Research Article

The Effectiveness of Multimedia-based Learning Media on the Achievement of Health Students' Competences: A Literature Study

Siska Mayang Sari[1]*, M. Zikri Ma'arij[2], Dian Roza Adila[3]

[1,2,3]Bachelor Nursing Program, Universitas Hang Tuah Pekanbaru, Indonesia

ORCID
Siska Mayang Sari: https://orcid.org/0000-0001-8791-0688

Abstract.
The development of information technology (IT) in the world covers all aspects of human life, including education by using technological developments and changes that occur in the learning process. The limited collection of reference books and classical (conventional) learning versions, becomes the basis for consideration when using multimedia-based learning media to create a good and interesting learning atmosphere, so learning media must be able to evolve to provide a better learning experience for students and teachers. This study aims to describe the effectiveness of multimedia-based learning media on the achievement of student competence in human anatomy and physiology. This study was a literature review using several articles sourced from Google Scholar, Directory of Open Access Journal, and Garuda. The inclusion criteria for reviewed articles included articles that investigated multimedia-based learning with various research methodologies. The results of several studies indicate that there is an influence of multimedia-based learning media in improving the competence or skills of health students. Researchers recommend lecturers be able to further develop multimedia-based learning media such as video, powerpoint, audio-visual, and others.

Keywords: student competence, learning media, multimedia

Corresponding Author: Siska Mayang Sari; email: siskamyg@htp.ac.id

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1. Introduction

Teaching and learning are two inseparable parts of our life. During one's growth and development period, from childhood to grown-up, the majority of time is spent in those processes at educational institutions. Like many other aspects of teaching and learning processes such as teachers, facilities, and infrastructure, learning media plays inseparable roles in the learning process. In teaching and learning processes, there are some obstacles and difficulties in achieving learning outcomes. Students at some point still have difficulties in mastering learning materials provided by their lecturers. Those difficulties are known as 'learning disabilities. The use of the 'disability' term is to create an optimistic impression that one in reality still can perform learning activities.

Other things that can be used as a measurement to determine the causes of learning disabilities among students are obstacles that they face in the learning process (1,2)

The shift in the learning process as well as in communication and information technology advancement has created convenience in the learning and teaching process, and one of them is the use of learning media (1,3). Learning media can be defined as a way to deliver information and present learning materials to stimulate the learning process. Learning media plays important roles in the learning process and the use of learning media can improve students' motivation to learn and deepen their understanding of learning materials. Multimedia can also facilitate interaction between students and their lecturer to help develop an optimal learning process. the Media in learning process plays a unique role as a helping tool to create active, effective, and fun learning situations (4).

Innovation in learning media can be achieved by taking advantage of the functions and roles of computer-based technology. One piece of advice that can support the learning process is through the use of interactive multimedia. Multimedia is one learning media presented in a more interesting way that it can contain audio-visual contents and elements in that particular media. The content of learning media is not only texts or static pictures, but also voice, graphs, animation, or videos to present the learning materials and help students to understand them more easily. Some programs used to create multimedia are *PowerPoint, Macromedia Flash*, *3D Studio Max, Adobe Flash*, and many others (5,6) multimedia in the forms of digital books can improve technical drawing skills among students. In addition, the use of interactive learning media can increase psychological effects that boost motivation, spirit, and independence in learning.

Multimedia is defined as learning media with complex nature that it not only combines several media, but also joins together several media into a connected and effective program. Some media that can be combined together are texts, voice, pictures, or videos. A study by (7) on systematic review of multimedia devices in teaching and learning process shows that the effectiveness of multimedia devices highly affects audience understanding, and technology advancement and teachers' ability to improve their learning materials delivery through media to the target audience should be paid more attention to. Of many benefits of using multimedia in learning are that it provides variety of information and learning methods, stimulates students to be closer to real condition while learning, and develops multisensory experience at once (8).

The effect of multimedia as an alternative in using learning media is proven in one of the results of the study by (9) on the effect of multimedia learning method of Cardiopulmonary Resuscitation (CPR) on high quality CPR. Some components of this learning methods are voice, pictures, videos, and moving animation, which draw

students' interests as well as improve their motivation and knowledge of what they have learned. Other learning materials in health major that employ multimedia as a choice of efficient learning media is human anatomy and physiology subject. A study by (10) on *Developing digital multimedia of human anatomy and physiology material based on STEM (Science, Technology, Engineering, Math) education* reveals that learning human anatomy physiology subject using STEM-based education has been developed and declared valid in the following aspects: media eligibility (96.89%), learning materials (89.31%), benefit (97.53%), and readability (85.22%). The multimedia was applied to 47 students of Biology Department of IKIP Budi Utomo year 2017 in three cycles. The average score for critical thinking ability in cycle 1 was 50.09, cycle 2 was 61.69, and cycle 3 was 75.09. These results showed that the application of multimedia-STEM education improved students' ability to do critical thinking proven by the improved average score in the three cycles. This can be a reference to the notion that the use of multimedia is effective to develop students' critical thinking ability.

Some students of health major learning these subjects are those in nursing and radiology majors. In nursing major, anatomy physiology subject is considered as one of important subjects because a nurse should possess strong knowledge about anatomy physiology in order to develop caring skills in practice that allow them to provide safe, effective, and complex nursing care. All of this can be achieved if they understand how the human body works. On the other hand, in radiology major, anatomy physiology subject is strongly influential because it plays vital roles in health service with the main duty as health service officer that provide images of the human body using radiology techniques. Depkes RI (1990) states that to take anatomy radiology subject, one should pass basic anatomy subject the prerequisite subject (11). It is predicted that students with better understanding in basic anatomy subject will have better understanding in anatomy radiology subject.

Learning anatomy physiology subject requires logical reasoning and thinking as well as broad scientific understanding (12). Anatomy physiology is one of the subjects that contain many concepts that are compulsory for health students to master and is claimed to have a collection of concepts that need to be memorized. As a result, many students of anatomy physiology subject feel bored and show lack of attention to what the lecturer explains. A study by (13) on difficulties in learning anatomy among Diploma 4 physiotherapy students of Universitas 'Aisyiyah Surakarta shows that many students experience difficulties when learning this subject. The data show that not all students get A (Excellent) in this subject. Anatomy 101 subject is considered difficult for students as many anatomy parts using Latin and not all students have educational background that

supports their current major. These factors lead to difficulties experiment by students when learning and understanding the subject. Therefore, this literature review aims to describe the effectiveness of multimedia-based learning media on the achievement of student competence in human anatomy and physiology.

2. Methodology

Research Question: the research question have been addressed was how effective the multimedia-based learning media on the achievement of students competence in human anatomy and physiology?

Study Design:

We conducted a literature review by adopting PICO (Population, Intervention, Comparation, Outcomes, Study design and publication types).

Eligibility Criteria:

Studies satisfying the following criteria were included: (1) assessing multimedia-based learning media toward improving the student's competencies (including terms related and similar to, eg, learning media, technology, application, competency, skill, android, video; (2) targeting health students; (3) adopting a quantitative design (eg. Randomized control trial, quasi-experimental trial, longitudinal, cross-sectional studies); (4) published year of 2017-2022; and (5) written in Bahasa Indonesia and English. Therefore, qualitative studies, commentaries, editorials, letter, PhD dissertations, conference abstracts, and all studies that investigated multimedia learning media were excluded.

Data Searching:

The search string was designed and developed with the support of an expert research librarian and then preliminarily piloted in a database to ensure its accuracy according to the review aims.

The search string was applying in the following databases: Google Scholar, ProQuest, Science Direct, Directory Open of Access Journal, and Garuda. Below is the list of keywords used in this study:

Study Selection:

The title, the abstract, and the full-text screening of eligible studies were performed by 2 researchers (SMS and MZM) independently. The PICOS in this study is summarized in Table 2, and the study selection process is summarized in Figure 1 according to the PICOS.

Using literature review diagram flow to select journal articles

Table 1: Literature Review Keywords.

Learning Media	Multimedia	Kompetensi Mahasiswa
Learning Media	Technology	Skill
OR	*OR*	*OR*
Learning Device	Application	Ability
OR	*OR*	
Learning Material	Communication Device	
	OR	
	Android	
	OR	
	Video	

Table 2: PICOS in *Literature Review*.

Criteria	Inclusion	Exclusion
Population	Health students	Students
Intervention	Multimedia-based learning media	Learning media other than multimedia
Comparation	None	None
Outcome	To improve health students' achievement competence	To improve students' achievement competence
Study Design and Publication Type	Quasi-experimental studies, systematic review, qualitative research and cross-sectional studies, randomized controlled trials	None
Publication ear	After 2017	Before 2017
Language	Indonesian, English	

The analysis of quality of methodology for each study (n=6) was conducted using scoring checklist comprising several questions to score the quality of the study. Scoring criteria included "Yes", "No", "Unclear" or "Not Applicable", with 1 point for "Yes" criterion, and 0 point for other criteria. Each selected journal article then was scored. Critical appraisal was employed to evaluate journal articles that met the criteria. Should the score met 50% of critical appraisal criteria with cut-off score determined by the researchers, the journal article can be included into inclusion criteria. Researchers made exception to low-quality journal articles to avoid bias or errors in validity result and review recommendations.

The risk of bias in literature review for each of the journal articles analyses was assessed using research methodology scoring which comprises:

1. **Theory**: The theory is not correctly used, obsolete, and less-credible.

2. **Design**: The design does not match the purpose of the study.

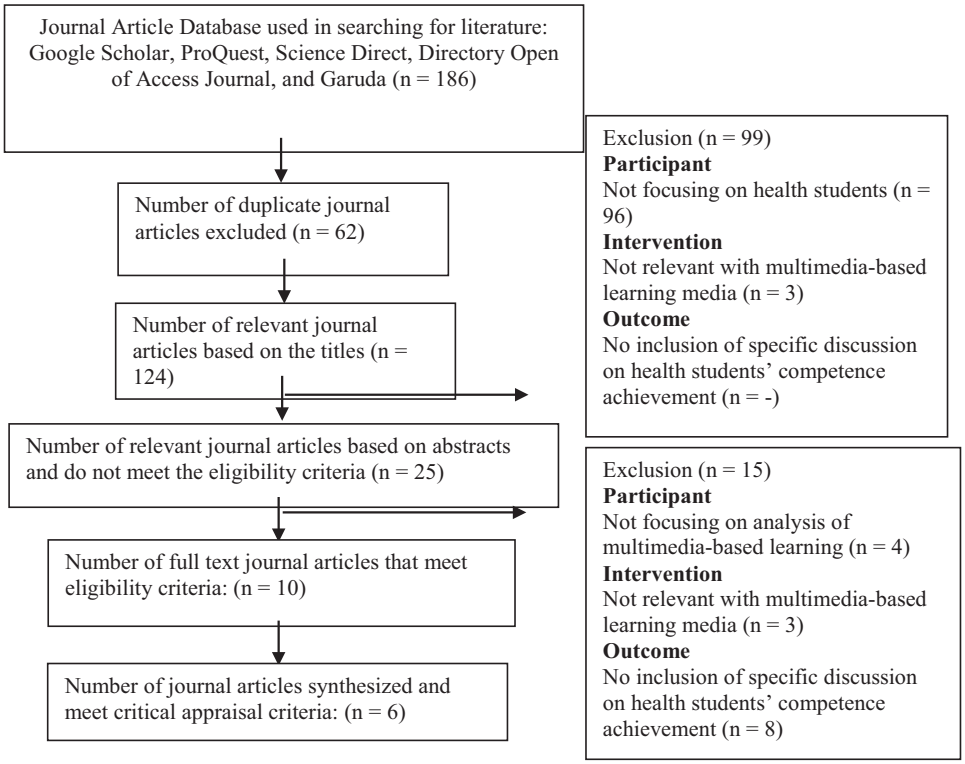

Figure 1: Study Selection.

3. **Sample**: 4 things considered are population, sample, sample selection, and sample size do not meet agreed sampling rule.

4. **Variable**: The collection of variables does not match in term of quantity, variable control, confounding variables, and other variables.

5. **Instrument**: Instruments used in the study do not have specification, sensitivity, and validity-reliability.

6. **Data analysis**: Data analysis is conducted not based on standard and agreed set of rules (Nursalam, 2020).

3. Result

Table 3 shows the search result of journal articles using database that was predetermined by the researchers: 134 journal articles from Google Scholar, 2 journal articles from ProQuest, 3 journal articles from Science Direct, 37 journal articles from Directory Open of Access, and 10 journal articles from Garuda, with the total of 186 journal articles from the period of 2017-2022. Then, the journal article selection using critical appraisal

Table 3: Search Result Based on Research Database.

Language	Year	Database	N	Types of Research Study				
				Cross Sectional	Quasi-experimental	Systematic review	Qualitative research	Randomized controlled trials
Indonesian, English	2017-2022	Google Scholar	134	0	3	0	0	0
		ProQuest	2	0	0	0	0	0
		Science Direct	3	0	0	0		
		Directory Open of Access Journal,	37	0	2	0	0	0
		Garuda	10	0	1	0	0	0
Result			6	0	6	0	0	0

method was conducted, resulting in 6 journal articles using Quasi experimental design: 3 from Google Scholar, 2 from Directory Open of Access, and 1 from Garuda. On average, 30 to 68 health students were involved in those research studies. Overall, every research study analysed in this paper discusses the effectiveness of multimedia-based learning and factors related to health students' competence.

Table 4 shows that based on several journal articles, multimedia-based learning using audio-visual and education video effectively increases students' skills and ability.

Table 5 shows the effect before using learning media and after the use of multimedia-based learning media, and it suggests that there is improvement in students' learning competence after the use of the multimedia-based learning media. The respondents in those studies are healthcare students namely nursing, midwifery, and medical records students. Those studies discuss factors related to the effect of multimedia-based learning media toward health students' competence achievement. The number of respondents on average is 30 to 68 students and between the productive age of 18-20. The gender characteristics are both male and female active health students, and most of them are nursing students.

4. Discussion

The results showed that there were several factors affecting students' competence and the effectiveness of multimedia-based learning in achieving competence of health students.

Table 4: Results of Literature Review.

Authors and Published Year	Study Design, Sample, Variable, Instrument, Analysis	Result of Factor Analysis	Result in Brief
(Nurhaliza, S et al., 2021)	**Design***:* Quasi experiment pre-test and post-test design with two comparison treatments. **Sample**: 68 respondents selected simply and randomly **Variable**: Sex, age, knowledge, skills, learning effectiveness **Instrument**: questionnaire **Analysis**: Univariate and Bivariate using T-test	Facilities and infrastructure	The use of audio-visual media in learning can improve students' knowledge and skills in performing bed shift.
(Putri L dan Sazarni R D. 2021)	**Design**: Quasi experiment **Sample**: 35 participants selected using simple random sampling technique **Variable**: mastery level pre-test, mastery level post-test **Instrument**: questionnaire **Analysis**: descriptive and inferential statistics	Motivation and lack of variation in presentation while using learning media	Students' ability level in mastering and understanding learning material before the use of multimedia-based learning media is relatively low. Students' ability level in mastering and understanding learning material after the use of video is relatively high.
(Suharti et al., 2022)	**Design**: *Quasi experiment* **Sample**: 60 respondents selected using total sampling technique **Variable**: Learning outcomes, interactive media, media, and motivation **Instrument**: questionnaire and test instrument **Analysis**: Anova	Students found it difficult to understand anatomy physiology	The use of interactive media and motivation increase the learning outcomes in anatomy physiology subject among midwifery students of Poltekkes Jambi.
(Avelina Y dan Pora Y D, 2021)	**Design***: Quasi experiment* with pre-test and post-test design **Sample**: 30 5^{th} semester students **Variable**: ability, skill, effect of ability **Instrument**: observation **Analysis**: Univariate and Bivariate	Limited learning methods	Educative videos improve students' skills in performing therapeutic communication with patients with mental disorders in implementing risk strategy of violent behaviour compared to those using only role play learning without combining with educative videos.
(Sari I P dan Sundari S, 2021)	**Design**: *Quasi experiment* with *pre-test and post-test with control group* **Sample**: 60 3^{rd} semester students **Variable**: knowledge and skill **Instrument**: questionnaire **Analysis**: data normality and homogeneity test, score percentage, and correlation coefficient test	Implementation of learning method taught to students is not optimal and conventional methods are still being used.	Knowledge and skills of students who learn using video improve that their average score is higher than those who only learn using lecture method.
(Dahrizal dan Dewi G P 2019)	**Design**: *Quasi experiment* with *pre-test and post-test with control group* **Sample**: 30 respondents selected using simple random sampling technique **Variable**: age, skill in catheter insertion **Instrument**: the intervention group was given a link of video about catheter insertion on social media and was asked to watch the video with the duration of 16:33 minutes twice a day for two days in a row. On the other hand, the control group was given standard operating procedure of catheter insertion. **Analysis**: Bivariate	Lack of variation of learning media	The use of video on social media affects nursing students' skills in catheter insertion

Table 5: PICOS Last Result.

Author	(Nurhaliza, S et al., 2021)	(Putri L dan Sazarni R D. 2021)	(Suharti et al., 2022)	(Avelina Y dan Pora Y D, 2021)	(Sari I P dan Sundari S, 2021)	(Dahrizal dan Dewi G P 2019)
Population	68 respondents from Nursing Faculty of Riau University	35 respondents of 1^{st} semester students from D3 RMIK Sapta Bakti Health School	60 respondents of 2^{nd} semester Midwifery students from Poltekkes Kemenkes Jambi	30 respondents of 6^{th} semester university students	60 respondents of Nursing students	30 nursing students of Poltekkes Kemenkes Bengkulu
Intervention	Learning material delivery through the use of audio-visual learning media	Video-based learning	Learning material delivery through the use of interactive media	Provision of educative videos	Learning using videos	Provision of a link for a video of the process of catheter insertion on social media, and the students watch the video with the duration of 16:33 minutes that should be watched twice a day in two days in a row.
Outcome	Factors affecting students' knowledge and skills are learning facility and infrastructure. The use of audio-visual media highly affects students' knowledge and skills in performing bed shift.	Factors affecting students are lack of motivation to learn and lack of variation in using learning media, leading to students' lack of interest in the subject. Participants experience changing, from not knowing to knowing, from being passive to become active due to stimulus given by the lecturers using video-based learning media.	Lack of studying time leads to difficulties for students to understand the subject. Interactive media and motivation affect learning outcomes in anatomy physiology subject of midwifery students of Poltekkes Jambi	With limited and monotonous learning media, students find it difficult to understand the content of subject. The use of educative video improves nursing student' skills in performing therapeutic communi-cation with patients with mental disorders.	Factors affecting students' knowledge are lack of method imple-mentation and the use of conventional method causing students easily feeling bored. The use of video improves clinical knowledge and skills of nursing students.	Lack of variety in learning media can lower students' ability to perform catheter insertion. The use of video improves students' skills in catheter insertion

4.1. Factors Affecting Health Students' Competence

Students show lack of interest when they think the learning facilities are not convenient and not complete. In one study discussed, 54 respondents experienced difficulties in facilities and infrastructure, while 9 respondents felt that facilities and infrastructure were inadequate. Facilities and infrastructure consist of items that support learning process

namely books, media, learning materials, other supporting facilities, and classroom condition. The more complete and convenient learning facilities, the easier for students to conduct learning activities. By having complete activities, it is expected that there will be more positive changes, such as higher motivation, reduced dependence to other students. It is also hoped that complete facilities will help students accomplish more since they have everything to complete the assignments (13)

One subject that students feel difficult to understand is human anatomy. In addition, many students consider this subject one of the most complicated (14). Some difficulties faced by students are to understand position in anatomy, terms in anatomy, movement, and field movement, while most students do not have difficulties memorizing muscle parts, bones, joints, and nerves. Some, but not many, students experience difficulties especially in nerves. These circumstances are line with some studies that students' lack of ability to recall or memorize scientific terms in Latin is one of the difficulties in learning. It can be concluded that Latin can lead to learning obstacels among students (13). Also, students' lack of motivation in learning is another limitation found in learning anatomy and physiology subject. It is because students think that anatomy and physiology subject is boring that it only discusses learning materials (14)

The over-use of conventional learning methods such as lecture can lead to boredom among students in achieving learning target to develop their knowledge. Lecture as part of traditional teaching method only focuses on the lecturer in preparing education activities, and in general students are not really active. Hence, this method only is no longer suitable to develop students' clinical knowledge and skills in higher education. One advantage of this method is that it can be used to train some students in certain period of time (15). Lack of variety in using and maximizing learning media leads to students feeling bored in taking part in learning process (16).

4.2. Effectiveness of Multimedia-based Learning Media

Presenting learning materials using audio-visual-based learning makes students more interested. This method can display not only pictures or videos but also paly sounds, which can make learning process more realistic and students can easily visualize the materials taught by the lecture. For example, on average, the score for students' ability in performing bed shift before given the material is 5.00, and after receiving the material, the score increases to 15.29. It is logical to conclude that the improvement on the average score of students performing bed shift is due to the use of audio-visual media (17). Audio-visual media can help students to understand learning materials. Also, it

helps students to broaden their knowledge and experience which describe nonverbal learning to help make proper generalization. In learning anatomy physiology subject, respondents are taught to master 4 language skills: speaking, reading, writing, and listening. Based on some studies analysed in this paper, it can be concluded that the use of problem-based learning using video among medical record students of Sapta Bakti Health School went well, in general. Problem-based learning and video-based media can improve activities and learning outcomes among students. Video-based learning media can provide more realistic learning pas well as give new experience. In learning process, lecturers can avoid becoming boring as media can create conducive environment. Multimedia-based learning media possesses computerized characteristic that, if properly used as media, can improve 4 language skills (14).

A study by (18) suggests that the use of interactive media *PowerPoint* and motivation improve the result of anatomy physiology subject in students of midwifery in Poltekkes Jambi. Using media *PowerPoint* can give beneficial impacts in learning process. According to (19,20) some benefits of learning media are: learning materials are presented in more interactive, standardized, and arguably more interesting; explanation time is reduced; quality of learning improves; learning materials can be distributed anytime and anyhere when needed; students' positive attitudes toward learning process can be improved; and the roles of lectures can shift into something better. (21) suggests that interactive multimedia synergizes and combines all media such as audio, text, and graphics with interactivity. PowerPoint program is one example of the software that is specially developed to display multimedia program in interesting way, with no additional tools than data storage. PowerPoint is easy to make, easy to use, and cheap. It is also the basis for presentation of conventional learning, such as lecture, course, training, seminar, and workshop (22,23).

Researchers believe that the use of multimedia-based learning media can have strong effects toward achieving students' competence. One reason is that multimedia-based learning is more interested and relatively not boring. Multimedia-based learning allows lecturers or students to use pictures or videos and other interesting and easy-to use displays so that students are more motivated to focus and more serious on their learning process. By doing so, students will improve their skills and knowledge quicker compared to when they do not use multimedia-based learning media. Previous studies discussed in this paper show that the use of multimedia highly affects learning process in class as well as improves students' learning outcomes or competences. This should be consideration that if this method of learning is continuously employed, the maximum results can be achieved. Strong efforts to make multimedia-based learning as one method to present

learning materials for students are needed. However, sufficient trainings on how to design multimedia-based learning materials well should be provided for lecturers to maximize learning achievements.

5. Conclusion

Some contributing factors that influence students' competence, skills, ability, and learning outcomes are learning facilities and infrastructure, student's lack of motivation, lack of variety in learning media that leads to students feeling bored if they are only given assignment and explanation without real examples from videos or other sources, and learning materials that are difficult to understand by health students. Technology indeed can help to improve students' competence. One of the best uses of the technology is multimedia-based learning media namely videos, *PowerPoint*, and many others. Multimedia is proven to improve health students' knowledge and competences.

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CONFLICT OF INTEREST

There is no any conflict interests in this study.

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