



ANALYSIS OF THE NEEDS OF COGNITIVE CONFLICT-BASED TEACHING MATERIALS INTEGRATED WITH AUGMENTED REALITY ON LIGHT WAVE

Luth Fiyah Atiqah¹, Fatni Mufit^{1*}

¹Department of Physics, Universitas Negeri Padang, Jl. Prof. Dr. Hamka Air Tawar Padang 25131, Indonesia

Corresponding author. Email:fatnimufit@fmipa.unp.ac.id

ABSTRACT

21st century learning demands student centered learning and requires integration of technology in learning including augmented reality (AR) technology. This study aims to determine the needs of teachers and students for cognitive conflict-based teaching materials that are integrated with augmented reality (AR) so as to increase student understanding and reduce misconceptions that occur in light wave material. This type of research is preliminary research. The instrument used was a questionnaire regarding the needs of learning devices and the implementation of physics learning as well as journal analysis of students' conceptual understanding of the material of light waves. This test was conducted at several schools in the city of Padang with a total of 130 students and 3 teachers. The results of the study stated that learning was still centered on the teacher and there was no learning model to overcome misconceptions and there was no teaching material integrated with augmented reality (AR). The results of the journal analysis concluded that students' understanding of the concept of light waves was still low. Therefore, it is necessary to develop cognitive conflict-based teaching materials integrated with augmented reality (AR) on light waves in accordance with 21st century learning.

Keywords: *Augmented Reality, Cognitive conflict, Misconceptions, Conceptual understanding.*



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I. INTRODUCTION

The growth of technology and information is currently increasing rapidly, causing many changes, one of which is in the world of education, including educational procedures, learning methods, learning media and learning processes. The embodiment of the growth of this information system can bring major changes to the world, including in the world of education, starting from changes in curriculum, media and technology. So, life in this century requires mastering various skills including technological skills in education. Currently, teachers must use technology that can facilitate and motivate students to increase students' knowledge, especially in learning physics.

Changes that occur in it. Physics learning plays a role in developing Science and Technology (IPTEK). In learning physics, students' interaction with nature or the environment is very necessary so that knowledge can be constructed rather than knowledge that was previously formulated by physicists. Therefore, in learning physics students must be active in looking for concepts and how physics concepts, not only getting and listening to explanations of the material being taught by the teacher.

Among the goals for studying physics is to provide an explanation of physics concepts and related concepts so that students can implement them in everyday life [1]. To realize the goals of learning physics in the 21st

century, teachers are required to master technology skills. This is because students are currently familiar with technology, for example smartphones, so students are only interested in smartphones. To make students increase their interest in learning physics, teachers are asked to make teaching materials or material interesting and adaptable to today's times so that students can improve and be motivated in learning physics.

Physics learning can occur with the interaction between a teacher and a student in the process using learning resources in the learning environment. In studying physics, there are several characteristics, namely that physics has conditional properties of matter. That is, each new concept often requires understanding the previous concept as a prerequisite. If not, effective physics learning must be able to help students overcome misunderstandings or misconceptions, or incomplete understanding, misunderstandings must be replaced with correct and appropriate concepts. Because by learning physics using terms are often similar to the language used in everyday life but with different meanings.

However, in reality the mastery of the concepts of physics lessons is still low and not as expected and misconceptions often occur. Misconceptions are misunderstandings of concepts that may occur during new teaching being taught that contradicts some scientific concepts that have been developed [2]. Misconceptions can occur due to several things, including the students themselves, teacher errors, errors from the textbooks used, context errors and method errors applied by the teachers in the learning process [3]. Misconceptions that occur can come from oneself, the way the teacher teaches at school, the teaching materials and the media used by the teacher in teaching. Misconceptions that occur in students need to be understood and known by the teacher so that they can help in correcting 3 student misconceptions effectively [4]. However, few teachers pay attention to and resolve student misconceptions [5]. Misconceptions can occur in the physics learning process including the material of light waves.

One solution to the problem above is to create learning tools such as open materials. The existence of teaching materials in every lesson is very important to create learning that is centered on student activities. The more students are involved with teaching materials, the more their knowledge, attitudes and skills will develop [6]. Teaching materials are useful as the main source of learning, communication tools and providing information. commonly used in education [7]. If interesting teaching materials are used, attention, feelings, thoughts, imagination and motivation to learn will be used. For this reason, teachers can realize student-centered learning activities through teaching materials that integrate Augmented Reality (AR) technology [8].

Teaching materials with technological innovation will create a new atmosphere and special attraction for students. One technology that can be integrated into teaching materials is augmented reality (AR). Augmented reality is the combination of the real world with the virtual world at the same time [9]. Augmented reality can be implemented widely in various media, as an application on a smartphone, in a product package, even in printed media such as books, magazines or newspapers [10]. It is hoped that with the presence of Augmented Reality (AR), teaching materials will be more varied and interesting, the presentation of teaching materials that only present text, apart from causing boredom, will also make students less able to imagine and tend to forget quickly because they will usually remember something better if they see and hear it rather than just reading it [11].

The teaching materials we want to develop also address learning problems by creating cognitive conflict-based teaching materials. Cognitive conflict-based teaching materials have four syntax (1) Preconceptions and activation of misconceptions, (2) Presentation of cognitive conflicts, (3) Discovery of concepts and similarities, (4) Reflection [12]. Making teaching materials based on cognitive conflict will make it easier for students to determine a concept, be critical in thinking, be more creative, have communication skills, and unite to unite their thoughts. If we look at the advantages of the cognitive conflict-based learning model, it is superior in its ability to remediate misconceptions and is able to provide appropriate teaching to students [13]. This research aims to create cognitive conflict-based teaching materials to increase students' conceptual understanding of integrated light waves in augmented reality (AR).

From the background that has been described, the research objectives are: 1) knowing the teaching materials needed by schools, 2) knowing the learning media needed by schools, and 3) knowing students' insight and understanding of students' concepts regarding the material of light waves.

II. METHOD

This research was conducted as an early stage in the development of the Plomp model. In Plomp stated that in development studies there are several studies in it such as survey studies, case studies, experiments, and so on [14]. This advance study was done to find out the problems of school learning and understanding concepts, especially light waves. The instruments used in this study were two of the teacher's questionnaire and the student's questionnaire.

In the early stages, the researcher collected information about teaching materials used in schools and analyzed journals using a needs analysis instrument from dissemination to teachers and students. Needs analysis instrument by distributing questionnaires to teachers and students at senior high school A Padang and senior high school B Padang. Data analysis was obtained qualitatively and quantitatively to determine students' needs for instructional media in order to improve conceptual understanding of the light wave material. An analysis of learning device needs was carried out on 65 students at senior high school A Padang and 65 students at senior high school B Padang as well as 2 teachers from senior high school A Padang and 1 teacher from senior high school B Padang. The journals analyzed consisted of 3 published conceptual understanding journals on light waves.

The questionnaire addressed to teachers consisted of 47 questions on light waves. The questionnaire has 4 values to choose from where 4: very agree; 3: Agree; 2: disagree; and 1: strongly disagree. The questionnaire indicators used in the analysis of the implementation of teacher learning are as follows: (1) Use of the Independent Curriculum in Schools, (2) Use of Learning Models on Light Waves, (3) Identification of Students' Conceptual Understanding on Light Waves Material, (4) Use of Materials and Media on Light Wave Material, and (5) Use of Augmented Reality (AR) Technology on Light Wave Material.

The questionnaire addressed to students consisted of 40 questions on the light wave material, there were 4 value categories where 4: very agree; 3: Agree; 2: disagree; and 1: strongly disagree. The questionnaire indicators used in the analysis of the implementation of learning aimed at students are as follows: (1) Understanding of Light Wave Material, (2) Use of Learning Models, (3) Use of Materials and Media in Light Wave Material, and (4) Use of Augmented Reality Technology (AR) On Light Wave Matter. Journal analysis selected 3 journals of understanding the concept of light wave material that had been published.

The results of the percentage analysis of the teacher's questionnaire on the application of learning physics and the analysis of the student's questionnaire on the needs of physics learning devices used the following equation.

$$percentage = \frac{\text{score obtained}}{(\text{maximum score} \times \text{number of students})} \times 100\%$$

This equation uses a percentage technique with the score obtained being the score produced and the maximum score being the number of questionnaires produced.

III. RESULTS AND DISCUSSION

Results

The results of distributing the teacher's questionnaire show that there are almost the same problems as can be seen in table 1. In general, in schools in the implementation of learning at this time it is still the teacher who is the center of information. the teachers still apply the lecture system, that is, they only listen to the teacher speak and do not involve their students in exchanging ideas or discussing the lessons learned.

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Table 1. Results of distributing questionnaires to 2 teachers from different schools

NO	Indicator	Results (%)
1	The need for teachers to use the Independent Curriculum in Schools	76,8
2	The teacher's need to use the Learning Model on Light Waves Material	75
3	The need for identification of students' conceptual understanding of light wave material	73,9
4	Teacher needs to use printed teaching materials and learning media on light wave material	80,6
5	The need for the use of Augmented Reality (AR) Technology in Light Wave Material	75

The results of distributing student questionnaires show that the problems are also almost the same in different schools. In general, students still have difficulties in the learning process on light wave material, there is a lot of ignorance due to the fact that there are not yet available books to understand light wave material, and students need a stimulus presentation in the form of 3D visuals in the learning process. This can be seen in table 2.

Table 2. The results of the questionnaire for analyzing the needs of learning tools for students in different schools

NO	Indicator	Results (%)
1	Students' Difficulties in understanding Alternative Energy Materials	80,4
2	Students need to understand the material using a learning model on light waves material	85,48
3	Student needs to use printed teaching materials on alternative energy materials	78,93
4	Student Needs to use Augmented Reality (AR) Technology Learning Media on Alternative Energy Materials	80,98

The Likert scale is used as a measuring tool for how the attitudes and thoughts of a person or group regarding a phenomenon that occurs in society where the measuring instrument has answers, both very, very positive and vice versa [15]. Likert scale variables are things that will be measured and then translated into variable indicators. which later these indicators will be used and are the starting point for unifying and compiling instrument items that produce either a question or a statement. The following is the scale used in this study: 1. Disagree; 2. Disagree; 3. Agree; and 4. Strongly Agree. With a range of results: 1. Strongly Agree = 100-76; Agree = 75-51; 3. Disagree = 50-26; and Strongly Disagree = 0-25.

From the analysis of journals, three journals were found related to understanding the concept of light waves. it turns out that the results of the analysis stated that students had misconceptions about light waves. So, if you want to see the results of the analysis, you can see in table 3.

Table 3. Results of Journal Analysis of Students' Concept Understanding of Light Wave Material

No	Journal	Understand concept (%)	Misconception (%)	Don't Understand the Concept (%)
1	Journal 1 [16]	13,20	35,60	51,20

2	Journal 2 [17]	30	48	22
3	Journal 3 [18]	22	38	40
	Average	21,73	40,53	37,73

Discussion

After distributing and filling out questionnaires by teachers and students regarding the implementation of physics learning aimed at teachers and the need for learning tools aimed at students as well as journal analysis a student's knowledge of the concept of light waves. The need to use the independent curriculum in schools has been fulfilled 76.8%. Teachers at senior high school A Padang and senior high school B Padang are of the opinion that this independent curriculum is suitable to be implemented in schools because it is quite effective in being used and the independent curriculum is quite different from the previous curriculum so special training is needed on the independent curriculum.

The independent curriculum is very different from the previous curriculum, teachers also feel that there are many obstacles experienced when implementing it and the need for special training in implementing the independent curriculum in schools. Students' difficulty in understanding topics in senior high school A Padang city and senior high school B Padang city was 80.4%. This is because teaching materials are inadequate and learning is still teacher-centered. Difficulties experienced by students in the learning process can be overcome by implementing a special application model. A learning model is a form of learning that is described from start to finish and presented specifically by the teacher [19]. One of the characteristics of a learning model is the existence of a learning syntax [12]. The syntax of the learning model functions as a guide to achieving the learning objectives to be achieved during the learning process. In fact, teachers at senior high school A in the city of Padang and senior high school B in the city of Padang have implemented the learning model by 75% according to the learning module. However, teachers have not implemented a special learning model to overcome misconceptions about light material. The cognitive conflict-based learning model is very suitable to use because it is superior in its ability to remediate misconceptions and is able to provide appropriate teaching to students [13].

In identifying students' conceptual understanding of light wave material at senior high school A Padang city and senior high school B Padang city, 73.9% has not been implemented so it needs special attention. Teachers have not fully identified students' misconceptions about light waves. The fact can be seen from the need for teachers to use teaching materials and learning media using light waves which can identify misconceptions of 80.6% and the needs of students at senior high school A in Padang City and senior high school B in Padang City at 78.93%. According to students, teaching materials and media are very necessary in learning. However, the available teaching materials and media are not sufficient and are not enough to understand the material of light waves. It is necessary to present 3D stimuli in studying light waves with pictures, 3D animations or videos to improve memory of the information studied.

The need for teachers to use technology-integrated teaching materials such as augmented reality is 75% and the need for students to use printed teaching materials integrated with augmented reality is 80.98% in senior high school A Padang city and senior high school B Padang city. This is in line with the article developing IT-based teaching materials that have been managed by existing researchers, namely cognitive conflict-based teaching materials that integrate video analysis of real experiments so that they can get support when learning is done online and get support in understanding concepts such as movement material [20]. This is in line with the article entitled Preliminary Research on the Development of Physics Teaching Materials that integrate New Literacy and Disaster Literacy which states that in the 21st century there is a need to continuously improve teaching materials [21]. Therefore, the development of IT-based teaching materials based on cognitive conflict is very necessary in the physics learning process which can provide students with a strong understanding of concepts and can also overcome misconceptions.

The solution by developing IT-based teaching materials has been managed by existing researchers, namely cognitive conflict-based ebooks that integrate real experimental video analysis so that they can get support when

learning is carried out online and get support in understanding concepts such as motion material. This is in line with the article entitled Preliminary Research for the Development of Physics Teaching Materials that integrates New Literacy and Disaster Literacy which states that in the 21st century there is a need for continuous improvement in teaching materials. Therefore, the development of IT-based teaching materials based on cognitive conflict is very much needed in the physics learning process which can provide a strong understanding of students' concepts and can also overcome misconceptions.

Based on the literature review, students' understanding of concepts is still quite low, which often gives rise to misconceptions among students. Journal analysis data shows that students' knowledge about light waves is low. The data in Table 3 shows that students' misconceptions and conceptual understanding are higher compared to conceptual understanding in light wave material. From the average obtained, the percentage of misconceptions is higher than understanding the concept and not understanding the concept is higher than understanding the concept. A similar problem was found in another article. The solution given to the problem of low conceptual understanding of wave material is to try to transform it into development using cellular telephones [22]. This interactive multimedia was processed and created using the latest Adobe Animate CC 2019 which contains the latest features and can be used offline, which can help provide a more detailed understanding of students' concepts and interests in mechanical wave material. The solution given in the article entitled design and validity of cognitive conflict-based teaching materials that integrate virtual laboratories to increase understanding of wave concepts is to create cognitive conflict-based teaching materials that integrate virtual laboratories so that they can increase students' understanding of physics concepts. One solution to overcome misconceptions is to use a cognitive conflict-based learning model. The Cognitive Conflict Model is a learning model that plays a role in increasing students' misconceptions about science concepts by presenting conflicts in students' minds as misconceptions [23]. This is also in line with the article about the conditions of physics learning and students' conceptual understanding of the concept of motion during the Covid-19 pandemic which states that the low understanding of students' concepts is due to the lack of discussion and experimental activities that actively involve students, as well as the unavailability of IT-based teaching materials. supporting student learning activities in online learning [20]. So, the use of teaching materials that integrate Augmented Reality (AR) technology becomes a driver of student-centered learning. The use of integrated AR teaching materials can provide conceptual understanding, increase interest in learning and motivate students in the learning process. The use of integrated AR teaching materials can also be used as a guide for teachers and students to overcome misconceptions in the learning process regarding light waves.

IV. CONCLUSION

Looking at the results of data analysis it is known that the application of an independent curriculum at senior high school A Padang and senior high school B Padang is suitable and effective for current use. Teaching materials in the independent curriculum are still limited issued by Ministry of Education, Culture, Research and Technology. The teacher has not specifically identified students' misconceptions about light waves. from the results of the analysis that the level of understanding of the journal is still low low and students still have many misconceptions about light waves. In addition, the role of technology in the 21st century is needed to improve students' understanding of concepts, but the media that teachers often use is only in the form of power point text (PPT) and phet simulations to conduct experiments, so that new innovations are integrated with technology such as Augmented Reality (AR) to deepen students' knowledge and understanding of concepts and reading interest. Students were very enthusiastic and agreed that it turned out that cognitive conflict-based teaching materials on light material were integrated with technology. Therefore, with this preliminary research, it is needed for the development of cognitive conflict-based teaching materials that are integrated with Augmented Reality on light waves for senior high school students.

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