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Development of an Interactive Multimedia Based E-modul on Geometric Isomer Material

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Abstract
This research uses the Research and Development (R&D) method with the ADDIE model. Validation techniques were analyzed using Content Validity Ratio (CVR) and Content Validity Index (CVI). Collecting data from student response questionnaires uses measurement techniques with indirect communication. The results of product validation from every aspect, both in e-modules and interactive videos, obtained a CVI value of 0.99 and were declared valid and suitable for use. The results of the student response questionnaire in the initial field test reached an average of 89.72% in the very good category and the main field test reached an average of 88.16% in the very good category.

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INTRODUCTION

The learning process requires supporting learning media that can motivate students in improving independent learning activities. Interactive learning media can help the learning process so that the meaning of the message conveyed becomes clearer and educational goals can be achieved effectively and efficiently (Afifah et al., 2022). One of the teaching materials that can be used is in the form of modules. Modules can be combined with interactive multimedia teaching materials in the form of e-modules. Multimedia is a new concept and technology in the field of information technology, where information in the form of text, images, sound, animation, and video is put together in a computer to be stored, processed, and presented both linearly and interactively (Cucus & Aprilinda, 2016). E-modules are learning resources that contain materials, methods, limitations and ways of evaluating that are designed systematically and interestingly to achieve competencies that are in accordance with the curriculum electronically (Laili et al., 2019)

The Organic Chemistry course is a course that is considered difficult for the majority of students, this is because the characteristics of Organic Chemistry materials in universities are quite complex, especially because of the many concepts that must be understood. This is reinforced by the results of the analysis of the difficulty of the materials in the Organic Chemistry course as a whole where 98% of students stated that the material in the Organic Chemistry Course was in the categories of very difficult (5.88%), difficult (34.32%) and quite difficult (57.84%) (I. Lestari & Erlina, 2020). Based on a literature study conducted by Rico & Fitriza (2021), information was obtained that hydrocarbon compound materials are still

found errors and misconceptions of students on the topic of isomers which are part of hydrocarbon stereochemical materials (Rico & Fitriza, 2021). In addition, it is also necessary to understand the use of certain stereochemical terms, visualize structures in three dimensions and transform between different structural formulas and projections (Durmaz, 2018).

Stereochemical materials are considered difficult especially on the topic of geometric isomers. This has been proven based on the results of research by Lestari & Erlina on students of the chemistry education study program FKIP Untan batch of 2019 and 2020 who still find errors and misconceptions on the topic of geometric isomers (I. Lestari & Erlina, 2021). Analyzing geometric isomers on hydrocarbons found that 51.25% of students had misconceptions and 13.75% of students did not understand the concept. Identifying geometric isomeries in hydrocarbons found that 46.25% of students had misconceptions and 40.00% of students did not understand the concept. Analyzing geometric isometry in hydrocarbons (Entgegen and Zusammen systems) found that 41.25% of students experienced misconceptions and 36.25% of students did not understand the concept. This is reinforced based on the results of previous research conducted by Rico & Fitriza which also found misconceptions experienced by students on isomeric topics (Rico & Fitriza, 2021). It was also found in previous research conducted by Djarwo that 20.83% of students still experience misconceptions in geometric isomer materials (Djarwo, 2019)

Based on the problems that have been found, pre-research is carried out to identify students' understanding of isomeric materials. The results of pre-research conducted on students of the chemistry education study program class of 2019 totaling 42 students on September 15, 2021 using questionnaires obtained information that strengthens previous research, found difficulties in understanding isomeric materials, especially in the geometric isomer material group. On the topic of the Entgegen-Zusammen isomer (66.66%) students have difficulty in determining priority substituents so they cannot provide nomenclature with the Entgegen-Zusammen (E-Z) system. It is known that students still do not understand the naming of the E-Z system because in this system the groups that are bound are all different. On the topic of cis-trans isomers (26.29%) students have difficulty in determining the compound classified as a type of cis compound or trans compound and tends to be reversed in determining it. These findings are in line with the factors that make Organic Chemistry considered difficult because it requires an understanding of molecular geometry and the large amount of specialized vocabulary in Organic Chemistry (O' Dwyer & Childs, 2017). The Organic Chemistry is a course that is considered difficult for most students, this is because the characteristics of Organic Chemistry at the university level are fairly complex because of the many concepts that must be understood and the relationship between concepts (I. Lestari & Erlina, 2020). Organic Chemistry is a course that is difficult to prove with many errors and misconceptions found on the topic of geometric isomers (I. Lestari & Erlina, 2021).

Learning at the university level certainly requires effective learning media so that course learning outcomes can be achieved. In this study, the e-module was developed based on interactive multimedia on geometric isomer material. Media-based interactive multimedia was chosen because users can control what and when multimedia elements will be displayed. Based on research conducted by Ira Lestari & Erlina explained that the type of media most desired by students for the Organic Chemistry course when learning is carried out is learning media containing videos. Students prefer videos because the media in the form of video explanations of the material is presented visually (I. Lestari & Erlina, 2020). It was found that there were three types of learning media that were most in demand, namely videos (48.54%), images (23.62%), and modules (13.59%). Combining learning media with audio-visual

makes the material easier to understand because the learning material can be heard and seen so that the learning process can be more interactive (Afifah et al., 2022). The advantages and benefits of delivering material with the concept of multimedia learning are that the learning process is more interesting, more interactive, estimated teaching time can be more efficient, the quality of student learning can be improved and the teaching and learning process can be done anywhere and anytime (Cucus & Aprilinda, 2016). The purpose of this study is to develop interactive multimedia-based e-modules on geometric isomer material, determine the feasibility of e-modules and student responses to the e-modules developed. Hopefully, the results of this research can be the basis for researchers and lecturers to be able to develop learning media that are right on target and effective in their use.

METHOD

The research method used is the research and development method (R&D). Development procedure uses the ADDIE development model which consists of the stages of analyze, design, development, implementation and evaluation (Afifah et al., 2022). In this study, the implementation stage was not carried out because it was only needed to determine the validity and response of students (A. Lestari et al., 2021). This research was conducted in the odd semester of the 2023/2024 academic year. The subject of this research is an interactive multimedia-based e-module on geometric isomer material which was carried out a response test to students of the chemistry education study program at Tanjungpura University class of 2020 who have studied the Monofunctional Compound Organic Chemistry Course, especially on geometric isomer material.

The first stage is analysis. Problem identification was carried out by providing an online response questionnaire to 42 students of the chemistry education study program class of 2019 to identify the understanding and level of difficulty in isomeric materials. It was found that most of the students had difficulties with geometric isomeric materials. After identifying the problem, a needs analysis is carried out. Needs analysis is carried out by identifying the needs needed by students based on the results of problem identification.

The second stage is design. Determined course learning outcomes, content limits in the modules developed, and the search for resources or materials used in the modules. In addition, at the design stage, story boards were also made and validation questionnaires for validators and response test questionnaires for students which were the initial illustrations of the e-modules developed. The following development design has been created.

The third stage is development. The development of interactive multimedia-based e-modules based on story boards that have been created is carried out. The developed e-module contains multimedia aspects such as interactive video, images, and audio so it is necessary to test the validity of all content in the e-module. Next, the product is carried out a validity test stage by five validators. The validity test is carried out with two assessments, namely on the e-module and on the interactive video contained in the e-module. Validity tests are carried out on aspects of language, aspects of graphics, and aspects of material. After that, the product is carried out an improvement process in accordance with the opinion of the validator until the product is declared valid so that it is suitable for use for the response test stage to students. Then the initial field test and main field test were carried out for students of the chemistry education study program FKIP Untan class of 2020 in the odd semester of the 2023/2024 academic year. The initial field test was conducted on 6 respondents, while the main field test was carried out on 30 respondents. Based on the development research procedure prepared by Borg and Gall in conducting early stage field trials carried out using 6-10 subjects, while in conducting main stage field trials carried out using 30-80 subjects. In the response test, the aspects assessed are the appearance of the e-module, presentation of the material, and usability. Finally, after improvements were made from the validity test results and the results of the response test, the final product of interactive multimedia-based e-modules on geometric isomer material was obtained.

The e-module validity test result data was processed using Content Validity Ratio (CVR) analysis techniques. CVR is an approach to determine the suitability of items to the domain measured based on the assessment of experts or validators. The CVR analysis formula is:

$$\mathrm{CVR} = \frac{\mathrm{Ne} - \frac{\mathrm{N}}{2}}{\frac{\mathrm{N}}{2}}$$ (Lawshe, 1975)

Information:

Ne : Number of experts who agree and strongly agree with the validity of the media (stated agree if the score of the statement item ranges from 3 to 4, if the score of the statement item < 3 then it is stated that it does not agree with the validity of the media)

N : Number of validator members conducting the assessment

After obtaining the CVR value, then calculated the CVI (Content Validity Index) value to describe the overall instrument items have good content validity. The CVI formula is:

$$\mathrm{CVI} = \frac{\mathrm{CVR}}{\sum \mathrm{n}}$$

Information:

CVR : CVR value of all aspects

$\sum$n : Number of items of the entire aspect

If the CVI value is in the range of 0 to 1, then the instrument can be said to be good. If in the final calculation the CVR and CVI scores meet the minimum limit value of Lawshe (1975)

which is 0.99, then the e-module is declared valid and suitable for use. Student response data was analyzed with a Likert scale which was divided into four categories, namely, 4 (strongly agree), 3 (agree), 2 (disagree), and 1 (strongly disagree). A calculation is carried out for each item of the statement on the aspect under review. Data from student responses is calculated using a formula :

$$P = \frac{\Sigma x}{\Sigma xi} \times 100\%$$

Information:

P : Score percentage

Σx : Total score obtained

Σxi : Total score maximum

Furthermore, the average total score percentage of all aspects assessed is calculated using a formula :

$$\overline{P} = \frac{\Sigma P}{n}$$

Information:

$\overline{P}$: Average percentage of all aspects assessed

ΣP : The sum of the average score percentage of each aspect

N : Number of assessed aspects

The criteria for student response results to the e-module developed according to Amirullah & Susilo can be seen in Table 1.

Table 1. Student Response Results Criteria

Percentage (%)	**Category**
86 – 100	Excellent
76 – 85	Good
60 – 75	Good enough
≤55 - 59	Bad

(Amirullah & Susilo, 2018)

RESULTS AND DISCUSSION

The first stage is analyze, at this stage a problem analysis and needs analysis are carried out (Asmar & Suryadarma, 2021). First, a problem analysis was carried out by providing an online response questionnaire to 42 students of the chemistry education study program class of 2019 to identify the understanding and level of difficulty in isomeric materials. It was found that most students had difficulty in understanding isomeric materials, especially in the geometric isomer material group. On the topic of E-Z isomers, students have difficulty in determining priority substituents so they cannot provide nomenclature with the E-Z system. On the topic of cis-trans material, students have difficulty in determining which compounds are classified as cis or trans compounds because they cannot distinguish the spatial positions of the atoms and tend to be reversed in determining them.

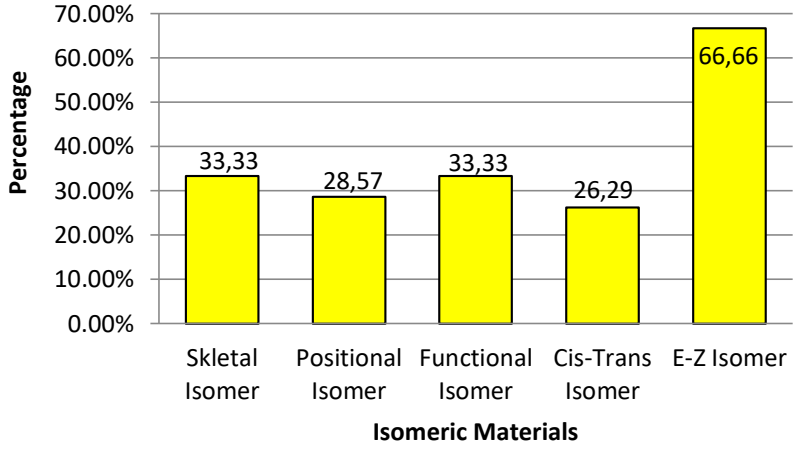


Figure 1. The level of difficulty in isomeric materials

Based on Figure 1 on the most difficult material, namely on the topic of E-Z isomers, which is 66.66%. On the topic of cis-trans isomers, it was found as much as 26.29%. These findings are in line with the factors that make Organic Chemistry considered difficult because it requires an understanding of molecular geometry and the large amount of specialized vocabulary in Organic Chemistry (O' Dwyer & Childs, 2017). The Organic Chemistry is a course that is considered difficult for most students, this is because the characteristics of Organic Chemistry at the university level are fairly complex because of the many concepts that must be understood and the relationship between concepts (I. Lestari & Erlina, 2020). Organic Chemistry is a course that is difficult to prove with many errors and misconceptions found on the topic of geometric isomers (I. Lestari & Erlina, 2021).After knowing the existing problems, a needs analysis process is carried out. Needs analysis is obtained from the results of problem analysis. Based on existing problems, a learning media is needed that can explain isomeric material visually, in order to get a more in-depth explanation of the material.

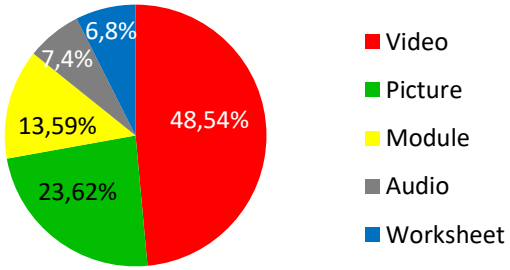


Figure 2. Types of learning media that are most in demand

Based on Figure 2, in research conducted by Ira Lestari & Erlina, it was found that there are three types of learning media that are most popular during the learning process in the Monofunctional Compound Organic Chemistry course, namely in the form of videos (48.54%), images (23.62%), and modules (13.59%) (I. Lestari & Erlina, 2020). The concept of multimedia is the merger of two or more media elements consisting of text, images, photos, audio, video and animation in an integrated manner (Cucus & Aprilinda, 2016). Combining learning media with audio-visual makes the material easier to understand because the learning material can be heard and seen so that the learning process can be more interactive (Afifah et al., 2022). Therefore, the development of e-modules is carried out that combines the three types of learning media by focusing more on interactive videos that contain explanations of material and practice questions and discussions.

The second stage is design, at this stage the design of the e-module developed is in the form of determining course learning outcomes based on semester learning plans, collecting learning materials, collecting development support software, making validation questionnaires and response test questionnaires, and making story boards (Basori, 2016). The learning outcomes of the course are determined based on the semester learning plan that has been designed by the lecturer of the Monofunctional Compound Organic Chemistry course. Collection of learning materials based on literature studies through organic chemistry books for universities. The collection of software used is Microsoft Word 2010, Microsoft Powerpoint 2010, Photoshop CC 2018, ChemDraw Professional 15.0, and Flip Builder Corporation. Making validity test questionnaires and response test questionnaires based on previous research that has been modified. Making a story board in the form of an initial overview of the developed e-module. Multimedia aspects are displayed on the e-module such as interactive video, pictures, and audio.

a) Interactive video b) Picture c) Audio

Figure 3. Multimeda aspects of the e-module: a) Interactive video, b) Image, c) Audio

The third stage is development, at this stage the development of e-modules based on previously made story boards (Kunto et al., 2021). The e-module is written in Microsoft Word 2010. Next, the e-module is converted in jpg format and then converted into pdf. The module in pdf form is converted into the Flip Builder Corporation app. Furthermore, in the Flip Builder Corporation application, an interactive video was added containing material explanations along with sample questions and discussions edited using Microsoft Powerpoint 2010, the addition of audio made using Text to Speech online and the addition of images obtained from Google and the addition of chemical structures made using ChemDraw Professional 15.0. After being created, finally the e-module is exported into a link. The resulting e-module is in the form of a flipbook that can be accessed via mobile phones and laptops. At the development stage, the e-module developed was carried out validity analysis using the CVR and CVI methods. If the final value of CVR and CVI is 0.99, it can meet the minimum limit for 5 validators who carry out the assessment set by Lawshe, then the e-module is considered valid and suitable for use as a learning medium. After the validity test, field trials were carried out on the e-module to students to determine the students' response to the e-module developed.

At the development stage, validity tests were carried out on e-modules and interactive videos. The validity test assessment is assessed using a Likert scale with four assessment criteria, then subjective criticism and suggestions are given by validators to get an e-module that is worth using (Nalarita & Listiawan, 2018). Feasibility assessments for each aspect are assessed by five validators. After that, field trials were carried out on e-modules to students to find out student responses to the e-modules developed. Assessment items are valid if the CVR value reaches the minimum value. If there are 5 validators who assess the product developed, then the minimum CVR limit value is 0.736 (Nengsih et al., 2019).

Table 2. Results of Validity Test on Language Aspects in E-module

Indicators	**Statements**	**Validators**					**CVR**
		1	**2**	**3**	**4**	**5**	
Straightforward	1. Every word used is clearly written.	4	4	4	3	4	0.99
	2. Use effective sentences.	4	4	4	3	4	0.99
Communicative	3. The sentences used are easy to understand.	4	4	4	3	4	0.99
	4. The sentences used can convey information well.	4	4	3	3	4	0.99
Compliance with Indonesian rules	5. The sentence structure used is in accordance with the General Guidelines for Spelling Indonesian	4	4	4	3	4	0.99
	6. Word selection is correct and in accordance with Enhanced Spelling	4	4	4	3	4	0.99
CVI value							**0.99**

Based on Table 2, it is known that the results of the validity test on the language aspect in each e-module obtained a CVR value of 0.99 and a CVI value of 0.99, which means that the indicators contained in the language assessment aspect in the e-module are valid and suitable for use. Assessment items are valid because the CVR value exceeds the minimum value of 0.736 (Nengsih et al., 2019). This shows that the information in the e-module is easy to understand which is presented with a proper and effective sentence structure and the language used is in accordance with Indonesian rules. The assessment of validity analysis on linguistic aspects consists of several aspects, namely straightforward aspects, communicative aspects, and aspects of regularity with Indonesian rules (Rahmatika & Ratnasari, 2018). The language in learning media must be easy to understand in order to facilitate students in learning (Masrifah et al., 2020).

Table 3. Validity Test Results on Language Aspects in Video

Indicators	**Statements**	**Validators**					**CVR**
		1	**2**	**3**	**4**	**5**	
Communicative	1. The sentences used are easy to understand.	4	4	4	4	4	0.99
	2. The sentences used can convey information well.	4	4	3	4	4	0.99
Compliance with Indonesian rules	3. The sentence structure used is in accordance with the General Guidelines for Spelling Indonesian.	4	4	4	4	4	0.99
	4. The word selection is correct and in accordance with Enhanced Spelling.	4	4	4	4	4	0.99
CVI value							**0.99**

Based on Table 3, it is known that the results of the validity test on the language aspect in each video indicator obtained a CVR value of 0.99 and a CVI value of 0.99, which means that the indicators contained in the language assessment aspect in the video are valid and suitable for use. Assessment items are valid because the CVR value exceeds the minimum value of 0.736 (Nengsih et al., 2019). This shows that the intonation of the voice in the video is appropriate and the information conveyed is easy to understand and the grammar spoken is in accordance with the rules of Indonesian. The assessment of validity analysis on linguistic aspects consists of several aspects, namely straightforward aspects, communicative aspects, and aspects of regularity with Indonesian rules (Rahmatika & Ratnasari, 2018). The language in learning media must be easy to understand in order to facilitate students in learning (Masrifah et al., 2020).

Table 4. Results of Validity Test on Graphic Aspects in E-module

Indicators	Statements	Validators					CVR
		1	2	3	4	5	
E-module cover design	1. The appearance of the layout (title, author, image, logo) is proportional.	4	4	3	4	4	0.99
	2. The writing used on the cover is easy to read and understand.	4	4	4	4	4	0.99
	3. The illustration on the cover is in accordance with the content of the material.	4	4	4	4	4	0.99
	4. The color combination of the cover is harmonious.	4	4	3	4	4	0.99
Contents of the e-module	5. Proportional layout (images, videos, illustrations).	4	4	3	4	4	0.99
	6. The space between the text and illustration is harmonious.	4	4	4	4	4	0.99
	7. The spacing between paragraphs is clearly visible.	4	4	4	4	4	0.99
	8. The writing of the material can be seen clearly.	4	4	4	3	4	0.99
	9. The design of the contents page is attractive.	4	4	3	3	4	0.99
Software	10. Audio can be heard clearly.	4	4	4	4	4	0.99
	11. The video can be clearly seen.	4	4	4	4	4	0.99
	12. The navigation buttons can be easily operated.	4	4	4	4	4	0.99
CVI value							**0.99**

Based on Table 4, it is known that the results of the validity test on the graphic aspect of the e-module obtained a CVR value of 0.99 and a CVI value of 0.99, meaning that the indicators on the graphic assessment aspect of the e-module are valid and feasible to use. Assessment items are valid because the CVR value exceeds the minimum value of 0.736. (Nengsih et al., 2019). This shows that the cover design of the e-module has illustrations that are adapted to the content of the material, the typography of the e-module is simple and easy to read and the software on the e-module can be used and functions properly. The assessment of validity analysis on graphic aspects consists of several aspects, namely the module cover design aspect and the graphic aspect of the module content (Nurfadilah et al., 2019). Apart from that, there is an additional aspect, namely the software aspect. The graphic aspect must contain clarity of layout, type and size of letters, presentation of illustrations and colors and symbols that are attractive and make it easier for students to understand the material (Ayuningtyas, 2016).

The following are the results of improvements made to the graphic aspect of the e-module.

a) Before revision

b) After revision

Figure 4. Cover e-module: a) Before revision, b) After revision

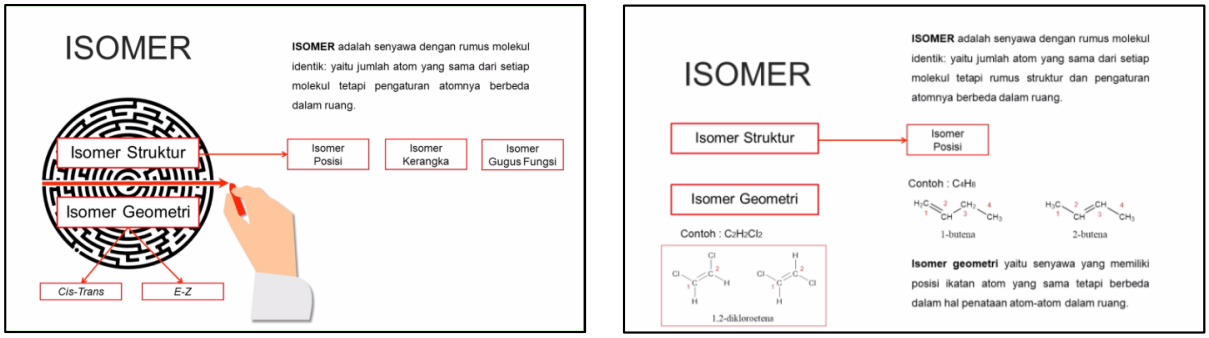
Table 5. Validity Test Results on Graphic Aspects in Videos

Indicators	Statements	Validators					CVR
		1	2	3	4	5	
Media design	1. Color display illustration and matching writing.	4	4	3	4	4	0.99
	2. The illustrations displayed make it easier to understand the material.	4	4	4	4	4	0.99
	3. The typeface used is easy to read.	4	4	4	4	4	0.99
Media formats	4. The resolution of the displayed video is clear.	4	4	4	4	4	0.99
	5. The size of the illustration in the video is appropriate.	4	4	3	3	4	0.99
	6. The length of the displayed video is appropriate.	4	4	4	3	4	0.99
Media audio	7. The sound on the video can be heard clearly.	4	4	3	4	4	0.99
CVI value							**0.99**

Based on Table 5, it is known that the results of the validity test on the graphic aspect of the video obtained a CVR value of 0.99 and a CVI value of 0.99, meaning that the indicators on the graphic assessment aspect of the video are valid and suitable for use. Assessment items are valid because the CVR value exceeds the minimum value of 0.736 (Nengsih et al., 2019).

This shows that the illustrations displayed can make it easier to understand the material, the typeface used is easy to read, and the resolution and sound in the video can be seen and heard clearly. The graphic assessment aspects of videos consist of media design, media format and media audio (Utami et al., 2024). The graphic aspect must contain clarity of layout, type and size of letters, presentation of illustrations and colors and symbols that are attractive and make it easier for students to understand the material (Ayuningtyas, 2016).

Here are the results of improvements made to the graphic aspect of the video.



a) Before revision b) After revision

Figure 5. The results of the revision of graphic aspects in the video: a) Before revision, b) After revision

Table 6. Results of Validity Test on Material Aspects in E-module

Indicators	Statements	Validators					CVR
		1	2	3	4	5	
Material coverage	1. The material presented includes geometric isomer material.	3	4	4	4	4	0.99
	2. The material asked about the evaluation question is in accordance with the measured competence.	3	4	4	3	4	0.99
Accuracy of the material	3. The presented examples correspond to the concept of the material.	4	4	4	4	4	0.99
	4. The displayed image can support the visualization of the material.	4	4	3	4	4	0.99
	5. The formula and chemical structure used are exact.	4	4	4	4	4	0.99
Serving technique	6. Systematize the presentation of material coherently and consistently.	3	3	4	4	4	0.99
Completeness of presentation	7. E-modules are complete and arranged systematically from cover to bibliography.	3	4	3	4	4	0.99
Presentation	8. Using the audio aspect in the form of sound icons can help in. explanation of the	4	4	4	4	4	0.99

support	material.						
	9. Using interactive videos in delivering material.	4	4	4	4	4	0.99
CVI value							**0.99**

Based on Table 6, it is known that the results of the validity test on the material aspect in the e-module obtained a CVR value of 0.99 and a CVI value for the entire indicator of 0.99, meaning that the material aspects contained in the e-module are valid and suitable for use. Assessment items are valid because the CVR value exceeds the minimum value of 0.736 (Nengsih et al., 2019). Expert validators provide several suggestions namely, changes to the concept map, changes to the image, and marking important parts (Alwanuddin et al., 2022). This important sign is done by giving red color to atoms with higher priority so that they look clearer. The feasibility aspect of material is good if the material has conformity with the concept of science, the accuracy of the material and in accordance with the thinking context of students (Ayuningtyas, 2016).

Table 7. Validity Test Results on Material Aspects in Videos

Indicators	**Statements**	**Validators**					**CVR**
		1	**2**	**3**	**4**	**5**	
Material compatibility	1. The material presented corresponds to geometric isomeric material.	3	4	4	4	4	0,99
	2. The material contained in the video is in accordance with the learning objectives.	3	4	4	4	4	0.99
Stimulates curiosity	3. The material presented in the video can foster students' curiosity.	4	4	3	3	4	0.99
Serving technique	4. The video shown is clearly visible.	4	3	4	4	4	0.99
	5. The material is explained in a coherent and systematic manner.	4	3	4	3	4	0.99
Presentation of material	6. The delivery of material on the video is easy to understand.	4	4	4	4	4	0.99
CVI value							**0.99**

Based on Table 7, it is known that the results of the validity test on the material aspect in the video obtained a CVR value of 0.99 and a CVI value of 0.99, meaning that all indicators on the material assessment aspect on the video are valid and suitable for use. Assessment items are valid because the CVR value exceeds the minimum value of 0.736 (Nengsih et al., 2019). This shows that the video displayed can make it easier to understand the material, the typeface used is easy to read, the resolution and sound in the video can be seen and heard clearly (Utami et al., 2024). The feasibility aspect of material is good if the material has

conformity with the concept of science, the accuracy of the material and in accordance with the thinking context of students (Ayuningtyas, 2016).

Field Trials

Field trials were conducted to determine student reactions, responses and comments to the e-modules developed. In addition, this field test also aims to determine the feasibility of e-modules from a student perspective. Field trials are carried out in two stages, namely early stage field trials and main field trials. Early or small-scale field trials are carried out to anticipate errors and reduce obstacles when conducting main field trials or on a large scale (Puspita et al., 2017). The initial field trial was carried out on 6 students of the chemistry education study program class of 2020 who obtained an A grade (very good) in the Monofunctional Compound Organic Chemistry course so that the e-modules developed could be assessed properly. The main field test was carried out on students of the chemistry education study program class of 2020 totaling 30 randomly selected people. Respondents were selected based on the development procedure prepared by Borg & Gall and provided that they had studied the Monofunctional Compound Organic Chemistry course. There are three aspects to the student response questionnaire, namely module display, material presentation, and usefulness. There are several suggestions given by students both in the early stages of field tests and main field tests that have been considered for improvement.

Table 8. Student Response Questionnaire Results

No.	Aspects	Early Stage Field Test (%)	Main Field Test (%)
1	Module view	90	88.66
2	Presentation of material	90.27	88.33
3	Usefulness	88.88	87.5
Average		89.72	88.16

Based on Table 8, it can be seen that in the initial field test it showed a percentage of 90% in the aspect of the module display with a very good category, while in the main field test it was 88.66% with a very good category. The display aspect of the module is evaluated to find out how media experts assess various matters concerning the display of covers in the learning modules that have been developed (Nurfadilah et al., 2019). There was a decrease in percentage between the initial field test and the main field test, but the decrease was not significant when compared to the number of respondents (Utami et al., 2024). This shows that the graphics components in the module such as color and font compatibility, image, audio, and video layout compatibility, text readability in the module, and navigation button operations in the module are declared very valid (Alwanuddin et al., 2022).

In the aspect of material presentation, the results of the initial field test showed a percentage of 90.27% with the very good category while in the main field test it was 88.33% with the very good category. There was a decrease in percentage between the initial field test and the main field test, but the decrease was not significant (Utami et al., 2024). Based on the research that has been done, the response of students in the aspect of presenting the e-module

gets a good response because in the e-module there are videos and images that help students understand the content of the material, the presentation of material in the e-module helps students in learning and the questions contained in the e-module are easy to do (Qamariah & Windiyani, 2023). According to Ayuningtyas & Budiyono, good teaching materials contain language, elaboration of assignment questions and exercises that are easily understood by students (Ayuningtyas, 2016).

In the usability aspect, the results of the initial field test showed a percentage of 88.88%, with a very good category while in the main field test of 87.5%, with a very good category. There was a percentage decrease between the initial field test and the main field test, but the decrease was not significant and was still in the very good category (Utami et al., 2024). This shows that the e-module developed can provide good benefits for its users, especially in understanding geometric isomer materials. Explanation of material such as instructions on modules, images, audio, video, questions is very helpful in understanding the material (Alwanuddin et al., 2022). Learning media can be said to be good if the media can be useful in the learning process and has had an influence on the learning outcomes of students (Alfiriani & Hutabri, 2017).

CONCLUSION

Based on the results of the study, it can be concluded that interactive multimedia-based e-modules on geometric isomer material obtained good validity. Based on the results of validity tests on aspects of language, graphics, and material both in the e-module and interactive videos contained in it obtained a CVI value of 0.99 so that the e-module developed can be declared valid and suitable for use as a learning medium. The e-module developed also showed a good response from students in terms of various aspects. The results of the initial field trials showed an average of 89.72% in the very good category and the main field trials showed an average of 88.16% in the very good category.

RECOMMENDATIONS

E-modules produced in the form of flipbooks are paid products that are limited to access time for approximately one month. If it has reached that time, a watermark will appear on the e-module that can interfere with users when accessing it. It is necessary to re-convert the Flip Builder Corporation application so that the e-module can be accessed again without any interruption. This research was only carried out until the field trial stage. Therefore, it is necessary to test the effectiveness of the e-modules that have been produced to overcome misconceptions in geometric isomer materials.

BIBLIOGRAPHY

Afifah, N., Kurniaman, O., & Noviana, E. (2022). PENGEMBANGAN MEDIA PEMBELAJARAN INTERAKTIF PADA PEMBELAJARAN BAHASA INDONESIA KELAS III SEKOLAH DASAR. *Jurnal Kiprah Pendidikan*, *1*(1), 33–42. https://doi.org/10.33578/kpd.v1i1.24

Alfiriani, A., & Hutabri, E. (2017). PRACTICALITY AND EFFECTIVINESS OF BILINGUAL COMPUTER-BASED LEARNING MODULE. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *1*(1), 12–23. https://doi.org/10.21831/jk.v1i1.10896

Alwanuddin, A., Hairida, H., Ulfah, M., Enawaty, E., & Rasmawan, R. (2022). Pengembangan Modul Elektronik Berbasis SAVI pada Materi Bentuk Molekul. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, *4*(3), 4856–4873. https://doi.org/10.31004/edukatif.v4i3.2994

Amirullah, G., & Susilo, S. (2018). Pengembangan Media Pembelajaran Interaktif Pada Konsep Monera Berbasis Smartphone Android. *WACANA AKADEMIKA: Majalah Ilmiah Kependidikan*, *2*(1), 38. https://doi.org/10.30738/wa.v2i1.2555

Asmar, A., & Suryadarma, I. G. P. (2021). Pengembangan Perangkat Pembelajaran IPA Terpadu Model Nested Berbasis Perahu Phinisi untuk Meningkatkan Keterampilan Komunikasi dan Pengetahuan Konseptual. *Jurnal Pendidikan Sains Indonesia*, *9*(4), 565–578. https://doi.org/10.24815/jpsi.v9i4.20994

Ayuningtyas, R. (2016). Analisis Kualitas Buku Siswa Kurikulum 2013 Kelas VII Sekolah Menengah Pertama. *IJCETS*, *1*(4), 17–24.

Basori, M. (2016). PENGEMBANGAN MULTIMEDIA INTERAKTIF UNTUK MATA PELAJARAN ILMU PENGETAHUAN SOSIAL (IPS) SEKOLAH DASAR KELAS V. *Jurnal Prima Edukasia*, *1*(1), 1. https://doi.org/10.21831/jpe.v1i1.2311

Cucus, A., & Aprilinda, Y. (2016). Pengembangan E-Learning Berbasis Multimedia untuk Efektivitas Pembelajaran Jarak Jauh. *Explore: Jurnal Sistem informasi dan telematika*, *7*(1). https://doi.org/10.36448/jsit.v7i1.765

Djarwo, C. F. (2019). ANALISIS MISKONSEPSI MAHASISWA PENDIDIKAN KIMIA PADA MATERI HIDROKARBON. *Jurnal Ilmiah IKIP Mataram*, *6*(2), 90–97.

Durmaz, M. (2018). Determination of Prospective Chemistry Teachers' Cognitive Structures and Misconceptions About Stereochemistry. *Journal of Education and Training Studies*, *6*(9), 13–20. https://doi.org/10.11114/jets.v6i9.3353

Kunto, I., Ariani, D., Widyaningrum, R., & Syahyani, R. (2021). Ragam Storyboard Untuk Produksi Media Pembelajaran. *Jurnal Pembelajaran Inovatif*, *4*(1), 108–120. https://doi.org/10.21009/JPI.041.14

Laili, I., Ganefri, & Usmeldi. (2019). EFEKTIVITAS PENGEMBANGAN E-MODUL PROJECT BASED LEARNING PADA MATA PELAJARAN INSTALASI MOTOR LISTRIK. *Jurnal Imiah Pendidikan dan Pembelajaran*, *3*(3), 306–315.

Lawshe, C. H. (1975). A QUANTITATIVE APPROACH TO CONTENT VALIDITY [1]. *Personnel Psychology*, *28*(4), 563–575. https://doi.org/10.1111/j.1744-6570.1975.tb01393.x

Lestari, A., Hairida, H., & Lestari, I. (2021). PENGEMBANGAN LEMBAR KERJA PESERTA DIDIK (LKPD) BERBASIS DISCOVERY LEARNING PADA MATERI ASAM DAN BASA. *Jurnal Zarah*, *9*(2), 117–124. https://doi.org/10.31629/zarah.v9i2.3122

Lestari, I. & Erlina. (2020). ANALISIS KEBUTUHAN SUMBER DAN MEDIA PEMBELAJARAN KIMIA ORGANIK. *EduChemia (Jurnal Kimia dan Pendidikan)*, 1–8.

Lestari, I. & Erlina. (2021). Identifikasi Pemahaman Mahasiswa Pendidikan Kimia pada Materi Stereokimia Hidrokarbon. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, *3*(6), 4810–4817. https://doi.org/10.31004/edukatif.v3i6.1555

Masrifah, S., Musdansi, D. P., & Rahayuningsih, J. (2020). PENGEMBANGAN MEDIA PEMBELAJARAN BOOKLET PADA MATERI SISTEM KOLOID UNTUK KELAS XI IPA (SMA NEGERI 1 BENAI). *JOM FTK UNIKS*, *2*(1), 159–166.

Nalarita, Y., & Listiawan, T. (2018). Pengembangan E-Modul Kontekstual Interaktif Berbasis Web pada Mata Pelajaran Kimia Senyawa Hidrokarbon. *MULTITEK INDONESIA*, *12*(2), 85. https://doi.org/10.24269/mtkind.v12i2.1125

Nengsih, N. R., Yusmaita, E., & Gazali, F. (2019). Evaluasi Validitas Konten dan Konstruk Bahan Ajar Asam Basa Berbasis REACT. *EduKimia*, *1*(1). https://doi.org/10.24036/ekj.v1i1.104017

Nurfadilah, N., Arifin, I., & Ahmad, A. A. (2019). PENGEMBANGAN MODUL PEMBELAJARAN SENI RUPA KOMPETENSI DESAIN POSTER UNTUK SMA. *JURNAL IMAJINASI*, *3*(1), 33. https://doi.org/10.26858/i.v3i1.14115

O' Dwyer, A., & Childs, P. E. (2017). Who says Organic Chemistry is Difficult? Exploring Perspectives and Perceptions. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(7), 3599–3620. https://doi.org/10.12973/eurasia.2017.00748a

Puspita, A., Kurniawan, A. D., & Rahayu, H. M. (2017). PENGEMBANGAN MEDIA PEMBELAJARAN BOOKLET PADA MATERI SISTEM IMUN TERHADAP HASIL BELAJAR SISWA KELAS XI SMAN 8 PONTIANAK. *JURNAL BIOEDUCATION*, *4*(1). https://doi.org/10.29406/524

Qamariah, N., & Windiyani, T. (2023). PENGEMBANGAN E-MODUL BERBASIS FLIP PDF PROFESSIONAL PADA MATERI PECAHAN. *Didaktik : Jurnal Ilmiah PGSD STKIP Subang*, *9*(2), 1274–1283. https://doi.org/10.36989/didaktik.v9i2.765

Rahmatika, D. F., & Ratnasari, N. (2018). Media Pembelajaran Matematika Bilingual Berbasis Sparkol Videoscribe. *Desimal: Jurnal Matematika*, *1*(3), 385–393. https://doi.org/10.24042/djm.v1i3.3061

Rico, A. E., & Fitriza, Z. (2021). Deskripsi Miskonsepsi Siswa pada Materi Senyawa Hidrokarbon: Studi Literatur. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, *3*(4), 1495–1502. https://doi.org/10.31004/edukatif.v3i4.525

Utami, N. I., Rasmawan, R., Lestari, I., Muharini, R., & Ulfah, M. (2024). Pengembangan Booklet Berbantuan Video Animasi dengan Memanfaatkan QR Code pada Submateri Isomer Konstitusional. *Jurnal Penelitian Pendidikan IPA*, *10*(4), 1816–1826. https://doi.org/10.29303/jppipa.v10i4.5735