98%.

c. The results of the Likert scale calculation showed that the average value of teacher response to Augmented Reality-based media was 4.8 or at a percentage of 96.08%. In this case, the value meets the *good* category, while students' response to Augmented Reality-based media was 4.16, with a percentage of 83.25% classified into the *very practical* category. This means that the Augmented Reality (AR)-based Shoulder Therapy media developed by researchers in the manipulative therapy course received a positive response from students of the sports science study program. The hail indicated that the Augmented Reality (AR)-based media developed is practical for use in lectures, especially for Manipulative Therapy courses.

d. The product of Augmented Reality on Shoulder Injuries can be downloaded on: https://www.figma.com/proto/6iaLL0OPndPzBI1TFeQNsT/Ceryneian-AR-UNY?node-id=2%3A2&scaling=scale-down&page-id=0%3A1&starting-point-node-id=2%3A

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