Jurnal

Guru Komputer

Designing Augmented Reality-Based Learning Multimedia Using Demonstration Methods to Improve Student Cognition in Basic Computer and Network Subjects

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A B S T R A C T

Basic Computer and Network subjects are compulsory subjects for the Computer and Network Engineering expertise program for class X. There are problems found during learning activity in this subject, such as less effective learning methods, the lack of variety in multimedia used by educators, a lack of understanding and student activeness in the learning process are. The aim of this study is to demonstrate a learning method assisted by multimedia learning based on Augmented Reality to determine the cognitive enhancement of students on the anatomy of computer hardware parts. This study used the Comprehensive Life Cycle model (SHM or Siklus Hidup Menyeluruh) model with students of the X grade Computer and Network Engineering Skills Program at SMK Harapan 1 Rancaekek as the sample. The results obtained from this study are: 1) Multimedia learning has obtained a percentage value of 87.32% which is interpreted "Very Good" by media experts. 2) Multimedia learning can improve students' cognitive and obtained an average gain value of 0.65 with the effectiveness criteria "Medium". 3) Students gave good responses to the multimedia created and the assessments of multimedia made an average percentage score of 86,16% is categorized as "Strongly Agree".

A R T I C L E   I N F O

1. INTRODUCTION

The rapid advancement of technology today is unavoidable and has affected all human activities, ranging from work, business, and even daily routines. Likewise, it has also affected the development of the education system in the world, including in Indonesia. Education itself is a development process of individuals and society that needs to balance religious values, culture, thoughts, and skills to the next generation so that they are truly ready to welcome the future of the life of the nation and a brighter country (Nurkholis, 2013). Technology is an inevitable choice as a new movement in the education system to respond to the industrial era 4.0. Therefore, teachers as the frontline in the world of education must improve competence, mastery, and utilize digital technology in learning. Vocational High School is one of the secondary education levels with the specialty of preparing ready-to-work graduates (Turistiati and Ramadhan, 2019). Vocational high schools as a sub-system of national education should prioritize preparing students to be able to choose the right careers, enter the workforce, compete, and develop themselves successfully in a rapidly changing and developing world (Muttaqien, 2018).

In the academic process of vocational education, Basic Computer and Network subjects are compulsory subjects for the Computer and Network Engineering expertise program. The core competencies expected while majoring in computer and network engineering is mastering the anatomy and parts of computer hardware so that later students during practice can assemble computers. Therefore, learning basic computers and networks requires learning methods that help support cognitive enhancement and student activeness by using demonstration methods and affordable learning multimedia as well. Based on the results of interviews with teachers of Computer and Network Engineering subjects at SMK Harapan 1 Rancaekek, it is known that the learning methods used in this subject are the old methods, such as lecture methods. With these methods, some students have difficulty understanding the material, and the learning media used is limited to just PowerPoint and projector. Ideally, students need an active atmosphere that students do not feel bored and interested in the learning process, which that can be created through varied media and methods.

The demonstration method is a teaching method which is done by demonstrating tools, events, rules, and sequences of performing an activity, either directly or through the use of teaching media relevant to the subject matter or material being presented (Rohendi, Sutarno, and Ginanjar, 2010). In addition to learning methods, the teaching and learning process in the classroom requires learning multimedia as a technology to help the teaching process. The teacher must create a more interesting, creative, innovative teaching and learning process so that it will increase learning motivation for students. One such technology that can be implemented is Augmented Reality.

Augmented Reality itself is a technology that combines virtual objects both two-dimensional and three-dimensional into a real environment and then projects these virtual objects in real time (Saherltian & Helilintar, 2017). By using Augmented Reality as an alternative learning media, it is expected to make learning more interesting for students. Through this technology, considerable benefits are obtained for schools that lack computer equipment facilities. The demonstration learning method armed with an application in the form of Augmented Reality is also expected to increase learning motivation, class activeness, and student cognition.

Therefore, the researcher conducted a study of multimedia learning assisted by Augmented Reality using the demonstration method which aims to determine whether or not it will improve student cognition in the subject of basic computer and network.

2. METHODS

The research method used in this research is the multimedia development method of the Comprehensive Life Cycle model (SHM). The purpose of this research is to produce a product in the form of learning multimedia in learning Basic Computers and Networks. The multimedia development consists of five stages, namely 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Assessment. The research workflow is described with a flowchart as in **Figure 1** below.
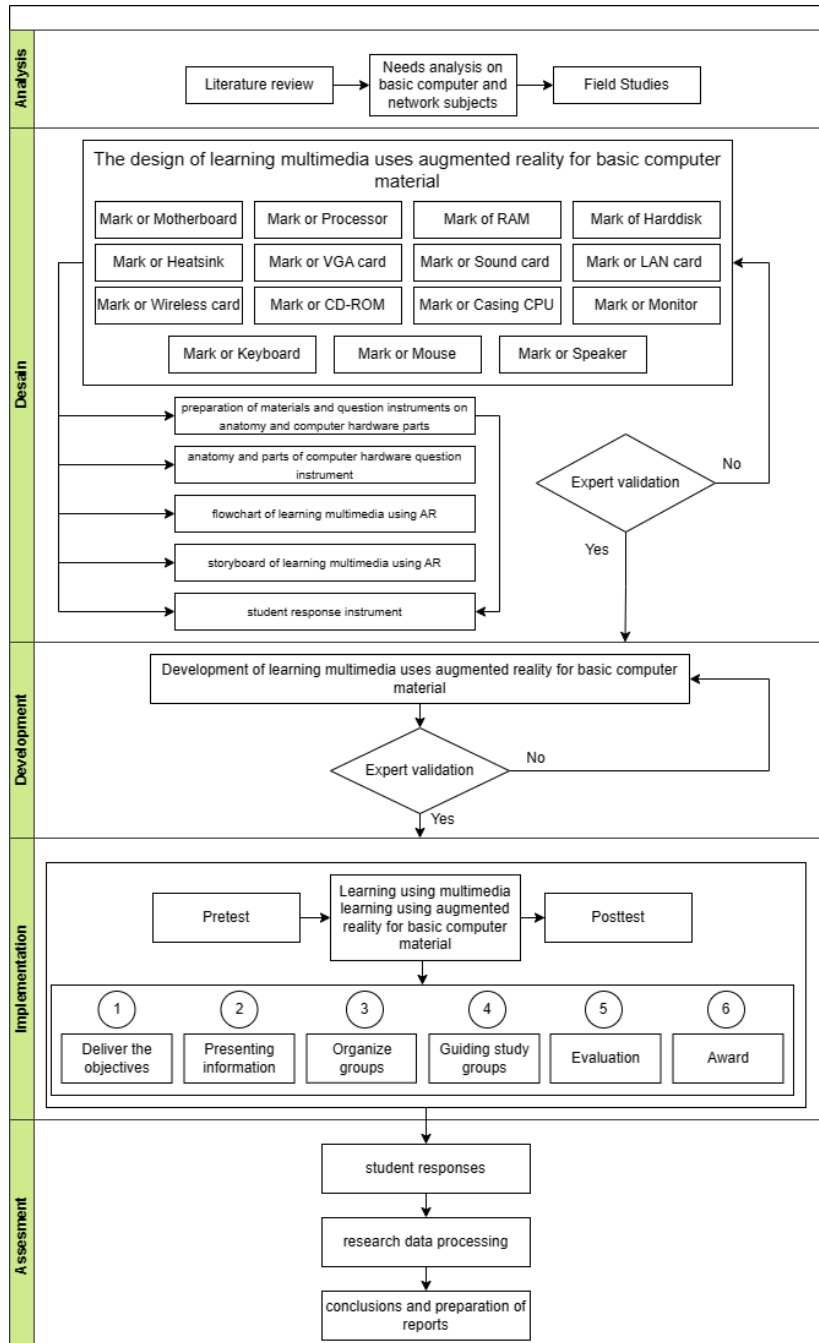

Figure 1. Flowchart of research procedure.

(i) Analysis Stage. At this stage, the researcher determines the need for software development involving learning objectives, student' needs, teachers' needs, and the

environment in accordance with the applicable curriculum from the results of field studies and literature studies.

(ii) Design Stage. At this stage, researchers compile teaching materials that will be used in multimedia that have been adjusted to the curriculum, compile question instruments that will be used in the pretest and posttest to measure the increase in understanding of the participants, then make a multimedia flowchart, and create a multimedia storyboard.

(iii) Development Stage. At this stage, researchers begin to develop the multimedia according to the flowchart and storyboard designs that have been made at the design stage. After the multimedia has been made, the next step is to obtain experts' validation which aims to obtain some input on the multimedia so that the multimedia made can be finalized for use. The development will be done in Unity to create an Android-based application.

(iv) Implementation Stage. Before the learning process is carried out, the researcher starts by giving the student a pretest. After the student is finished with the pretest, the learning process is carried out, which uses the demonstration method and multimedia that has been made. At the end, the students are asked to work on posttest questions to measure the increase in understanding when they have been given learning treatments using multimedia. At this stage, students are also asked to fill out a questionnaire of students' responses after learning using the multimedia.

(v) Assessment Stage. This stage is carried out to determine the results of the research that has been done by processing and analyzing the data obtained from the pretest and posttest to measure the increase in students' cognitive understanding after using the Augmented Reality-based learning multimedia. This stage is also done to find out the strengths and weaknesses of the multimedia developed so that improvements can be made.

2.1. Research Design

The research design that will be used in this study is a pre-Experimental design, namely One-Group Pretest-Posttest. The One-Group Pretest-Posttest design procedure can be seen in **Table 1**.

Table 1. Procedure one-group pretest-posttest.

Pretest	Treatment	Posttest
O_1	X	O_2

Description:

O_1 = Initial test score before treatment

X = Treatment or treatment in the form of the use of Augmented Reality-based learning media Reality-based learning media with demonstration method

O_2 = Final test score after given Treatment

2.2. Research Population

The population in this study were students of the Computer and Network Engineering Expertise Program of SMK Harapan 1 Rancaekek. The sampling technique used in this study was carried out by nonprobability sampling type purposive sampling, which is a sampling technique by determining certain criteria, considering that the selected sample is in accordance with the problems raised by the researcher. The sample in this study is the students of SMK Harapan 1 Rancaekek Computer and Network Engineering Expertise Program class X who are studying basic computer and network subjects with a total of 20 students.

2.3. Assessment Instrument

The instruments used in this research are Field study instruments, namely semi-structured interviews conducted with subject teachers, the question instrument for the student which is a collection of multiple-choice questions, media validation instruments that use The Learning Object Review Instrument (LORI), and student response instruments in the form of an assessment questionnaire and student responses to learning using multimedia.

2.4. Instrument Analysis

Analysis of data obtained from the results of field studies can be described directly because it is the result of interviews. The results of the question instrument data are taken from the results of testing first to students, then the question instrument will be analyzed in the form of validity, reliability, difficulty index, and question differentiation. Data analysis of expert validation instruments will be analyzed using a rating scale and student response instruments will be analyzed using Likert Scale. The level of validation of learning media in this study is classified into four categories using a scale as in **Figure 2**.
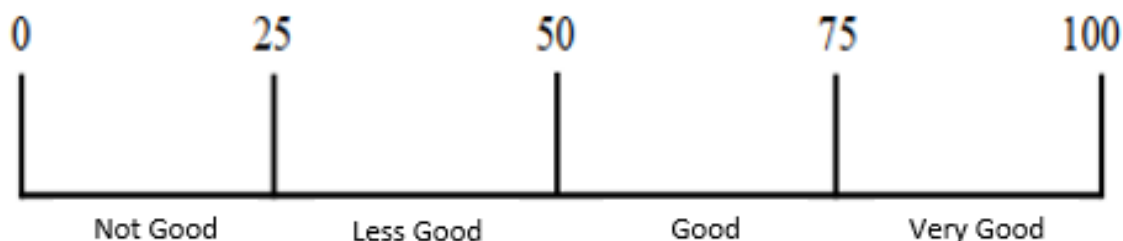

Figure 2. Expert validation category interval.

The n-gain test analysis aims to determine the improvement of students' comprehension skills. The calculation is obtained from the average results of the pretest and posttest scores. The n-gain percentage is classified into three categories, which can be seen in **Table 2**.

Table 2. N-gain classification.

Percentage	Effectiveness
$0,00 < g \leq 0.30$	Lower
$0,30 < g \leq 0.70$	Medium
$0,70 < g \leq 1.00$	High

3. RESULTS AND DISCUSSION
3.1. Needs Analysis Results

In the initial stage of designing and building Augmented Reality-based learning multimedia, researchers made an observation that included field studies and literature studies. The Field Study was carried out by the researcher by interviewing the teacher of Computer and Network Basic Computer and Network subjects at SMK Harapan 1 Rancaekek. The problems encountered according to the results of interviews with the teachers who teach these subjects are:

(i) The learning method in class uses lecture and question-and-answer methods.
(ii) Anatomy and Parts of Computer Hardware material which is the basis of learning still has a value below the average.
(iii) Student activeness in class is still lacking with only some students following the learning well.

Based on the results of the interview above, innovation is needed to make the learning process more exciting. The help of multimedia learning is expected to make the classroom atmosphere more exciting and make the students more active. Therefore, the researchers suggest creating learning multimedia using Augmented Reality with a demonstration method on the material of anatomy and parts of computer hardware.

3.2. Multimedia Interface Creation

The development of this multimedia interface refers to the storyboard and flowchart that has been designed. The following is the interface of the application:

3.2.1. Starting Page

The starting page is displayed when the student opens the application. There is only one button which is "Start" as shown in **Figure 3.** After the student clicks the start button, they will be directed to the main menu.

Figure 3. Starting page.

3.2.2. Main Menu

In the main menu (shown in **Figure 4**), there is a display of buttons, including "AR Computer Component" (AR Komponen Komputer), the "Help" button, and the "Exit" button to close the application. In addition, there is the "manual" button to help the student operate the application, a button with question mark icon as the creator profile on the left side, and a user profile button on the right side.

Figure 4. Main menu.

3.2.3. Material Page

As shown in **Figure 5**, this page contains material from each computer component that looks like a book with both pictures and text. On this page, there is also a back button to go to the main menu.

Figure 5. View material page.

3.2.4. Learning Objectives Page

As shown in **Figure 6**, this page contains information about the learning objectives in the multimedia. On this page, there is also a back button to go to the main menu.
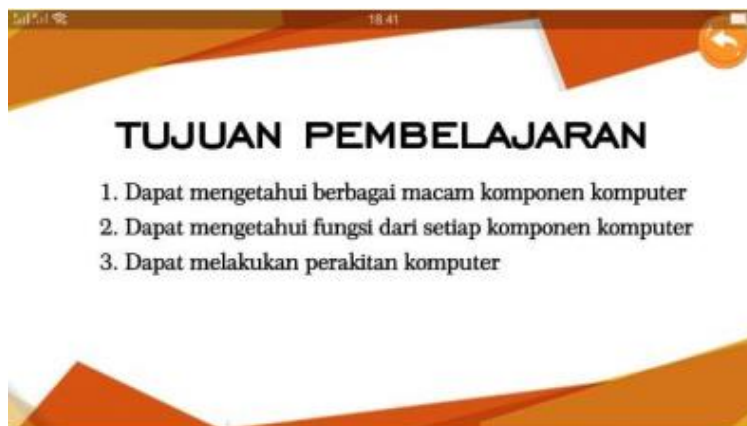

Figure 6. Learning objectives page.

3.2.5. Profile page

On this page contains information about the creator of the Augmented Reality learning application, as shown in **Figure 7**. There is also a back button to go to the main menu.

Figure 7. Profile page.

3.2.6. AR Page of Computer Components

Upon entering the "AR Computer Component" page, it will automatically open the smartphone camera which functions is to scan the marker that has been provided. If the marker is detected, a 3D model of a computer component object will appear according to the type of computer component marker, as shown in **Figure 8, Figure 9,** and **Figure 10**. There is a button to view the material and a back button to go to the main menu.

In **Figure 8**, there is an example of a marker and the 3D model which shows the motherboard part.
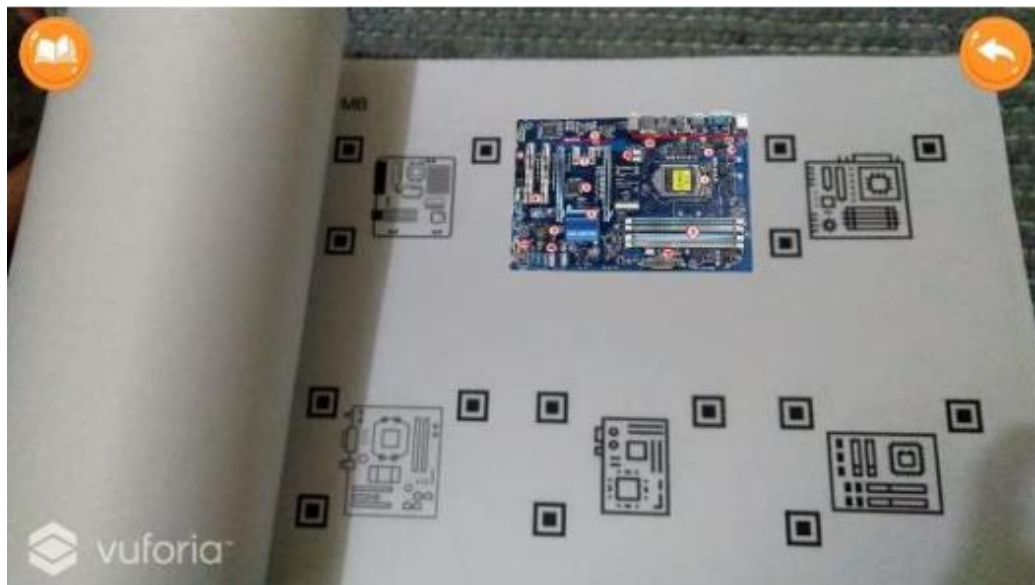

Figure 8. Marker motherboard.

In **Figure 9**, there is an example of a marker and the 3d model which shows the processor part.
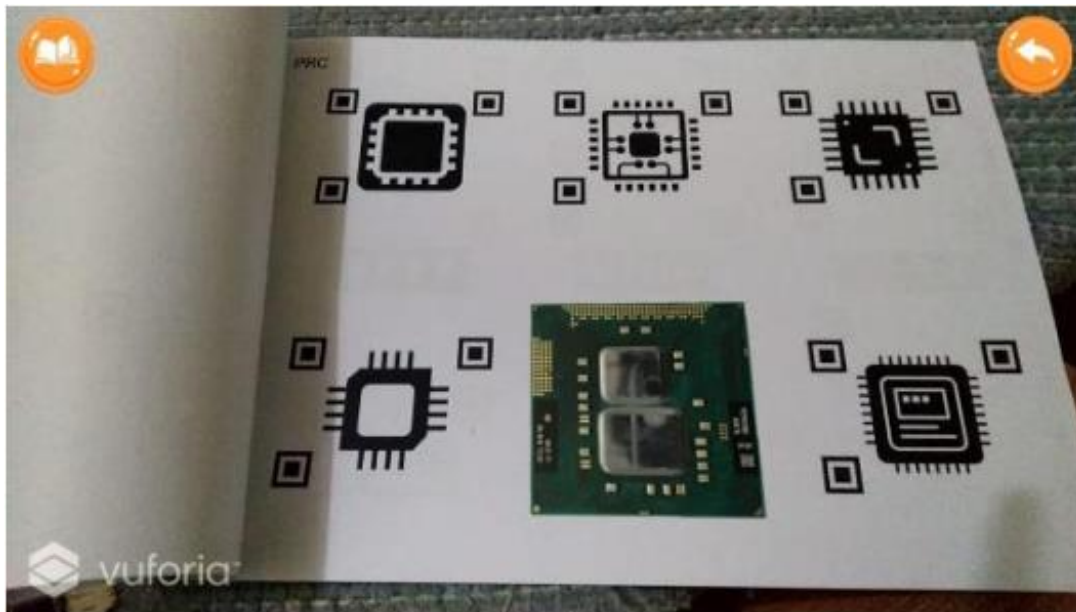

Figure 9. Marker processor.

In **Figure 10**, there is an example of a marker and the 3d model which shows the RAM part.

Figure 10. Marker RAM.

3.2.7. Help Page

On this page, there is information on how to use multimedia, and there is a download button that is given a down arrow symbol whose function is to download the computer component marker module. There is a back button to go to the main page. In **Figure 11,** there is the cover page of the help page**.**

Figure 11. Help page

In **Figure 12,** there is the instruction in a form of text and image on how download the marker or use the marker.

Figure 12. Module download help page.

3.2.8. Multimedia Exit Popup Page

This page contains "Yes" and "No" buttons to confirm the user if they want to exit the multimedia, as shown in **Figure 13**. If yes, the multimedia will exit, and if no, it will return to the main menu page. will return to the main menu page.

Figure 13. Pop up confirmation.

3.3. Media Validation Test Results

This media validation test was validated by media experts, namely lecturers. This stage must be done so that there are no errors in the multimedia and all functions and components run well. This media validation test uses the LORI approach. The value obtained from the validation results by media experts is 87.32%, so this learning multimedia can be categorized as "Very good" based on the validation results interval. The results of multimedia testing by media experts are described in Table 3 below.

Table 3. Media expert validation results.

No	Aspect	Maximum score	Score acquisition	Percentage (%)
1	Presentation design	5	5	100.00
2	Interaction usability	15	13	86.66
3	Accessibility	10	9	90.00
4	Reusability	5	4	80.00
5	Standards Compliance	5	4	80.00
	Average			87.32

3.4. Material Validation Test Results

After the results of the multimedia validation above, validation was carried out by material experts, namely lecturers of Computer Science Education. Computer Science Education lecturer. The brief results of the validation are as follows 93.75%, so that the material in this learning multimedia can be categorized as "Very Good". The material in this learning multimedia can be categorized as "Very Good". The results of material testing by material experts are described in **Table 4** below.

Table 4. Material expert validation result

No	Aspect	Maximum score	Score acquisition	Percentage (%)
1	Content quality	20	20	100.00
2	Learning goal alignment	20	19	95.00
3	Feedback and adaption	5	4	80.00
4	Motivation	5	5	100.00

Average	93.75

3.5. Results of Improving Cognitive Understanding

After the experiment, a significant increase was obtained. This is known from the increase in pretest and posttest scores. Before students do the posttest, students are given pretest questions to find out their initial understanding before using multimedia. After that, researchers conducted learning using the demonstration method and multimedia-based learning Augmented Reality in the learning process, after which students were given posttest questions. The results of the increase in student scores can be seen in **Figure 14**.
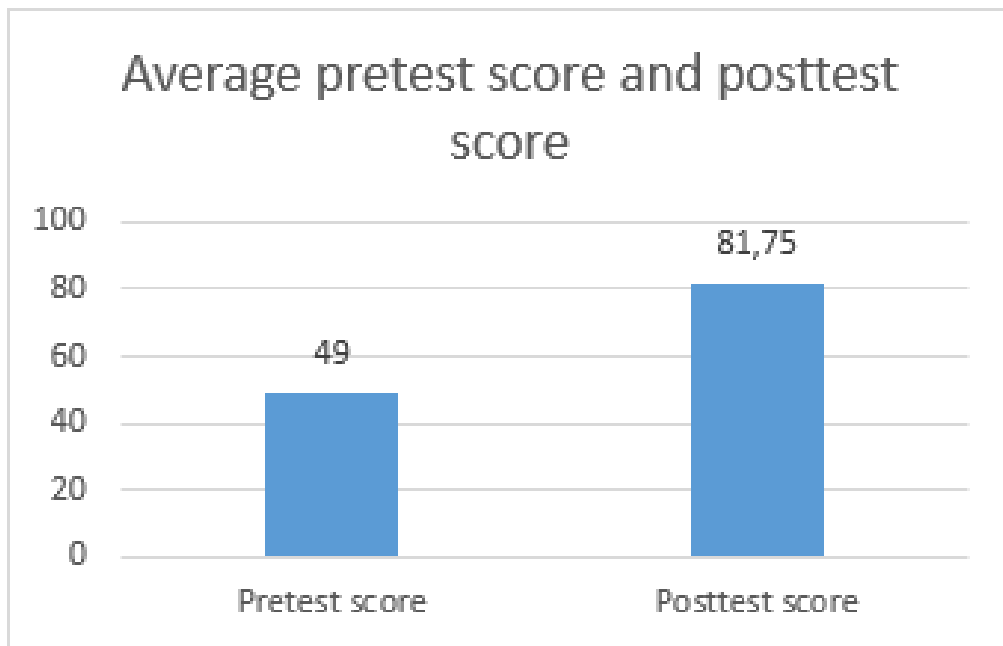

Figure 14. Average pretest and posttest score

Based on **Figure 14**, the average pretest and posttest scores have increased. From this comparison, a difference of 32.75 was obtained. To determine the increase in students' cognitive understanding of learning by using the demonstration method and Augmented Reality-based multimedia, the n-gain test was analyzed. The results of the n-gain analysis can be seen in **Table 5**.

Table 5. N-gain analysis result

x̄ pretest	x̄ posttest	x̄ n-gain	Effectiveness
49	81,75	0,65	Medium

Based on the table, the average n-gain obtained is 0.65 which if interpreted in the learning effectiveness criteria is "Medium".

3.6. Assessment Results and Student Feedback

The responses given by students to Augmented Reality-based learning multimedia are very agreeable; students are enthusiastic about using learning multimedia. This can be evidenced by the results of the student response instrument regarding learning using Augmented Reality-based multimedia with an average value of 86.16% with the category "Strongly Agree". with the category "Strongly Agree". The following are the results of the analysis on

the 3 main aspects, namely: Software Aspects Software Aspects of 86.25%, Learning Aspects of 87.25%, and Visual Communication Aspects of 85%.

4. CONCLUSION

Augmented Reality-based learning multimedia is designed and developed through several stages adapting from the Comprehensive Life Cycle (SHM) development model. The multimedia has been tested for feasibility and received an average score of 85.75%, and an average score for the teaching material of 93.75%, which can be categorized as "Very Good" and suitable for use. Students' motivation, activeness, and cognitive skills improved after the implementation of Augmented-reality multimedia to the Basic Computers and Networks subject, especially on anatomy and computer hardware. This is proven by the average gain value of 0.65 which is interpreted into the level of 0.65, which means it had achieved the level of effectiveness of "Moderate". Student responses to learning using multimedia-based learning Augmented Reality-based learning multimedia is quite good with an average score of 86.16% and included in the "Very Good" category.

Based on the results of the research that has been carried out, there are several suggestions that can be used as material for improvement for further research. The suggestions in question are as follows:

(i) Augmented Reality-based learning multimedia should be implemented in the teaching and learning process because it can support academic activities inside and outside the school environment

(ii) Learning multimedia must be updated in accordance with technological developments and existing learning materials.

(iii) Develop more interactive Augmented Reality-based learning multimedia in addition of video and audio to increase student' engagement in class

(iv) If the students do not have smartphones, they can work with other students to use Augmented Reality-based learning multimedia through smartphones.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

6. REFERENCES

Muttaqien, D. S. (2018). Peran SMK kelautan dalam mengembangkan potensi kelautan di pesisir Gunungkidul. *Spektrum Analisis Kebijakan Pendidikan*, *7*(5), 549-559.

Nurkholis, N. (2013). Pendidikan dalam upaya memajukan teknologi. *Jurnal kependidikan*, *1*(1), 24-44.

Rohendi, D., Sutarno, H., and Ginanjar, M. A. (2010). Efektivitas metode pembelajaran demonstrasi terhadap peningkatan hasil belajar siswa kelas X pada mata pelajaran keterampilan komputer dan pengelolaan informasi di sekolah menengah kejuruan. *Jurnal Pendidikan Teknologi Informasi dan Komunikasi*, *3*(1), 16–18.

Sahertian, J., and Helilintar, R. (2017). Pengembangan aplikasi mobile augmented reality sebagai media pembelajaran biologi materi sel. *Jurnal Sains Dan Informatika*, *3*(1), 49-53.

Turistiati, A. T., and Ramadhan, H. F. A. (2019). Pelatihan soft skills dan pendampingan siswa-siswi SMK di kota Bogor untuk persiapan memasuki dunia kerja. *Jurnal Komunitas: Jurnal Pengabdian Kepada Masyarakat*, *1*(2), 1-8.