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DEVELOPMENT OF INTERACTIVE MULTIMEDIA TO PREVENT MISCONCEPTIONS IN SALT HYDROLYSIS MATERIALS

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Abstract

This study aims to determine the feasibility of interactive multimedia that used to prevent misconceptions on salt hydrolysis material in terms of validity, practicality, and effectiveness. The type of this study is Research and Development (R&D) of the ADDIE model which consists of five stages, namely analysis, design, development, implementation, and evaluation. And this research is only limited to the implementation stage. The trial or product implementation was carried out on 20 students of high school students of eleventh grade Science. Based on the results of the research, the percentage of construct validation is 86.8% and content validation is 85.8%. Percentage of practicality based on the student response questionnaires is 86.3% and the observation questionnaires is 89%. And percentage of effectiveness obtained based on student learning outcomes is 83.4%. Thus the results of this study indicate that the interactive multimedia developed is valid, practical, and effective used to prevent students' misconceptions on the salt hydrolysis material.

Keywords: Interactive multimedia, misconceptions, Hydrolysis.

INTRODUCTION

Chemistry contains many abstract concepts, namely the material is not concretely visible and also contains reactions and calculations [1]. Because chemical concepts that are abstract, complex, and unobservable require more thinking for problem solving so it is quite difficult to understand [2]. The relationship of one material to another in chemistry causes increasingly complex problems so that a correct understanding is needed from the start. It is necessary to have three representative levels of chemistry, namely macroscopic, microscopic, and symbolic to understand the concept of chemistry, so in learning chemistry students must be able to integrate these three aspects [3]. However, in practice, many chemistry lessons only emphasize macroscopic and symbolic aspects by making students only memorize concepts even though memorized concepts do not necessarily understand concepts, so students have difficulty learning chemistry [4].

One of the chemical materials that have abstract and complex characteristics is salt hydrolysis [5]. The material has a relationship with the previous material which is a prerequisite namely acid and base. This characteristics of salt hydrolysis material can make it difficult for students to master the concept. Difficulties in understanding and mastering the correct concept can lead to misconceptions in students [6]. Chemistry has concepts that are interconnected between materials so if students experience misconceptions about a concept, it will cause difficulties in learning the next material [7].

Misconception is defined as an understanding of concept that students have different from the agreement of the experts. Sometimes students do not aware that they have misconceptions because they feel confident that the concepts they have are correct and make sense. There are several causes of misconceptions in students, namely: from students which can come from wrong intuition, preconceptions, associative thinking, stages of cognitive development of students, students' abilities, students' learning interests; from the teacher because of the lack of quality and mastery of the material; from the book's erroneous explanation; from contexts such as student experiences, parental explanations and inappropriate media content (TV, radio, films) and less effective and innovative teaching methods [8].

Identification of misconceptions experienced by students is done by using a diagnostic test technique. Misconception Diagnosis Test is an instrument to detect misconceptions by knowing the weaknesses and strengths of students in certain subjects. One of the misconceptions of diagnostic

testing is the three-level diagnostic test method. The first level is the choice of answers, the second level is the reason for choosing the answers, and the third level is the level of confidence or the level of confidence in the answers and reasons chosen [9]. misconceptions are hard to change but they can be reduced and prevented. One method that can be used is with the help of interactive multimedia.

Interactive multimedia is a computer-based learning media tool that can be used to explain chemical concepts. Interactive multimedia can minimize misconceptions in students. Multimedia can visualize and present abstract material, so it is expected to be able to prevent misconceptions [10]. Other research results also say that interactive multimedia can connect abstract concepts with real-life that can minimize the occurrence of misconceptions in science [11]. Multimedia integrates digital media, including a combination of electronic text, moving image graphics, and sound in a system [12]. In designing and making interactive multimedia, several multimedia principles must be considered, especially in terms of interactivity, namely the existence of dialogue or conversation between users.

Based on the facts from interactive multimedia that have been analyzed, it is obtained that interactive multimedia can connect abstract concepts in chemistry material so that it can prevent misconceptions in chemistry learning. So that based on the needs of educators and students for learning media which is also accompanied by the demands of the times, researchers develop interactive learning media that can contain text, images, videos, and animations based on chemical representations so that students can understand complex and abstract chemical concepts based on android as a solution to the problem. The aims of this study was to determine the feasibility of developed interactive multimedia based on its validity, practicality, and effectiveness in preventing misconceptions in salt hydrolysis material.

METHOD

This study used Research and Development (R&D) of the ADDIE model developed by Robert Maribe Branch in 2009 which consists of five stages. And five stages, namely Analysis, Design, Development, Implementation, and Evaluating [13]. This research is only limited to the implementation stage. The ADDIE Research Flow is presented in Figure 1.

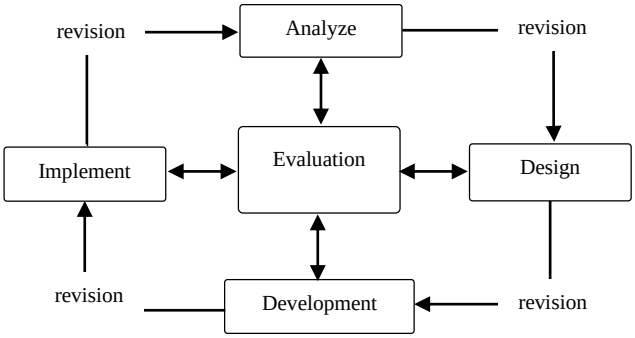

Figure 1. ADDIE Research Flow

The research instruments used to collect data include multimedia review sheets, multimedia validation sheets, student questionnaire sheets, student activity observation sheets, and pretest-posttest test sheets.

The multimedia review sheet is in the form of a questionnaire to obtain multimedia quality based on suggestions from chemistry lecturers and media experts on multimedia. The validation sheet is in the form of a questionnaire to assess the validity of the multimedia developed based on the criteria of content validity and construct validity obtained from the assessment of one chemistry teacher and two chemistry lecturers. Validity was assessed using a Likert scale in Table 1 [14].

Table 1. Likert Scale Multimedia Validation

Score	Evaluation
1	Very Not Good
2	Not good
3	Pretty good
4	Well
5	Very good

From the total score obtained, it is used to determine the percentage value using the validity criteria in Table 2. Interactive multimedia is declared valid if the percentage is 61%. The percentage of validation results is determined using the formula:

$$\text{Percentage}=\frac{sum\ of\ result\ scores}{criteria\ score}\ x\ 100\%$$

Table 2. Interpretation Criteria for Multimedia Validation Score

Percentage (%)	Criteria
0-20	Very less
21-40	Not enough
41-60	Enough
61-80	good/valid
81-100	Very valid

The results of student responses and the results observation of student activities are used to determine the practicality of the interactive multimedia developed. The data obtained were analyzed descriptively qualitatively using the Guttman scale, namely using the answers 'Yes' and 'No'. Score 1 if Yes and score 0 if No [14]. Interactive multimedia is declared practical if it gets a percentage of 61%. The percentage of practicality results using the formula:

$$\text{Percentage} = \frac{number\ of\ 'Yes'\ answers}{total\ number\ of\ students}\ x\ 100\%$$

Analysis of students' misconceptions is used to determine the effectiveness of interactive multimedia. The three tier diagnostic test method is used in the pretest-posttest test questions. Interactive multimedia is declared effective if it gets a percentage of 61%. The percentage of effectiveness results using the formula:

$$\text{Percentage} = \frac{amount\ from\ M\ to\ KC}{amount\ of\ initial\ M}\ x\ 100\%$$

RESULT AND DISCUSSION

The results of the interactive multimedia development research used the ADDIE research model are as follows:

The first stage is the analysis stage which includes job analysis and needs analysis. Performance analysis is carried out to identify and classify the problems that are being faced by the school while the needs analysis is to determine the solutions needed by students and educators to improve the quality of learning, especially chemistry learning.

At this stage, the researcher observes the students of class XI to find out the problems that occur and determine the solutions needed according to the characteristics of the students.

The second stage is the design stage which includes making the overall multimedia design, making materials and questions, selecting images, fonts, and supporting videos. Making a multimedia design that is adapted to the characteristics of the material and the analysis of the compilers of the learning indicators. In making this interactive multimedia using a computer-based application, namely Adobe Flash which is adapted to the purpose of developing this media [15] [16] [17].

Stage of preparation of materials and questions that will be included in the multimedia. The hydrolysis materials selected include sub-materials on the meaning of hydrolysis, types of hydrolysis, salt properties, and applications in everyday life. The questions are arranged according to the learning objectives, namely to prevent misconceptions so that the pretest and posttest questions are prepared using the three-tier diagnostic test method. In previous research about the three-tier diagnostic test method, this test was used to identify misconceptions in students [18]. Then followed by the selection of images and videos as supporting media to achieve three levels of chemical representation, namely macroscopic, microscopic, and symbolic [19].

The third stage is the development stage which includes product creation and assessment. The first step is to collect supporting materials and animations, including two-dimensional animation made with Adobe Flash and ChemDraw, the second step is to refer to flow cards and storyboards. The media sections are explained as follows:

a. Homepage

The start page is an accessible way to enter the media. Initial page view in Figure 2.

Figure 2. Homepage

b. Instructions page

The instructions page contains how to operate the media created and the order in which the material will be delivered. Display of the instructions page in Figure 3.

Figure 3. Instructions Page for Operating the Media

c. Pretest Questions

Before accessing the material, students are given several pretest to work on. The questions are in the form of a three-level diagnostic test model to find out the initial conceptions that already exist in students [9]. Then students are directed to the material menu to provide a conception that is in agreement with experts. Display of pretest questions in Figure 4.

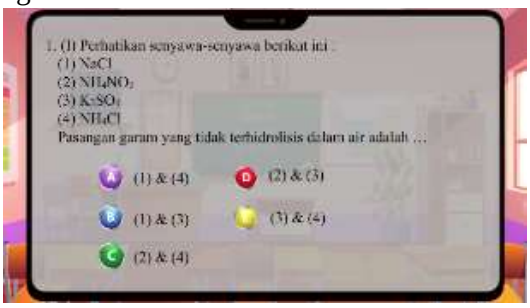

Figure 4. Pretest Questions

d. Pretest Results

The results of the pretest contain information related to the results of students' answers to each question and sub-material. There are conclusions from the conceptions that students already have. There is a camera logo in the upper right corner as a command for students to take screenshots. There is an arrow button to continue to the material menu. Display of pretest results in Figure 5.

Figure 5. Pretest Results

e. Material Contents

The material content page contains hydrolysis material from the definition, nature, and type of salt hydrolysis which is equipped with illustrations of three levels of chemical representation, namely macroscopic, microscopic, and symbolic [3]. The display of the material contents is in Figure 6.

Figure 6. Material Contents

f. Posttest Questions

After getting the material in the form of animation and video. To find out changes in students' conceptions, there is a posttest for the three-tier diagnostic test model [9]. Display of posttest questions in Figure 7.

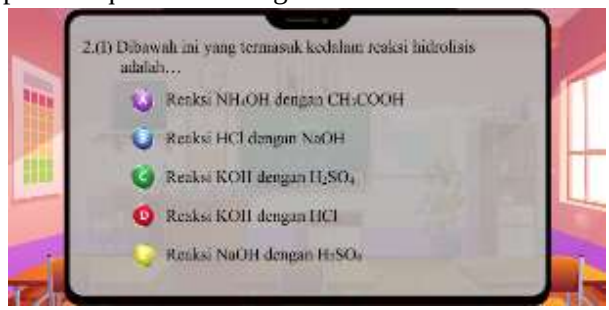

Figure 7. Posttest Questions

g. Posttest Results

The posttest related to the results of students' answers to each question and sub-material. There are conclusions from the conceptions that students already have. There is a camera logo in the upper right corner as a command for students to take screenshots. Display of posttest results in Figure 8.

Figure 8. Posttest Results

Multimedia Validation

The validity of the developed multimedia is based on design, material, and language aspects. Interactive multimedia validation is used to determine the level of validity of the media. The assessment includes content validation and constructs validation. Content validity includes completeness, accuracy, suitability, the correctness of the material, and questions with the curriculum on the media, while construct validity includes the use of language and media presentation.

Content validation

In content validation, 3 aspects are assessed, namely the truth of the concept, the suitability of the material and questions with the aim, and three levels of chemical representation, namely macroscopic, microscopic and symbolic. The results of the assessment of each aspect can be seen in Table 3.

Table 3. Content Validation Results

No.	Validity	Percentage	Category
1.	Concept Truth	86.6%	Very Valid
2.	The suitability of questions and materials	82.2%	Very Valid
3.	Three levels of chemical representation	88.8%	Very Valid

Based on the results of content validation, the aspect of the truth of the concept in interactive multimedia obtained a percentage of 86.6% which was included in the very valid category. This shows that the concept of material used in interactive multimedia is in agreement with experts both from symbols, numbers, compound formulas, and compound names so as not to cause misconceptions [20].

In the aspect of the suitability of the questions and materials with the objectives in interactive multimedia, the percentage of 82.2% is included in the very valid category. The questions and materials contained in the multimedia are per the purpose of developing this interactive multimedia, namely to prevent misconceptions and to detect misconceptions by using questions in the form of a three-level diagnostic test [9].

In the aspect of three levels of chemical representation in interactive multimedia, the percentage is 88.8% which is included in the very valid category. The developed interactive multimedia is equipped with an explanation of three representative levels of chemistry that can improve student learning outcomes [21].

The macroscopic aspect is visualized with a simple practicum video in Figure 9. A simple practical video showing how a salt solution changes the color of litmus paper after it is dipped.

Figure 9. Macroscopic Aspect

The microscopic aspects are explained by visualization through animation in Figure 10. This animation shows how the process of hydrolyzed salt.

Figure 10. Microscopic Aspects

And the symbolic aspect includes the reaction equation in Figure 11. Show the reaction of salt formation and the reaction of hydrolyzed salt.

Figure 11. Symbolic Aspects from Chemical Reaction Equations

Construct Validation

In construct validity, 3 aspects are assessed, namely aspects of presentation feasibility, language suitability, and graphic quality. The results of the assessment of all aspects can be seen in Table 4.

Table 4. Construction Validation Results

No.	Validity	Percentage	Category
1.	Feasibility of presentation	83.3%	Very Valid
2.	Language compatibility	86.6%	Very Valid
3.	Graphics quality	90.6%	Very Valid

Based on the results of construct validation, the presentation feasibility aspects include the ease of operation, the coherence of the material, the completeness of the material, and the accuracy of the navigator buttons. Obtaining a percentage of 83.3% which is included in the very valid category. Then interactive multimedia is feasible to use.

Aspects of language suitability include the use of Indonesian spelling that is in accordance with the rules, is easy to understand, and does not cause double meanings. Because the language aspect is one of the causes of misconceptions because students have difficulty understanding the language in the material [19]. Obtaining a percentage of 86.6% which is included in the very valid category. Then the linguistic aspect in interactive multimedia is feasible to use.

Graphics quality aspects include the accuracy of background selection, font shape and color, overall color, and layout of text and images. obtaining a percentage of 90.6% is included in the very valid category. Then the quality of interactive multimedia graphics is worth using.

From the explanation above, the results of the content validity assessment and interactive multimedia construct validity can be seen in Table 5.

Table 5. Result Validation

No.	Validity	Percentage	Category
1.	Content	85.8%	Very Valid
2.	Construct	86.8%	Very Valid

Table 5 shows that the developed multimedia obtained content validity of 85.8% and construct validity of 86.8%, both of which were included in the very valid category. Then the interactive multimedia developed is feasible to use.

The fourth stage is implementation in the form of limited trials on students. Students as respondents then give an assessment based on predetermined criteria based on practicality and effectiveness.

Multimedia Practicality

The practicality of multimedia in terms of the results of student response questionnaires and supported by observations of student activities. Student response data were obtained from a questionnaire given to 20 high school students of eleventh grade Science. The student response questionnaire has 2 objectives, namely to determine student interest in multimedia and to determine the level of ease of use of multimedia. The following are the results of student responses in Table 6.

Table 6. Student Response Results

No.	Rated aspect	Percentage	Category
1.	Student Interest	85.5%	Very Practical
2.	Multimedia practicality	83%	Very Practical
3.	Ease of use	83%	Very Practical
4.	Language Clarity	94%	Very Practical
	Average	86.3%	Very Practical

Based on the results of student responses, in the aspect of student interest, a percentage of 86.3% is included in the very practical category so that it can be stated that students are interested in the interactive multimedia developed. Students' interest in interactive multimedia can improve learning outcomes with interesting pictures, videos, and audio [22].

Observation data on student activities was obtained from the assessment of 3 observers. Assessment of student activities is carried out as long as students use interactive multimedia. In the observational study of student activities, there are 2 objectives, namely to determine the practicality of multimedia in general and to determine student learning activities using multimedia. The following are the results of student responses in Table 7.

Table 7. Student Activities Observation Results

No.	Rated aspect	Percentage	Category
1.	Practicality	90.6%	Very Practical
2.	Learning activity	87.5%	Very Practical
	Average	89%	Very Practical

On the results of observations of student activities. In the practical aspect, the percentage is 89% which is included in the very practical category. The student's response was said positively based on the score assessment with a percentage of ≥61% [14].

So it can be stated that students can operate interactive multimedia well, open all menus, and do pretest-posttest well.

Multimedia Effectiveness

The effectiveness of multimedia in terms of the results of the shift in students' misconceptions. The data on the results of the shift in misconceptions were obtained from the results of the pretest-posttest using the three-tier diagnostic test method [9].

The pretest questions are used to find out the students' initial concepts, whether they have misconceptions, don't know the concept, or know the concept. While the posttest questions are used to find out the shift in the concepts that students have. The following are the results of the shift in misconceptions in Table 8.

Table 8. The Shift in the Concept of Student

The Shift in the Concept of Student	The Concept of Hydrolysis			The Concept of Types and Properties of Hydrolysis		
	question			question		
	1	2	3	1	2	3
KC-KC	3	4	5	3	5	3
KC-M	0	0	0	1	0	1
KC-DKC	0	0	0	0	0	0
M-KC	8	7	8	9	8	8
M-M	2	0	0	2	1	0
M-DKC	1	2	0	0	0	2
DKC-KC	6	7	6	4	6	6
DKC-M	0	0	0	0	0	0
DKC-DKC	0	0	1	1	0	0

Based on Table 8 it can be seen that the shift in students' conceptions is. In the concept of understanding hydrolysis, question 1 as many as 3 students experienced a shift from KC-KC (Know the Concept to Know the Concept), 8 students experienced a shift from M-KC (Misconception to Know the concept), 2 students experienced a shift from M-M (Misconception to Misconceptions), and 6 students experienced a shift from DKC-KC (Don't Know Concepts to Know Concepts). Question 2 as many as 4 students experienced a shift from KC-KC, 7 students experienced M-KC, and 2 students experienced DKC-KC. Question 3 as many as 5 students experienced KC-KC, 8 students experienced M-KC, 6 students experienced DKC-KC and 1 student experienced DKC-DKC.

In the concept of the type and nature of hydrolysis, question 1 as many as 3 students experienced KC-KC, 1 student experienced KC-M, 9 students experienced M-KC, 2 students experienced M-M, 4 students experienced DKC-KC, and 1 student experienced DKC-DKC. Question 2 as many as 5 students experienced KC-KC, 8 students experienced M-KC, 1 student experienced M-M, and 6 students experienced DKC-KC. In question 3, 3 students experienced KC-KC, 1 student experienced KC-M, 8 students experienced M-KC, 2 students experienced M-DKC, and 6 students experienced DKC-KC.

The percentage shift of students from M to KC on the concept of understanding hydrolysis obtained a percentage of 83.3% and on the concept of types and properties of hydrolysis obtained a percentage of 83.5% so that the average percentage of all concepts was 83.4% which was included in the very effective category. So it can be concluded that interactive multimedia can prevent misconceptions in salt hydrolysis material.

CONCLUSION

Based on the results of the study, it can be concluded that the interactive multimedia developed can be declared feasible to be used to prevent misconceptions in salt hydrolysis material based on the percentage of validity, practicality, and effectiveness obtained with the following details:

1. The validity of multimedia based on content validation percentage got 85.8% with very valid category and construct validation percentage got 86.8% with very valid category.

2. The practicality of multimedia based on the percentage of student response questionnaire data results got 86.3% in the very practical category and from the percentage of student activity observation data results got 89% in the very practical category.
3. The effectiveness of multimedia based on the percentage shift in students' conceptions from misconceptions to knowing concepts got 83.4% in the very effective category.

SUGGESTION

Based on the research results, interactive multimedia has met the criteria of validity, practicality, and effectiveness. Some suggestions from researchers for further research are

1. This research was only carried out until a limited trial so that to obtain further information further research is needed so that it can be used by more students
2. Interactive Multimedia to prevent misconceptions developed can be applied to other chemical materials so that it can be used more widely.

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