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The development of flashcard learning media based on make a match on colloid

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A B S T R A C T

This study aimed to determined the feasibility of the Make a Match-Based Flashcard learning media on colloidal material. The subjects of this study were the students of the State Senior High School 1 Muara Batu and the Private High School Jabalnur as many as 25 students. This study refers to the type of Research and Development (R&D) with a 4D model. This research was carried out until the limited trial stage. The stages carried out in this research are Define, Design, Develop. In the Define stage, concept analysis is carried out, at the design stage, the design of learning media to be developed is carried out, at the Develop stage the development of Make a Match-Based Flashcard media is carried out and limited trials on research subjects. The results showed that the Make a Match-Based Flashcard media was valid with a media validity percentage of 88% (very good), and material validity of 85% (very good). The results of data analysis showed the feasibility with a percentage value of 92.30% (very feasible). Based on the results of the study conducted, it can be concluded that the Make a Match-Based Flashcard media is very suitable to be used as a learning medium on colloidal material.

INTRODUCTION

Education is a means to share knowledge, understanding and expertise with someone so that they can develop their talents and potential (Sagala, 2016). Good education is education that has a concept in the creation of human resources based on an understanding of values in life and is sustainable, so that education can be said to be successful if a person can develop the potential that exists within himself to face and solve the problems he will face (Fitriani, 2021; Yusuf, 2009;). The learning process is the core of the overall educational process. According to Tauhid (2016), the teacher is the main role holder in the sense that the teacher facilitates students in the learning process so that the material is given to students also greatly affects learning outcomes. The handbooks that have been given as teaching materials in teaching and learning activities without supporting learning media make it difficult for teachers to integrate the contents of the book, resulting in a lack of student understanding of the content of the material, especially for learning science. Chemistry learning is one of the science lessons that is considered difficult for students to understand because in general, it is abstract - and complicated, which makes students dislike chemistry lessons (Fitriani, 2017). One of the abstract and theoretical chemistry learning materials is the nomenclature of chemical compounds which requires students to memorize so that students tend to get bored during the learning process which results in the expected learning objectives not being achieved optimally.

Chemistry learning process, students do not understand the concept and are often mistaken and even wrong in naming compounds. This is because the way teachers teach tends to be monotonous and without using appropriate learning media to support the achievement of learning objectives. One of the learning media that can be applied to learning the order of chemical compounds is a make a match-based flashcard media. Make a match-based flashcard media is a card media that can be applied to deliver subject matter with game elements so that the learning process is not monotonous and fun so that students' interest in learning is higher so that understanding becomes good and does not feel bored during the learning process, with Thus, the expected

learning objectives will be achieved optimally. Several previous studies have explained that educational game media such as flashcards can support teaching and learning activities in the classroom. Flashcard media is feasible and effective with a feasibility rating of 96.87%, according to the appropriate criteria. The classical completeness obtained by students in the field implementation test reached 94%, which means that flashcard media is effective for use in learning (Istianah, 2015).

LITERATURE REVIEW

Media flashcards based on make a match

The word media in general is the plural of "medium", which means an intermediary or introduction (Suyanti, 2010). Media can also be interpreted as all tools and materials used both physically and technically in the learning process that can help teachers to facilitate the delivery of subject matter to students so as to facilitate the achievement of learning objectives that have been formulated (Suyanti, 2010; Tafonao, 2018). Media in a narrow sense also means components of tool materials in the learning system that are used to achieve certain learning objectives (Miftah, 2013). Flashcard media is a learning media in the form of picture cards measuring 25 x 30 cm (Maryanto, 2017). The drawings are made by hand or photos or using existing images/photos posted on a flashcard sheet. Arsyad (2009) added that flashcard media is a small card that contains images, text and can be adapted to the size of the class at hand. From the description, it can be concluded that flashcards are media in the form of picture cards whose shape and size are adjusted to the size of the class at hand. Flashcard media is a flat image media that is included in silent visual media (Hamalik, 1994; Sadiman, 2006). The make and match learning model are a learning system that prioritizes the cultivation of social skills, especially the ability to work together, the ability to interact in addition to the ability to think quickly through games to find partners with the help of cards (Aliputri, 2018; Mikran, 2018; Wandy, 2017). Therefore, the combination of flashcard media with the make a match learning model is suitable for use in the learning process.

Learning media are used to teach students, so there are a number of principles that must be considered, including (1) Must be in accordance with the learning material (2) In accordance with the learning to be achieved (3) Must pay attention to effectiveness and efficiency (4) In accordance with the teacher's ability to operate the principle errors in using learning media which ultimately the use of media does not add to the ease of student learning, on the contrary, it makes learning difficult (Suyanti, 2010). Hamalik (1994) states that flashcard media is a flat image media that is included in silent visual media. The use of flashcard media has several reasons stated by Sadiman (2006), namely: (1). Can overcome time constraints (2) Cheap in price without requiring special equipment (3) Clarify a problem, (4) Overcome observer limitations (5) It is concrete.

Make a Match is a student activity to find pairs of cards which are the answers to questions before the time limit, students who can match their cards will be given points and those who fail to match their cards will be punished according to what has been mutually agreed (Wandy, 2017). Make a Match is also a teaching and learning method by looking for pairs of answers while learning about a concept or topic to solve problems in a pleasant atmosphere (Mikran, 2013). Make a match is learning by playing in groups of two or more people. This is so that collaboration between students can run effectively with each other, thus enabling all students to be actively involved in learning to discuss and solve problems. Students will learn and work together in small groups to achieve maximum learning experiences, both individual and collective experiences as a form of the principles of student activity in learning (Mikran, 2012). The make a match learning model also aims to foster mutual respect, foster an attitude of responsibility, increase self-confidence in solving a problem, require students to be active in learning, and make a match democratic, students are given the freedom to express opinions (Aliputri, 2003). The application of the make a matching method in learning can make students more interested and opposed to learning because it can increase student activity.

Development model

The research and development method or R&D is a research method used to produce certain products and test the effectiveness of these products (Sugiyono, 2017:297). Research and development are a process or steps to develop a new product or improve an existing product that can be accounted for. These products are not always in the form of objects or hardware (hardware), such as books, modules, learning aids in the classroom or the laboratory, but can also be software (Software), such as computer programs for data processing, classroom learning, libraries or laboratories, or models of education, learning, training, guidance, evaluation, management, and others (Sukmadinata: 2016:164). According to Thiagarajan 4D consists of four stages, namely:

Define

Define This stage is carried out to define the development requirements. An analysis is usually done through a literature study or preliminary research. Thiagrajan (1974) analyzed 5 activities carried out at the defined stage, namely:

a) Front-end analysis. At this stage, the teacher conducts an initial diagnosis to improve the efficiency and effectiveness of learning.

b) Learner analysis. At this stage, the characteristics of students are studied, for example ability, motivation to learn, background experience, etc.
c) Task analysis. Educators analyze the main tasks that must be mastered by students so that students can achieve minimum competence.
d) Concept analysis. Analyzing the concepts to be taught, compiling the steps to be carried out rationally.
e) Specifying instructional objectives. Write learning objectives, expected behavior changes after learning with operational verbs.

Design

Thiagarajan (1974:7) divides the design stage into four activities, namely: construction criterion-referenced test, media selection, format selection, initial design. Activities carried out at this stage include:

a) Develop criteria tests, as the first action to determine the initial abilities of students, and as an evaluation tool after the implementation of activities.
b) Choose learning media according to the material and characteristics of students characteristic
c) The selection of the form of presentation of learning is adjusted to the learning media used. If the teacher will use audio-visual media, during learning, of course, students are asked to see and appreciate the visual media impressions.
d) Simulate the presentation of material with media and learning steps that have been designed. During the learning simulation, peer assessment was also carried out.

Development

The development stage consists of two activities, namely: expert appraisal and development testing. The expert appraisal is a technique for validating or assessing the feasibility of a product design. In this activity, an evaluation is carried out by experts in their fields. Development testing is a product design test activity on the real target subject.

Disseminate

The dissemination stage consists of three activities, namely: validation testing, packaging, diffusion, and adoption. This stage is done so that the product can be used by others. In the context of media development, the dissemination stage is carried out by means of media socialization through distribution in limited quantities to educators and students.

a) Colloidal matter

Dissolved particles such as molecules, atoms or ions are evenly distributed in the solvent. Colloidal material can be dispersed in a medium so that a colloidal dispersion is produced or it is called a colloidal system. The colloidal particles are considered as the dispersed phase and the medium for dispersing the colloidal particles is called the dispersing medium or dispersing medium. A spoonful of sugar is put in water to form water molecules. When granulated sugar is dispersed, a true solution is produced, essentially the size of the sugar particles in the solution is the size of a single molecule of sugar. The size of these particles is relatively very small, so they cannot be separated by filtration, as the solution in general.

b) Classification of colloids

Dispersed and dispersing substances can be gases, liquids, or solids (except they must not be gaseous), so there are eight kinds of colloidal systems as follows:

Table 1. Classification of Colloidal Systems

Dispersed substance	dispersing medium	Colloidal form	Example
Gas	Liquid	Foam	Soap foam, beer foam, whipped cream
Gas	solid	Solid foam	Pumice stone, foam rubber
Liquid	Gas	Liquid aerosol	Fog, clouds, aerosol
Liquid	Liquid	Emulsion	Liquid milk, liquid chocolate, sauce
Liquid	solid	Solid emulsion	Cheese, butter, jelly
solid	Gas	Solid aerosol	Smoke, dust
solid	Liquid	Sol	Paint, strait, coconuts starch water, gelatin
solid	solid	Solid sole	Metal alloy, ruby glass

c) Types and properties of colloids

A mixture is classified into a colloidal system if it has different properties from the true solution. Some of the physical properties that distinguish colloidal systems from true solutions will be described as follows: 1) Tyndall Effect 2) Brown's Motion 3) Adsorption 4) Colloidal Stability and Coagulation.

METHODS

According to Thiagarajni, the research design used in the 4-D model development research (Four D models) includes 4 stages, namely Define, Design, Development, and Disseminate, but here the researcher only uses 3 steps. The following is a description of the 4D development stages in this study:

1) Define The definition stage is the attitude to determine and define the terms of learning, namely by making initial observations about the condition of the school. In determining learning needs, things that need to be considered include the suitability of learning needs with the applicable curriculum, the level or stage of student development, school conditions, and problems in the field so that in this case the development of learning media is needed. This stage consists of 5 steps, namely:

a. Preliminary analysis The initial analysis aims to obtain and determine the basic problems faced in learning chemistry in high school so that it is needed by the problems faced.

b. Student analysis This student analysis aims to analyze the characteristics of students. The characteristics of the students in question are (1) initial competence and background abilities, (2) general attitudes/way of thinking about learning topics, (3) selection of media, format, and language. The results of this analysis determine how the product developed is presented.

c. Concept analysis aims to determine the content of the material in the developed flashcard media. This concept analysis is used as a means of achieving certain competencies by identifying and compiling systematically and in detail and then being included in the learning media.

d. Specification of learning objectives The specification of learning objectives is the process of converting the results of task and concept analysis, namely the formulation of learning objectives based on SK and KD listed in the applicable curriculum, namely revised K13 and identified concepts in Colloidal material.

e. Preparation of research instruments This step connects the define stage with the design stage. Research instruments include a validation questionnaire for expert lecturers and high school chemistry teachers.

2) Design
The design stage aims to design learning devices by the results of the specification of learning objectives at the defined stage. The media selection process and the product manufacturing process are the main basis for this stage. The design stage in this research is focused on designing the design of flashcard learning media with the material that has been determined in the previous stage.

3) Develop
The purpose of this development stage is to produce flashcard media that has been revised based on expert input and trials of students. There are two steps in this stage, which are as follows:

a. Expert Appraisal (Validation of experts or practitioners)
Expert validation serves to validate the flashcard media before testing and the validation results will be used to revise the initial product. The flashcard media that has been compiled will then be assessed by media expert lecturers with qualifications of lecturers who have master's degrees and who have taught learning media courses so that it can be known whether the flashcard media is suitable for use or not The results of this validation are used as improvement materials for the perfection of the developed flashcard media products. After the media has been validated and revised, it will then be tested on students in the limited field trial stage.

b. Product Development (Product Trial)
After expert validation was carried out, a limited field trial was conducted to determine the response of students to flashcard media in classroom learning. The results obtained from this stage are in the form of revised flashcard media.

RESULTS AND DISCUSSIONS

The development of making flashcard learning media based on make a match is carried out through four stages:

Define stage

This stage includes several explanations regarding the needs in the chemistry learning process at Public senior high school 1 Muara Batu and Private high school Jabal Nur. This stage consists of several steps, namely initial analysis and concept analysis. The initial analysis of this research is to find problems that exist in the field so that solutions are needed that are in accordance with the problems faced. Concept analysis aims to identify concepts that will be arranged systematically and in detail to be included in the make a match-based flashcard learning media which discusses the concept of nomenclature of chemical compounds that are interconnected between question cards and answer cards. The specification of learning objectives is based on the SK and KD listed in the applicable curriculum on the nomenclature of chemical compounds. This is as stated by previous researcher Fakhrurrazi (2018) that learning can be effective if it achieves the desired learning objectives in accordance with achievement indicators.

Design stage

This design stage aims to design learning devices in accordance with the results of the specification of learning objectives at the defined stage. The format used in making make a match-based flashcard learning media is a card format measuring 6 cm x 9 cm which is made with the Photoshop application with nomenclature material for chemical compounds. The media is used in chemistry learning to increase students' interest in learning and understanding of students' concepts and the initial design is obtained by making a match-based flashcard learning media which must be validated by material experts and media experts before the media is feasible to use. The media are in the form of question cards and answer cards in accordance with the nomenclature of chemical compounds.

Development stage

The development stage consists of expert validator assessments, revisions, product trials. The product that has been revised by the validator is tested in schools and is

given a response to teachers and students. Limited trials were conducted at the State High School 1 Muara Batu and the Jabal Nur Private High School. The trial results will be considered in the final product.

Media expert validation

The assessment for the feasibility of making a match-based flashcard learning media with a percentage value of media expert I was 87.2% and media expert II was 88% which was included in the very good category.

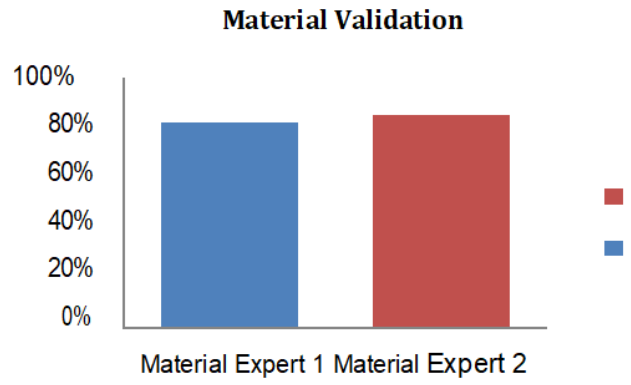


Figure 1. Percentage of Material Expert Assessment

The learning aspect of the material includes 6 components, namely conformity to the material, conformity to student characteristics, conformity to student learning styles, carrying capacity of application to learning, providing motivation to learn, and learning independently. The total aspect assessment scores obtained from the two material experts were 22 and 19 with a percentage value of 79% and 91.6% which were included in the very good category. Aspects of material content include 5 component points, namely easy-to-understand material, the accuracy of examples for clarity of the material, depth of material presented, providing learning assistance for students, and having an impact on teachers and students. This was conveyed by Miftah (2013); Imanda, etc. (2017); Setiawaty, etc. (2020) that the presentation of the media must be adjusted to the learning objectives set so that students better understand what is being learned. The number of aspect assessment scores obtained from the two material experts are 16 and 17 with a percentage value of 85% and 80% which are included in the very good category.

Limited Trial

After the product has been revised in accordance with the comments and suggestions of expert validators, the product will be tested on a limited basis. The trial is useful to determine the feasibility of the Make a Match-based flashcard learning media. The assessment of the results of the limited trial was carried out to determine the feasibility level of the make a match-based flashcard learning media based on the responses from the teacher as the user of the learning media. The percentages obtained from each teacher are teacher 1 of 85.8%, teacher II of 93.4%, teacher III of 92.3%, teacher IV of 100%, teacher V of 90%. This is based on several aspects, namely general appearance, special display, media presentation, learning, and material content. This aspect contains several components. Based on the details of the results contained in Figure 2 that the teacher's response to the make a match-based flashcard learning media is included in the very good category. The following is a review of each aspect of the teacher's response to the flashcard learning media.

The general appearance aspect includes three components, namely media design according to the material, attractive media design, and overall appearance. Nurrita (2018) states that attractive media designs and according to student needs can help students concentrate on learning in accepting the material given by the teacher well. The percentage of assessment obtained from the teacher's feasibility is 93.3% which is included in the very good category. Specific display aspects include 5 components, namely color selection in the media, product durability, image quality, text format, and clarity of usage instructions. The number of assessment percentages is 93% which is included in the very good category.

Aspects of media presentation include four components, namely easy to carry, titled media information, actively involved, colloid presentation on flashcards makes it easier for students to learn colloids. This has previously been explained by Agustya (2017) stating that difficult and boring lessons can result in low student learning outcomes, so the action that must be taken is learning that involves students to be more active in learning. The percentage of assessment obtained is 95% which is included in the very good category. The learning aspect includes six components, namely conformity to the material, conformity to student characteristics, conformity to student learning styles, application support capacity for learning, providing motivation to learn, and learning independently. The number of assessment percentages obtained from the teacher's eligibility is 90.8% which is included in the very good and good categories.

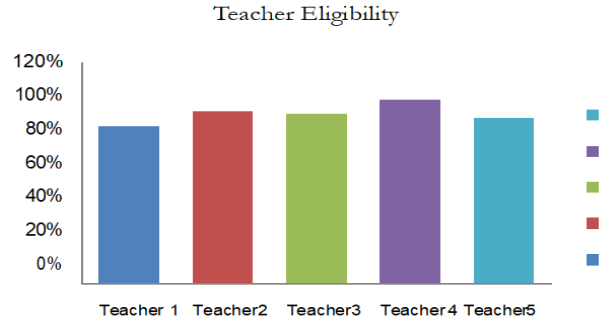
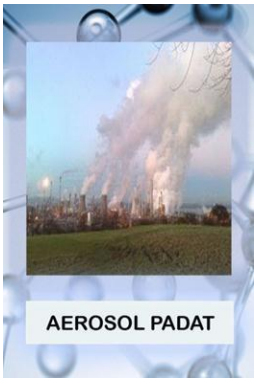
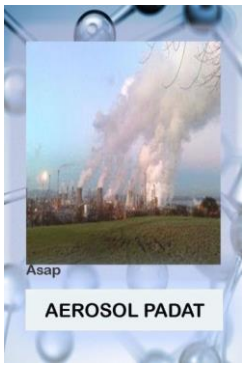
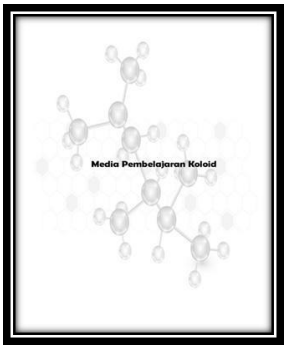


Figure 2. Percentage of Teacher Assessment

Aspects of material content include five component points, namely easy-to-understand material, the accuracy of examples for clarity of the material, depth of material presented, providing learning assistance for students, and having an impact on teachers and students. The number of assessment percentages obtained from the teacher's eligibility is 93% which is included in the very good category. Overall, make a match-based flash card media is suitable for use in learning. Some previous studies also state that learning using flashcards is included in the feasible category, and can be used as a learning media (Damayanti, 2018; hotimah, 2010; Mulyani, 2018; Safitri, 2018). Based on the validation stage by the expert validator that the media instrument can be used for further testing, but must provide improvements to the instrument. These comments and suggestions become material for revision which will be presented in table 1.

Table 2. Results of Revision of Flashcard-Based Learning Media Based on Make A Match Based on Comments and Suggestions from the Validator

Before Revision	After Revision
	
Comments and Suggestions Enter/add image name on the media front	Repair Enter/add name image on the front of the media
	
Comments and Suggestions Make the background of the back of the media more attractive add vivid images	Repair Create an attractive background background add images

CONCLUSIONS

Based on the results of the research that has been done, it can be concluded that the make a match-based flashcard media is appropriate to be used as a learning resource during the learning process on the nomenclature of chemical compounds.

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Author's Contributions

All authors discussed the results and contributed to from the start to final manuscript.

Conflict of Interest

The authors declare that they have no competing interests.

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