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The Use of Augmented Reality Based-Learning Media to Reduce Students' Misconceptions

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Abstract

The research objective is to determine whether using AR molecules as a learning medium can assist students in reducing their misconceptions about molecular materials. It was pre-experimental research with a one-group pre-test-post-test design. The average level of validity of the learning media used, according to the findings, is 70.3% ("valid" classification). The average reduction of misconceptions (MC) among students using learning media for the entire concept is 12.8 %, 9.2 % for students who do not understand the concept (DUC), and 22.0 % for students who understand the concept (UC). Based on these findings, it is possible to conclude that AR molecule-based learning media can be used to reduce students' misconceptions about molecular materials.

Keywords: Use of media, AR molecules, misconceptions

Introduction

Science learning, which is part of the Indonesian secondary school curriculum, is the teaching of exact sciences to students who have good cognition, formula knowledge, and research skills. Chemistry is one of the appropriate subjects for learning science. Chemistry is the study of a material or substance that discusses the composition, structure, properties, and changes in the shape of the substance (Putri et al., 2020).

The chemistry learning process is very much needed by the media in its learning, where a lot of chemical material is difficult to understand and is abstract. The shape of a molecule is one of the chemical materials that is claimed to be abstract because it requires an image for students to be able to imagine it (Shakina, 2020).

The molecular shape is a chemical science that describes the position of atoms in a molecule which is explained using several approaches, namely electron domain theory, molecular orbital theory, crystal field theory, and electron pair repulsion theory (VSEPR) (Palma et al., 2021).

One of the educational conflicts in Indonesia in the field of science is the low level of scientific literacy. The low level of scientific literacy and the quality of science education in Indonesia so far can be expected because of the lack of attention to the socio-cultural environment as a source of learning (Imansari et al., 2018).

Students' understandings of concepts that differ from scientific ideas or popular beliefs refer to misconceptions. Several chemistry myths have been debunked previously. This misunderstanding is common because the concepts presented by the teacher are abstract, resulting in previously experienced misunderstandings by students (misconceptions) (Afadil & Diah, 2018).

Misconceptions must be reduced through conceptual changes. Misconceptions can be overcome in general by (1) understanding students' misconceptions, (2) attempting to locate the source of these misconceptions, and (3) locating an appropriate treatment to overcome these misconceptions.

According to the research findings on the Ps-Trilogy Learning Model in Chemical Kinetics, the average percentage of students misconceptions (MC) reduction for all concepts is 20.9%. The number of students with concept knowledge (KC) increased by 33.1%, while the number of students with conceptual ignorance (UKC) decreased by 12.2% (Afadil & Diah, 2020). When using a contextual learning approach (CTL), the average percentage of misconceptions about salt hydrolysis among Class XI IPA-A and Class XI IPA-B students was 19.6% and 9.8%, respectively (Raisul et al., 2020).

Learning resources can be in the form of learning media. A medium can be referred to as a medium Learning when it can convey learning

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information from information sources to students recipients of the learning information. One form of audio-visual media that has been utilized by information and communication technology systems is augmented reality (AR). Augmented reality is an alternative intermediary that can be used as an appropriate visual media for students. Augmented reality is a technology that combines two-dimensional or three-dimensional virtual objects into a real three-dimensional environment and then projects these virtual objects in real-time (Acesta & Nurmaylany, 2018).

Virtual reality is a three-dimensional (3D) technology that allows users to interact with stimulants through their movements in a virtual environment (Sirakaya & Cakmak, 2018).

One benefit is that users in AR can interact simultaneously with virtual objects in a real-world environment; the second is that AR encourages students to participate actively in the formation of their knowledge base and provides them with opportunities for concrete interactions; and the third is that AR is more interactive, more effective to use, can be widely applied in various media, has a simple object model because it only represents a few low-cost objects, and is simple to use (Supriono & Rozi, 2018).

AR has managed to gain traction in terms of its use in education due to its pedagogical benefits and ease of use. Augmented reality tools were used by a diverse group of participants, ranging from pre-schoolers to graduate students and teachers in a variety of fields, including literacy education and astronomy education. According to a study conducted by Schrier in Sirakaya & Cakmak (2018), AR has the potential to develop skills expected of today's learners, such as problem-solving, group work, versatile assessment, and understanding different perspectives.

The use of media in learning, such as the use of augmented virtuality, apart from being able to help educators in delivering difficult-to-understand material and creating a pleasant learning atmosphere, can also be used to train certain skills desired by educators to meet learning objectives (Elisa & Wiratmaja, 2019). Furthermore, because AR can visualize abstract concepts for understanding and object model structures, the use of Augmented Reality in Learning Media can encourage students to think critically about a problem that arises in everyday life. Educators can benefit from using augmented reality props to reconstruct real-world objects that aren't visible to the naked eye. Students can access learning materials from anywhere and at any time, freeing teaching and learning from the constraints of lessons and classrooms.

Augmented Reality (AR) has characteristics that are consistent with the current revolutionary era. AR application technology is one of the relevant learning media solutions for learning development in the Society 5.0 and Industrial Revolution 4.0 revolution era because it is based on technology that can display mobile, interactive, and independent media (Tasrif et al., 2020).

Mustaqim & Kurniawan (2017) explain that through augmented reality, teachers Can create learning media that is fun, interactive, and easy Second hand. Augmented reality can do that to replace the learning module that is not yet in school in virtual form or virtual.

Based on research conducted by Aryani et al. (2019) the application of an inquiry learning model assisted by Augmented Reality learning media, during the learning process using Augmented Reality-based learning media students feels interested and motivated to learn so that student learning outcomes can increase.

The results of research conducted by Bau et al. (2022) using Augmented Reality learning media can help students understand concepts and theories, thus stimulating students to think conceptually. This can create a pleasant learning atmosphere and can motivate students to study chemistry on atomic structure material.

Augmented reality is a combination of the real and virtual worlds, is interactive in real-time, and is 3D animation. As stated by Iordache et al. (in Pratama, 2018) using AR media students understand and learn chemistry more easily and interactions in the classroom have a positive influence on effectiveness and efficiency in the learning process. Based on this background, research was carried out, namely the use of molecular augmented reality learning media to reduce students' misconceptions about molecular shape material.

Methods

This research applied pre-experimental research designed with a one-group pretest-posttest design. This research was conducted using one class before and after treatment.

Table 1. One group pretest-posttest design

O_1	X	O_2

Where:
X: Treatment through the use of molecular AR learning media
O1: Pre-test score
O2: Post-test score

SMA Santo Andreas Catholic Palu was the site of the research. This research included all students in class X IPA 1 in the 2021/2022 academic year, a total of 17 students (6 boys and 11 girls).

The researcher employed a purposive sampling technique. It is one of the non-random sampling techniques in which the researcher selects the sample by establishing specific characteristics that suit the research objectives to solve the research problem.

This research was carried out in three stages, the first stage of media preparation and validation, the second stage of implementation, and the third

stage the final stage. The research instruments are (1) an instructional learning document (lesson plan and students worksheet), (2) a learning media validation questionnaire, and (3) a misconception tracking test in the form of a multiple-choice format accompanied by CRI (Response Certainty Index). This CRI method identifies the occurrence of misunderstandings and distinguishes them from concepts of ignorance and knowledge of conceptual.

This research used the Certainty of Response Index (CRI) on a scale of 1 to 4 to collect data.

Table 2. Response Scale Certainty of Response Index

CRI	Criteria
1	Strongly Disagree
2	Disagree
3	Agree
4	Strongly Agree

There are four CRI scales in the table, with one indicating that the respondent does not understand the concept and four indicating that the respondent believes in it. Regardless of whether the answer is correct or incorrect, if the respondent's confidence level is low (CRI 1), he/she only guesses the answer. It shows that the respondents are unfamiliar with the concept. The respondent has a good concept understanding if the CRI score is high and the answer is correct. If the CRI score is high but the answer is incorrect, then misunderstandings are shared.

Identifying a student who has misconceptions or does not understand a concept is as simple as comparing the correct answer to a question with the level of the Certainty Index (CRI) assigned to the question. For individual and group respondents, the table below includes provisions for distinguishing between students who understand, misunderstand, and do not understand the concept (A'yun et al., 2018).

Table 3. CRI provisions for distinguishing UC, MC, and DUC

Answer Criteria	low CRI (<2,5)	High CRI (>2,5)
Correct Answer	The correct answer, but low CRI indicates that students do not grasp the concept (DUC)	Correct answer but high CRI indicates that students have mastered the concept (understand the concept) (UC)
Incorrect Answer	Wrong answers and low CRI indicate students lack understanding of the concept (DUC)	The wrong answer but CRI high CRI indicates misconception (MC)

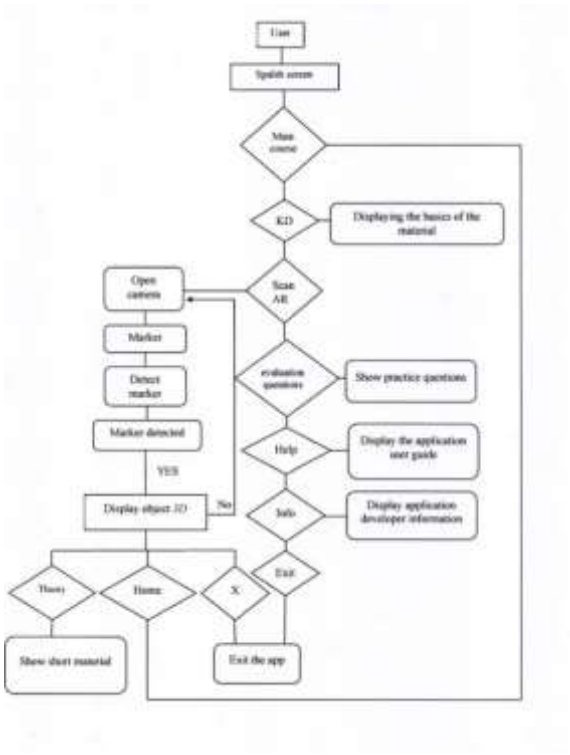


Figure 1. Flowchart

Results and Discussion

Learning media plays a vital role in the teaching and learning process; the use of appropriate learning media can assist students in the learning process, which is expected to improve in the future, and the use of learning media can also help educators in conveying material. As a result, the researchers decided to use augmented reality technology to create and use android-based learning media to reduce students' misconceptions.

The researcher chose the Augmented Reality application because it can directly display 3D objects without taking a long time and present material text, audio, and evaluation questions that support the learning process for reducing student misconceptions.

There are four stages that the researcher-designed learning media for the molecular in Augmented Reality (AR) application: needs analysis, literature review, conceptualization and design of molecular AR application, and the learning media validation **Figure 1**.

According to the validation results from the three expert validator teams, the average percentage of this AR molecule learning media validity is 70.3% with valid criteria.

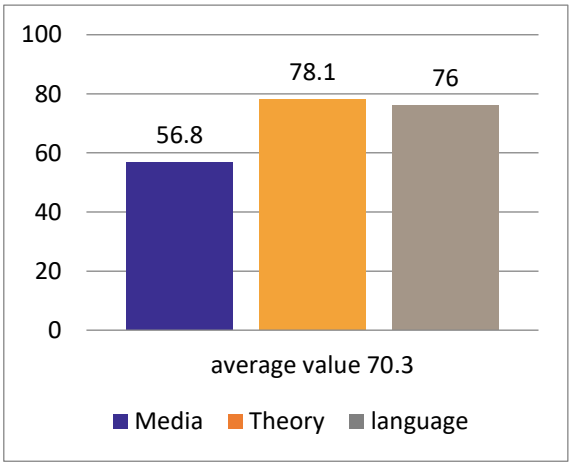


Figure 2. Validator team value percentage

Students conceptions are divided into three categories: understanding concepts (UC), not knowing concepts (DUC), and misconceptions (MC).

As a result, this AR molecule learning media is suitable for use as a teaching tool to assist students in overcoming misconceptions. In this research, implementation indicators and learning quality were tracked based on syntax use in lesson plans and student activities during the learning process. The teacher evaluates the use of syntax in lesson plans in chemistry classes. **Table 4** shows the percentage of learning that has been implemented:

Table 4 shows that the results of teacher and student learning activities are 86.7 and 85.4 percent, respectively, which is an excellent category (Depdiknas in Raisul, 2020) states that based on the theory, the value of the activity is classified to be very good if it is between 75% -100%.

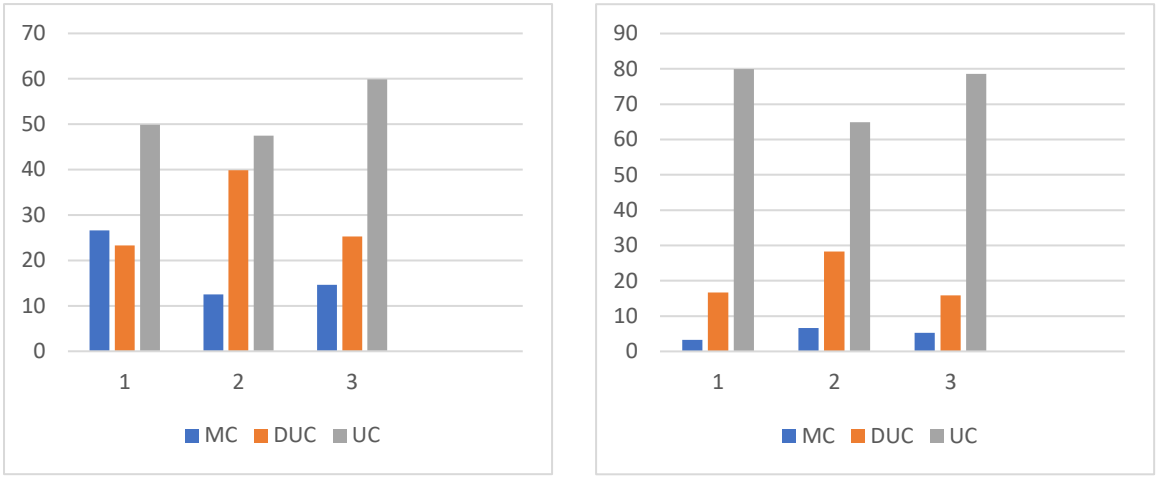
Table 4. The results of teacher's and students' learning activities

Meeting	Percentage	
	Teacher	Student
1	83.3	82.2
2	90.2	88.7
Mean Score	86.7	85.4

Figure 3 shows the percentage of students who have misconceptions, do not know the concept, and understand the concept at the time of the pre-test.

According to the pre-test results, the overall concept is that students have misconceptions, with an average percentage of misconceptions (MC) experienced by students of 17.9% and students do not understand the concept (DUC) at 29.5%, it happens because the concept or theory of molecular shape is quite abstract material so that it takes a medium that can represent a molecular shape in 3D, students understand the concept (UC) 52.4%. Based on this, most students have understood the theory of this molecular shape but some students still have difficulty and even experience misconceptions about this molecular shape material.

At the end of the learning process, the researcher administered a second test (post-test). Figure 3b shows that some misconceptions remain in each concept but have decreased since the pre-test.



a b

Figure 3. Percentage of pre-test(a)-post-test(b) results

Students who misconception (MC) at 5.1%; those who do not understand the concept (UC) at 20.3%, and who understood the concept (DUC) at 74.5%, according to the final test (post-test) results. The use of molecular Augmented Reality learning media can make the learning process more fun and can make it easier for students to understand this molecular shape material so that it can reduce students' misconceptions and student misunderstandings and can improve students' understanding of molecular shape material by using the Augmented Reality learning media. This is following Mustaqim (2016) that this augmented reality learning media can visualize abstract concepts for understanding and object model structures so that students are easier understand the concepts of a material.

The two test results indicated that the number of students who understood the concept (UC) increased by 22.0%, while students who misunderstand (MC) and do not understand the concept (DUC) decreased by 12.8% and 9.2%, respectively.

Conclusions

The AR molecule learning media had an average validation value of 70.3 % with valid criteria, and the use of molecular AR learning media could reduce students' misconceptions (MC) on the molecular form material for 12.8 %, students did not understand the concept (DUC) 9.2 %, and students understood concept increased (UC) 22.0%.

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