

**Development of Multimedia-Based Learning Modules on the Subject of Chemical Equilibrium****Muttakin<sup>1\*</sup>, Ainun Mardhiah<sup>2</sup>, Widya<sup>3</sup>, Ucia Mahya Dewi<sup>1</sup>, Riza Andriani<sup>3</sup>**<sup>1</sup>)Department Of Chemistry Education, Faculty of Teacher Training and Education, Malikussaleh University, North Aceh, Aceh, Indonesia<sup>2</sup>). Department Of Chemistry Education, Faculty of Teacher Training and Education, Serambi Mekkah University, Banda Aceh, Aceh, Indonesia<sup>3</sup>) Department Of Physic Education, Faculty of Teacher Training and Education, Malikussaleh University, North Aceh, Aceh, IndonesiaE-mail\*: [muttakin@unimal.ac.id](mailto:muttakin@unimal.ac.id)**Article Info****Article History:**Received March, 6<sup>th</sup>, 2023Revised April 10<sup>th</sup>, 2023Accepted May 31<sup>th</sup>, 2023**Keyword:**

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**ABSTRACT**

Technological developments demanded student-centered learning-based learning. The development of multimedia-based modules was expected to improve the learning process and existing learning resources. Chemical equilibrium material was one of the materials that were difficult to understand and had a broad scope and limited discussion time. Therefore, learning modules were needed that could be easily accessed and understood. This study aimed to produce appropriate multimedia-based learning modules easily understood by students. The research method used was Research and Development (R&D). The developmental design used by Borg and Gall. The feasibility of multimedia-based modules was obtained from the validation results of 3 experts, namely material experts, media experts, and linguists. The module was tested on teachers and students at school. The results of the expert validation stated that multimedia-based modules on the subject of chemical equilibrium were considered feasible from the categories of material, media, and language. The results of the multimedia-based module trial on the material of equilibrium for teachers and students received an assessment in the Very Good category.

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**INTRODUCTION**

The covid 19 pandemic made the learning process not optimal. Learning that is carried out online, the readiness of learning devices, learning media and teaching materials are challenges that must be faced by all educators. The ability of students to absorb knowledge information conveyed by the teacher is also limited. The pandemic requires educators to create teaching materials that are easy for students to understand in various conditions, both pandemic conditions and normal conditions.

Chemistry learning is one of the subjects that is severely hampered by the COVID-19 pandemic. Explanations of complex chemistry material consisting of calculations and practice are the reason that chemistry learning is not optimal during the pandemic. Ansori, (2000) Chemistry is a branch of natural science that studies the structure of matter, the properties of matter, changes from one material to another, and the energy that accompanies changes in matter. One of the most difficult chemicals to explain is chemical equilibrium. Broad material coverage, difficult calculations and explanation of material using the practicum method are a challenge for educators in

explaining chemical equilibrium material as a whole in the learning process which is carried out online.

Technological developments demand student-centered learning-based learning. One of the teaching materials based on student centered learning by combining technology is the development of multimedia-based learning modules. In the book *General Guidelines for the Development of Teaching Materials* (2004) published by the National Education Office, a module is defined as a book written with the aim that students can learn independently without or with the guidance of a teacher. Thus, a module must be used as teaching material as a substitute for the educator's function. If the educator has the function of explaining something, then the module must be able to explain something in language that is easily accepted by students according to their level of knowledge and age. Daryanto, (2013) states that a module is a teaching material that is packaged as a whole and systematically, containing a set of planned and designed learning experiences to help students master specific learning goals.

In general, multimedia is defined as a combination of data, sound, video, animation, graphics and text, where the combination of all these elements can be displayed via a computer. The development of multimedia-based modules can facilitate learning in all conditions, be it pandemic conditions or normal conditions. Rayandra, (2012). Through media, a learning process can be interesting and fun (joyful learning), for example students who have an interest in color can be given media with attractive colors.

Lee, William, W, (2004). reveals several stages in designing a content structure of a multimedia-based learning system, namely: 1. Describing content into material units which include: concepts, processes, procedures, principles, facts, and systems. 2. Mapping information includes: making lesson outlines, and laying out flowcharts. Development and research using multimedia modules was carried out during the covid 19 period. The modules used in this research make it easier for students to learn, because students can study anytime and anywhere. There has been a lot of research on developing multimedia-based modules such as that carried out by (Candra and Sunaryo 2017), namely developing interactive multimedia modules with two-dimensional animation. In addition (Meliawati, Hartono and Sugito, 2022) and (Tri Wahyuni, Sri and Yushardi, 2017), they have also conducted research on the development of multimedia-based modules. In their research, the use of interactive multimedia modules can increase student learning interest and motivation. Using this module can also improve student achievement. Therefore, the researcher wants to conduct a multimedia-based module development research on chemical equilibrium material. The developed modules become learning resources for teachers and students, and make it easier for students to learn independently. Multimedia-based modules are one of the learning media that is very much needed in the digital age as it is today.

## METHODS

### Types and Research Design

Research is research and development (R&D). R&D is a research method used to produce certain products and test the effectiveness of certain products (Sugiono, 2010).

The Borg and Gall version of the research and development method is a type or descriptive research method, where in this study no administration and control of treatment is required. In general, descriptive research is not intended to test hypotheses.

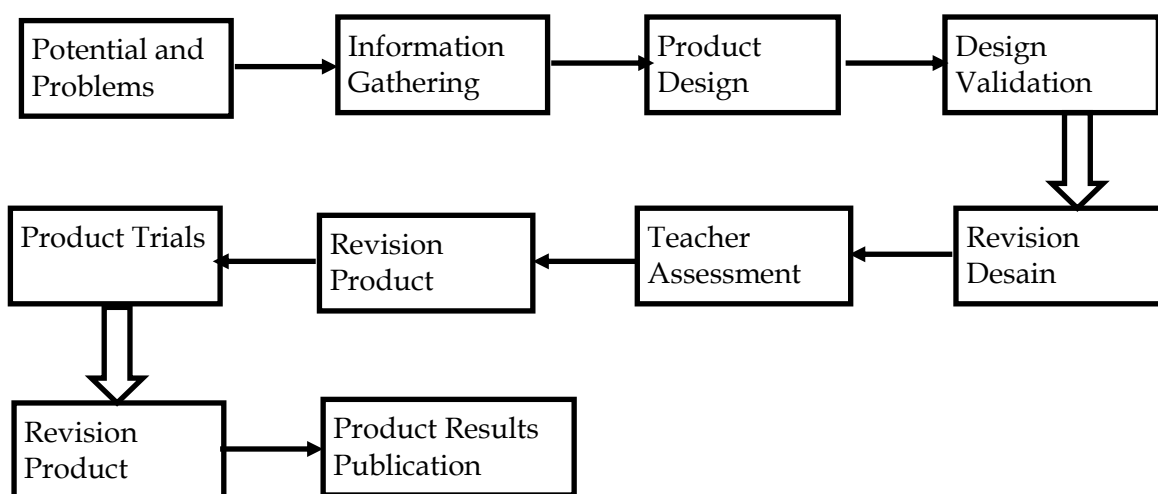


Figure 1. The steps for using the method research and development (R&D)

### Population and Research Sample

The population in this study were high school teachers and students in the city of Banda Aceh. Based on this population, three chemistry teachers in class XI and 15 students in class XI at SMA Kota Banda Aceh were selected as samples. The sample schools taken were: SMAN 8 Banda Aceh, SMAN 11 Banda Aceh and SMA Kartika Banda Aceh.

### Research Instruments

The research instrument consists of validation sheets that will be assessed by experts, namely validation of material, language, media and instrument sheets in the form of teacher and student response questionnaires. Instrument validation is carried out by experts in their field.

### Data collection technique

The data collection sources used by researchers use the following instruments: 1. Validation sheet, validation is carried out to test the feasibility of material, language, and media. Validation is carried out by experts in their respective fields. 2. Questionnaires, questionnaires given in the form of teacher and student responses to multimedia-based learning modules. Questionnaire created consists of several statements and for each statement there is an answer that must be chosen.

### Data analysis technique

Data analysis of the feasibility of multimedia-based learning modules in this study refers to the 2007 BNSP namely:

1. Expert Validation Data

Assessment of the feasibility of multimedia-based learning modules includes 3 components, namely: material, language and media. The feasibility of multimedia-based learning modules refers to the 2007 BSNP, namely:

- a. Calculating the average score of each component of the multimedia-based learning module research. The formula used is as follows

$$X = \frac{\sum X}{n}$$

With X is the average score,  $\sum X$  is the total score and N is the number of items / sub-components

Establish criteria for evaluating multimedia-based learning modules

Expert assessment criteria, multimedia-based learning modules are declared passed if the material has an average score of at least 2.75 in each subcomponent. The language and media components have an average score of greater than 2.5 for each subcomponent. Multimedia-based learning modules are declared to have passed with improvement if the material, language and media components have an average score of less than or equal to 2.50 for each sub-component. The module is declared not passed if it has an average score of 1 on all components. The assessment criteria are presented in Table 1 below:

**Table 1.** Expert Validation Assessment Criteria

Component	Score	Criteria
Material	$X \geq 2,75$	Worth developing
Language and Media	$X > 2,50$	Worth developing
Material, Language and Media	$X \leq 2,50$	Worth the repair
	$X = 1$	Not feasible

(BSNP, 2007)

2. Teacher and Student Response Data

Data analysis from the teacher's response questionnaire and student response questionnaire was measured using the Guttman scale. The data obtained is then calculated using the following formula:

$$P = \frac{\sum X}{N} X 100\%$$

Where P is the percentage,  $\sum X$  is the number of yes answers from the options, and N is the number of options on the questionnaire .

**Table 2.** Questionnaire Criteria for Teacher and Student Responses

No	Score	Criteria
1.	Skor 77% - 100%	Very good
2.	Skor 51% - 75%	Good
3.	Skor 26% - 50%	Enough
4.	Skor $\leq 25\%$	Not good

(Arikunto, 2009)

## RESULTS AND DISCUSSION

The results of this study were described based on multimedia-based learning modules that assessed the feasibility of multimedia-based learning modules by several

chemistry teachers in class XI in Banda Aceh City. The teachers selected were SMAN 8, SMAN 11 and SMA Kartika teachers in Banda Aceh. After the feasibility of the module was assessed by the teacher, the module was tested on 15 high school students in the city of Banda Aceh.

The initial stage of this research was that the researcher made a learning video on chemistry material for class XI high school students on the subject of chemical equilibrium. Next, the researcher conducted a validation. Validation is carried out by providing an assessment, namely instrument, material, language and media validation. Validation was carried out by four experts, 3 people from universities and 1 linguist from one of the language centers in Aceh Province. Furthermore, the questionnaire sheet has been validated by expert lecturers and given to 3 high school chemistry teachers for class XI and 15 class XI students at SMA Kota Banda Aceh.

The results of the validation of multimedia-based learning modules can be seen in Table 3 below.

**Tabel 3** Results of Validation of Multimedia-Based Learning Modules by Experts

No	Evaluation	Average Score	Criteria
1.	Material	3,71	worthy
2.	Language	4,6	worthy
3.	Media	3,4	worthy

Based on the results of validation by experts which include the feasibility of the material, language and media, it is declared suitable for use. But there are some suggestions from experts that must be corrected. Improvements are expected to improve the quality of the developed multimedia-based learning modules. The following sections should be revised according to expert advice.

**Tabel 4.** Revised Parts According to Expert Advice

No	Suggestion	Repair
1.	Material <ul style="list-style-type: none"> <li>• Submission of material related to examples in everyday life</li> <li>• Explaining examples of questions that are clearer and in accordance with the material that has been explained</li> </ul>	<ul style="list-style-type: none"> <li>• Explaining material related to everyday life so that it is easier to understand</li> <li>• Improving how to explain examples of questions that are clear and precise.</li> </ul>
2.	Language <ul style="list-style-type: none"> <li>• Not much repetition of words and correcting spelling</li> </ul>	<ul style="list-style-type: none"> <li>• Improved with less repetition of words and improved spelling to make it more precise and easy to understand</li> </ul>
3.	Media <ul style="list-style-type: none"> <li>• Change the background according to the chemical material and don't vary too much</li> </ul>	<ul style="list-style-type: none"> <li>• Using a background that matches the chemistry theme and doesn't vary too much.</li> </ul>

Development of multimedia-based learning modules that have been validated by experts with appropriate criteria for use, the modules were assessed by 3 class IX senior high

school chemistry teachers. The results of the assessment of 3 class XI high school chemistry teachers can be seen in Table 5 below:

**Table 5.** Teacher Response Results

No	Statement	Frekuensi		Persentase	
		Yes	No	Yes	No
1.	The contents of the material displayed are in accordance with the chemical equilibrium material	3	0	100	0
2.	The material explained is easily understood by students	2	1	66,66	33,33
3.	The examples of questions explained in the video are easy for students to understand	3	0	100	0
4.	The voice/audio in the learning video sounds very clear	3	0	100	0
5.	Interesting learning video design	2	1	66,66	33,33
6.	I am interested in teaching using this learning video.	3	0	100	0
7.	Using multimedia-based learning modules makes it easier for me to carry out the teaching and learning process online during the Covid 19 pandemic	3	0	100	0
8.	This multimedia-based learning module is very useful during the Covid 19 pandemic	3	0	100	0
9.	The resulting learning videos encourage students not to get bored learning.	3	0	100	0
10.	This learning video motivates me to teach	3	0	100	0
Average		2,8	0,2	93,332	6,666

The results of the percentage of teacher responses to multimedia-based learning modules were 93.332% with very good criteria. The development of multimedia-based learning modules can be tested on students. We can see the results of student responses regarding multimedia-based learning modules in Table 6 below:

**Tabel 6.** Results of Student Responses

No	Statement	Frekuensi		Persentase	
		Yes	No	Yes	No
1.	Are you interested in learning by using learning videos on chemical equilibrium material?	15	0	100	0
2.	Is the learning video in accordance with the chemical equilibrium material?	15	0	100	0
3.	Is the appearance and design of the chemical equilibrium learning video material interesting?	12	3	80	20
4.	Does the example image displayed in the learning video make it easier for you to understand chemical equilibrium material?	12	3	80	20
5.	Do you understand the chemical equilibrium material explained using learning videos?	13	2	86,66	13,33

6.	Are the examples of questions presented easy for you to understand through learning videos?	11	4	73,33	26,66
7.	Is it difficult for you to understand the discussion of the questions presented in the learning video?	11	4	73,33	26,66
8.	Can this learning video make your learning atmosphere fun?	15	0	100	0
9.	Doesn't this learning video make you boring in learning?	13	2	86,66	13,33
10.	Are there any benefits for you after using learning videos on chemical equilibrium material?	15	0	100	0
Average		13,3	1,8	87,99	9,33

Based on the results of trials on students, student responses to the developed multimedia-based learning modules were included in very good criteria with a percentage of 87.99%. Students' negative responses regarding the learning module were 9.33%.

**Discussion**, the results of the validator's assessment show that the multimedia module in terms of language, media and material is feasible to use and very good. Priambudi (2018), that the color template used must be contrasting, which means that the color differences on the background and writing must be contrasting which aims to make it easier for students to read and understand learning. Daryanto (2013), modules should have user-friendly characteristics. All information conveyed must be able to help users, such as using simple and easy-to-understand language and using common language.

Based on expert validation, teacher assessment and student responses indicate that there is a slight improvement in the content of the multimedia module. This is in line with the meaning of the module, namely the material is made in full which in it contains a lesson in which there are learning objectives, materials, and evaluations and are arranged and regulated so that they can help and achieve learning goals (Pratiwi and Martiana, 2017).

Based on table 3 above from these results, multimedia-based learning modules can be used by teachers as teaching materials on chemical equilibrium material. This is in accordance with the theory (BSNP, 2007), namely teaching materials are categorized as appropriate if the content component has an average of  $\geq 2.75$  and an average score of  $> 2.5$  on the language and media feasibility components. If the average score for content, language and media is  $\leq 2.5$ , then the teaching material is categorized as worthy of revision. This module was developed during the Covid-19 pandemic so that learning could not run normally. (Meliawati, 2022), teaching materials that contain material in the form of text, images, sound, and video make it easier for students in the learning process. The use of multimedia modules can increase student interest and understanding of concepts in informatics education study programs (Yosi Nur Kholisho, 2017). The existence of this module is felt suitable because it can help students still be able to study material at home and study time can be adjusted

## CONCLUSION

Based on the results of the research that has been done, it can be concluded that the development of multimedia-based learning modules is feasible to use and develop. The teacher's response to the multimedia-based learning module was 93.33% in the very good category. Student responses to multimedia-based learning modules were 87.99% with very good criteria. Based on the results of the development of this module, it can be suggested that in the future multimedia modules can be made using other, more varied materials. Need to add evaluation questions that are more diverse.

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