



Analysis of the Needs of Cognitive Conflict-Based Teaching Materials Integrated with Augmented Reality on Heat

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ABSTRACT

In the 21st century, the increasing development of technology and informatics has brought significant changes in the world of education. The independent curriculum is a response to the demands of education in the era of evolving technology. The main goal is to deepen concept understanding and strengthen student skills. Concept understanding is one of the basic competencies in the independent curriculum that students must have. But in fact, based on research of preliminary, it was got that the problem of concepts understanding from students was still low and tended to occur misconceptions, the use of cognitive conflict learning could contribute to improving understanding of concepts in the independent curriculum. The research purposes was to analyze the characteristics, validity, and practicality of teaching materials based on cognitive conflict.

This research type is preliminary research. Three Padang City High School teachers were given a questionnaire to complete in order to assess how physics is being taught in classrooms. Subsequently, the survey was distributed to 130 students in class XI across two distinct high schools in Padang City, with the objective of examining the requirements for physics educational resources in the classroom. Journal analysis was done in addition to the questionnaire to examine high school students' conceptual grasp of heat topic. Both quantitative and qualitative analyses were done on the data. Misconceptions about hot content and low concept understanding among students are the outcome of an analysis of multiple published papers. Furthermore, there are still few teaching resources available, less technology-integrated learning media, and a teacher-centered approach to education. Consequently, based on the findings of preliminary research, physics instructional materials integrating augmented reality technology and cognitive conflict must be developed.

Keywords: *Augmented Reality, Cognitive Conflict, Misconception*



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I. INTRODUCTION

In the 21st century the progress of technological development and informatics is increasing, this has covered all areas of human Life, especially the educational sector, forces mankind to keep up with the rate of technological advancement; in the twenty-first century, technology is now the primary addition to every activity in learning. In addition, the changes that occur in the world community towards digitalization force the learning process in schools to follow technological developments . This is in accordance with Permendikbut No. 22 of 2016 in relation to elementary and secondary education process standards. One of them is the application of information and communication technologies to raise learning's efficacy and efficiency. Education is one of the important foundations in the progress of a nation in order to form human resources quality so that they are able to keep up with the times that are increasingly advanced [1].

The Indonesian government is trying to pay special attention to the education sector, this is evidenced by the policy of the Minister of Education and Culture to implement a new curriculum, known as the independent curriculum. The Independent Curriculum's implementation encourages autonomous learning and the use of technology in the classroom while giving schools, instructors, and students the freedom to design and implement their own curricula [2]. The process of learning in Merdeka Curriculum aims to enable students to explore concepts and strengthen competencies [3]. The two main elements of science outlined in the Merdeka Curriculum are science as a product and process. The product is an understanding of the material while the process is a way of doing scientific activities [4]

Physics is the most essential natural science because it can provide a fundamental conceptual and theoretical basis for the further development of technology and other disciplines [5]. In essence, physics learning does not only contain theories or formulas that must be memorized but also concepts that must be understood deeply. The concept understanding is a very crucial element in physics [6].

The concept understanding in physics is defined as the ability of students to understand physics learning material, where students not only know but are able to remember and convey it back in a simpler and easier to understand form and are able to provide data interpretation and apply concepts in accordance with their cognitive structure [7]. The students success in physics learning is revealed by their ability to understand the concepts, laws and theories contained in physics learning [8]. Low understanding of student concepts causes students to not develop in learning and has an impact on student study, namely the occurrence of misconceptions in learning physics. Concept understanding according to Mufit (2018) is divided into 3, namely understanding the concept, misconceptions and not understanding the concept [9]. Misconception is the science concepts used that are not in related with the concepts stated by experts or scientists who have been scientifically accepted [10]. Misconceptions can occur in physics learning including in heat material.

Heat material is one part of the learning outcomes of physics phase F SMA / MA which there are several subjects in it such as temperature, thermometer, heat, expansion, shape change, specific heat and heat transfer. The heat material is also the basic material for students to learn thermodynamics. This material was also studied previously at the junior high school level so that students already have concepts about temperature and heat [11]. Heat is one of the materials that has a difficult concept that raises confusion in students in understanding the concept of heat. Because of this confusion, it sometimes makes students prefer to use their own initial knowledge and views rather than using scientific concepts according to experts [12]. In studying temperature and heat material, it requires the right methods and learning resources in building student knowledge in a structured and systematic manner to increase concept understanding of students. One way to fix problem misconceptions and improve concept understanding of students' is by using learning tools such as teaching materials [13].

The materials for teaching have a very crucial role in the learning process. A teacher needs to develop teaching materials, the reasons include: the accessibility of resources in accordance with curricular requirements, target characteristics, and requirements for resolving issues with learning [14]. In learning, teaching materials or media are needed which strive to purpose students in comprehending the course material. Independent curriculum materials for teaching Considering that learning is student-centered and

concentrates on literacy and numeracy competencies, have a significant influence. This can be supported by the development of technology-integrated teaching materials. The advantage of technology-integrated teaching materials is that they make students more interested and can identify student work, because students can interact with images, sounds, even videos and something instant. The materials for teaching should be able to assist students in order to enhance their conceptual grasp, one of which is in heat material. One solution that can fix the low concept understanding of students is to design technology-integrated materials for teaching using a cognitive conflict-based model of learning.

The learning model is organized using the syntax of the cognitive conflict-based learning paradigm in related with to Mufit (2018) there are 4 syntaxes including: (1) preconceptions and misconceptions activation, (2) cognitive conflict presentation, (3) concepts and equations discovery, (4) reflection. This model of cognitive conflict-based learning is an alternative learning model that can remediate student misconceptions, improve concept understanding, and increase students' positive views on Physics lessons and can increase student learning motivation.[9]. Cognitive conflict-based teaching materials will be more interesting and can motivate students more if they can utilize the use of technology in making these teaching materials. One of the technological innovations that have been developed in education is *augmented reality*.

Augmented reality is the incorporation of objects that exist in the virtual world (virtual) into the real world in two-dimensional or three-dimensional form that can be touched, or seen, and can also be heard.[15]. The use of *augmented reality* technology. It is possible to merge the domains of education and entertainment to develop new approaches that enhance teaching and learning in both formal and casual settings [16]. *Augmented reality* can mitigate the weaknesses of materials for teaching in the form of books and *e-learning*, so that the application of AR in materials for teaching is expected to attract students' interest in learning and improve students' understanding of concepts. *Augmented reality* has great potential in attracting, inspiring, and encouraging students to find and take hold of alternative viewpoints that they had not before encountered in the field of education [17]. *Augmented reality* has fulfilled the requirements of the curriculum, with the presence of *augmented reality* that applies graphics, video or text and audio in textbooks in *real time* becoming a possible right [18].

Based on the explain that has been described, it can be concluded that the objectives of the study are 1. Knowing the teaching materials needed by schools, 2. Knowing the learning media needed by schools, and 3. Knowing students' concept understanding of heat material.

II. METHOD

The type of preliminary research is observation research and journal analysis which is the initial stage of development research. In this research, the Plomp model (2013) was used which consists of 3 stages, namely the *preliminary research* stage, known as the needs analysis and literature study, the development research stage (*prototyping research*), namely designing the product and revising the prototype, and the *assessment phase*, which is the test and evaluation stage in practice [19]. In the early phase of the research, the needs analysis stage was conducted by distributing questionnaires to teachers and students in two different schools. The data was analyzed qualitatively and quantitatively. This stage of the research

purposes to reveal the needs of students for learning media in the form of materials for teaching in order to improve students' understanding of concepts in heat material. This needs analysis was conducted by distributing questionnaires to 2 SMA A teachers and 1 SMA B teacher in Padang, distributing this questionnaire to 64 SMA A students and 60 SMA B students. The journals analyzed consisted of 3 journals on understanding the concept of heat material that had been published.

The needs analysis stage uses an instrument in the shape of a learning implementation analysis questionnaire consisting of 40 questions about heat material with 4 assessments, namely: 4: strongly agree; 3: agree; 2: disagree; and 1: strongly disagree. The components of the learning device needs analysis questionnaire addressed to students are as follows: (1) Students' difficulties in understanding heat material, (2) Students' needs to use printed teaching materials on heat material, and (3) Students' needs in using Augmented Reality (AR) technology learning media on heat material.

The questionnaire for analyzing the needs of learning devices on heat material for educators consists of 4 assessment indicators with 46 questions. This educator questionnaire consists of 4 assessment options, namely: 4: strongly agree; 3: agree; 2: disagree; and 1: strongly disagree. The needs analysis questionnaire for physics learning tools on heat material for educators consists of 5 indicators, namely: (1) the need for teachers to use learning models on heat material (2) The use of an independent curriculum in schools, (3) The need for teachers to use teaching materials and media on heat material, (4) the need for teachers to identify students' concept understanding on heat material and (5) The need to use Augmented Reality (AR) technology on heat material. Journal analysis of concept understanding of heat material consists of 3 journals, namely: journal 1 [20], journal 2 [21] and journal 3 [22]

The results of the percentage analysis of educators' questionnaires on the implementation of physics learning and the analysis of students' questionnaires on the needs of physics learning tools used the following equation

$$\text{presentase} = \frac{\text{skor yang diperoleh}}{\text{skor maksimum}} \times 100\%$$

III. RESULTS AND DISCUSSION

Results

The results of distributing questionnaires given to 2 teachers at SMA A in Padang City and 1 teacher at SMA B in Padang City, showed almost the same problems in different schools. The general problem is still applying the direct learning model, and does not have a special model to identify student misconceptions. The questionnaire given to this teacher has 5 components and shwon in Table 2 and Table 3.

Table 2. Analysis of physics learning implementation in SMA A

No.	Indicator	Percentage (%)
1	The need to use the independent curriculum in schools	76,30
2	The need to use a learning model on heat material	78,27

3	The need to identify students' concept understanding on heat material	77,18
4	The need to use teaching materials and media on heat material	79,65
5	The need for utilization of <i>augmented reality</i> technology in heat material	76,90

Table 3. Analysis of physics learning implementation in SMA B

No.	Indicator	Percentage (%)
1	The need to use the independent curriculum in schools	78,57
2	The need to use a learning model on heat material	77,20
3	The need to identify students' concept understanding on heat material	75,27
4	The need to use teaching materials and media on heat material	78,94
5	The need for utilization of <i>augmented reality</i> technology on heat material	75,50

The results of distributing questionnaires to 130 students consisting of 65 students at SMA A in Padang City and 65 students at SMA B in Padang City, showed almost the same problems in different schools. In general, students still have difficulties in the learning process on heat material, this is because printed books as learning resources in the independent curriculum are not enough. The questionnaire given to students consists of 3 components and can be seen in Table 4 and Table 5.

Table 4. Needs analysis of physics learning tools in SMA A

No.	Indicator	Percentage (%)
1	Students' difficulty in understanding heat material	77,54
2	Students need to use printed teaching materials on heat material	75,41
3	Students need to use <i>Augmented Reality</i> technology learning media on heat material	76,30

Table 5. Needs analysis of physics learning tools in SMA B

No.	Indicator	Percentage (%)
1	Students' difficulty in understanding heat material	78,15
2	Students need to use printed teaching materials on heat material	74,95
3	Students need to use <i>Augmented Reality</i> technology learning media on heat material	78,62

The results of the journal analysis, first based on Febrianti, et al, (2019) with a percentage value of understanding the concept of heat material of 5.9%, misconceptions of 57.85% and not understanding the concept of 35.34%. Second, based on the research of Asmin & Rosdianti, (2021) with a percentage value of understanding the concept of heat material 12.3%, misconceptions 66.5% and do not understand the concept 21.1%. the last journal based on the research of Wulandari et al., (2018) with a percentage value of understanding the concept of heat material 13%, misconceptions 43% and do not understand the concept 33%. From these three journals, it can be seen that in heat material, misconceptions tend to occur.

Discussion

In preliminary research, journal analysis and observations to schools have been carried out by giving a needs analysis questionnaire to teachers and students. At the stage of providing a needs analysis questionnaire, several problems were found, namely the percentage of curriculum implementation in schools that had only been implemented 76.30% at SMA A and 78.57% at SMA B. this happened because the independent curriculum is a new curriculum whose implementation is not entirely perfect, there is still a great need for special training for teachers to better master the process of implementing the independent curriculum at school so that the independent curriculum is implemented properly and effectively. The independent curriculum is a new curriculum based on one of the policies of the Minister of Education and Culture, known as Merdeka Belajar Kampus Merdeka (MBKM). This curriculum is very different from the previous curriculum, teachers also feel that there are many obstacles experienced during the independent curriculum implementation. Therefore, special training is needed in implementing the implementation of the independent curriculum at school.

Students' difficulty in understanding heat material at SMA A Padang City was 77.54% and SMA B Padang City was 78.15%. This happens because there is no teaching material that uses a particular learning model so that it can overcome students' difficulties in understanding heat material and learning tends to be teacher-centered. Students' difficulties in understanding this heat material can be overcome by using a cognitive conflict learning model. The cognitive conflict model is a process of students discovering a concept when faced with a conflict phenomenon that exists in their thinking [16]. The learning model syntax is arranged using the cognitive conflict-based learning model syntax, according to Mufit (2018) there are 4 syntaxes including: (1) preconceptions and misconceptions activation, (2) cognitive conflict presentation, (3) concepts and equations discovery, (4) reflection. This cognitive conflict-based learning model is an alternative learning model that can remediate student misconceptions, improve concept understanding, and increase students' positive views on Physics lessons and can increase student learning motivation.[10].

In identifying students' conceptual understanding of heat material in SMA A Padang City 77.18% and in SMA B Padang City 75.27% have not been implemented so that it needs special attention. Teachers have not fully identified students' misconceptions. This can be seen from the needs of teachers in the use of printed teaching materials and learning media on heat material in SMA A Padang City 79.65% and SMA B Padang City 78.94%, this is because the independent curriculum printed materials for teaching to heat material available are limited. In addition, the unavailability of materials for teaching that can fix students' misconceptions, the unavailability of materials for teaching integrated with technology. This is also supported by students' needs for teaching materials at SMA A Padang City 75.41% and at SMA B Padang City 74.95%. According to students, the books and media available are not enough to understand the heat material, 3D stimulus presentation is

needed in learning heat, and the presence of images, 3D animation, or videos will make students able to remember the information learned.

When viewed from the needs of teachers in using technology-integrated teaching materials such as *Augmented Reality* (AR) 76.20% and the needs of students to use printed teaching materials integrated *Augmented Reality* (AR) technology of 76.30% in SMA A and 78.62% in SMA B Padang City. This is because *Augmented Reality* (AR) integrated teaching materials have never been used in schools. *Augmented Reality* (AR) is an application that combines the real and virtual worlds in two or three dimensions that are simultaneously projected in a real setting [23]. *AR Augmented reality* in teaching materials is expected to improve the quality of a learning process. This is because *Augmented Reality* is proven to be able to increase students' interest in learning a material because *Augmented Reality* has an interesting aspect that can increase students' interest and motivation to learn. In addition, students can also get an atmosphere of learning and playing because in learning a material, they can project it realistically so that it makes it easier for students to understand the concepts in the learning material [24]. *Augmented reality* technology Combining entertainment and education can result in new approaches to support teaching and learning in both official and informal setting [25]. So that with the application of AR in teaching materials, it is hoped that it will attract more students' interest in learning and improve students' understanding of concepts.

IV. CONCLUSION

From the results of the data analysis that has been conducted, it can be seen that the use of an independent curriculum in SMA A Kota Padang and SMA B Kota Padang has been well implemented and is suitable to be applied in schools at the present time. Teaching materials for heat material are still limited. Teachers do not have a special model to identify students' misconceptions, for that cognitive conflict model is suitable to be used to increase concept understanding of students' and remediate students' misconceptions. In addition, the role of technology in the 21st century is also very necessary, the media that are often used by teachers in the form of power point (PPT), so teaching materials with new innovations that are integrated with technology such as *Augmented Reality* (AR) can be used to attract students' reading interest. It is also hoped that the use of *Augmented Reality* technology can help print teaching materials to be made have great potential in attracting, inspiring, and motivating students, to find and control other different perspectives, which were not previously realized in the world of education. Students also agree and are interested if heat teaching materials are integrated with technology. Therefore, with this preliminary research, the need to develop materials for teaching based on cognitive conflict integrated *Augmented Reality* on heat material to improve the understanding of the concept of SMA / MA students.

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