Interactive E-Module Based on WordPress Content Management System to Improve Student Learning Outcomes on Chemical Bond Material

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Abstract. *This study aims to create a learning media in the form of an interactive e-module based on CMS Wordpress to improve student learning outcomes in chemistry lessons, especially on chemical bonding material. This research uses the type of R&D research. The model used in this research is the 4D model by applying three stages. The subjects of this research are students of SMAN 16 Surabaya. The results of the validation of the product showed that the data on the aspects of content and construct validation were very valid at 90% and 91.6%. This E-Module also obtained a practicality percentage of 88% with a very practical category. Then in terms of effectiveness, based on the increase in pretest-posttest results, the n-gain score is 0.71 which is in the high category. Based on these results, the interactive e-module produced is feasible to use as a learning media to improve participants' learning outcomes.*

Keywords: *E-Modul Interactive, CMS Wordpress, Chemical Bond, Learning Outcomes, R&D*

INTRODUCTION

The word "educator" comes from the word "didik" which means to provide training (teaching, guidance) related to moral and intellectual intelligence. According to the Law of the Republic of Indonesia No. 21 of 2003, it is stated that education is a conscious and planned effort to create an atmosphere and learning process that enables students to actively develop their potential, so that they possess spiritual and religious strength, self-control, personality, intelligence, noble character, as well as the skills needed for themselves, society, the nation, and the state [1].

An effective learning process can improve the quality of education. With good educational quality, this will impact the quality of human resources, which in turn is directly related to the civilization of the Indonesian nation in the future. Education today focuses on developing high-achieving graduates to meet the demands of the 21st century and to be able to compete at a global level. The challenges of education in Indonesia in facing the demands of the 21st century require the utilization of technology as a primary support in the learning process. Currently, we live in an era of the application of artificial intelligence, using robots to replace human labor. To face the challenges of this era, we need to establish a harmonious relationship with artificial intelligence as an important step for survival. Indonesia must immediately improve the quality of human resources and their skills, as well as utilize advancements in digital technology within the education system. Therefore, one way to utilize technology to facilitate learners and educators in achieving a more effective and efficient is through the use of technology-based learning media (ICT).

The use of media and learning resources plays a part that can influence the learning process and outcomes of students. Learning media can stimulate the imagination, abilities, and skills of learners, thereby encouraging the learning process. Currently, the education system in Indonesia has begun to implement the Independent Curriculum Program, which is

designed to emphasize essential materials and the development of students' competencies according to their developmental stages. This curriculum is expected to create a deeper, meaningful, well-structured learning process and provide enjoyable learning experiences for students. Therefore, teachers are expected to develop the learning process by utilizing technological advances to create a learning environment that can make students more active and interactive. The use of technology in learning media is seen as an innovative approach that is effective, user-centered, interactive, and provides easy access for everyone [4].

Chemistry is one of the exact sciences that has many fields of study that examine facts, concepts, laws, and theories related to everyday life. The subject of chemistry encompasses various fields of study that are systematically designed and interconnected. Therefore, learners need to understand chemistry concepts thoroughly in order to master and study chemistry without significant obstacles [5]. Chemical bonding material often becomes one of the topics that is quite challenging for students to understand. As a fundamental aspect of chemistry, this material encompasses concepts and characteristics that are abstract in nature, involving macroscopic, microscopic, and symbolic perspectives. Furthermore, this material feels distant from everyday experiences because students cannot directly observe atoms, structures, or interactions between atoms, thus requiring a special approach in its learning [6]. In addition, students tend to feel bored when studying abstract materials, because they cannot visualize or interact directly. The learning resources that are still conventional, monotonous, and only consist of explanations make students uninterested in studying them. This can impact students' learning outcomes.

One solution to address these challenges is to utilize web-based learning media. This method is a form of implementing electronic learning (e-learning) that uses the internet network as the main means in the teaching and learning process. Rizal and Walidain (2019) stated that by implementing e-learning, it is one way to practice self-directed learning, especially web-based learning that can be accessed through the internet anytime and anywhere. The use of website-based media can be flexibly accessed by students even outside of class hours. Thus, students can learn independently to enhance their understanding.

The development of learning media in the form of interactive web-based e-modules will be easier to implement if using the WordPress CMS. This is because WordPress has settings that are much more flexible and easy to integrate with plugins or other CMS. There are many features offered by WordPress that can be used to develop a specific website page as a learning media for chemistry on the topic of the periodic table of elements. One of the advantages of developing a website based on the WordPress CMS is the availability of Plugins and Templates that facilitate the construction of a website page, even without any coding at all [7]. Furthermore, in the research conducted by Huda and Dwiningsih (2021) the results showed an improvement in students' understanding, can be seen from student learning outcomes after using learning website media, where the pretest-posttest results produce an average n-gain score of 0.708, which is in the high category. From this research, it can be referenced that the development of interactive e-modules based on CMS Wordpress is important to enhance students' learning outcomes, especially in the subject of chemical bonding.

Based on the above background, researchers want to develop a WordPress-based interactive e-module to improve student learning outcomes in an interactive and practical way with the title “Development of an Interactive E-Module Based on Content Management System (CMS) WordPress to Improve Learners' Learning Outcomes on Chemical Bonding Material”.

METHOD

This research uses the R&D method which refers to the 4D (four D models) development model recommended by Thiagarajan, Semmel, and Semmel in Ibrahim (2014) consisting of four stages: define, design, develop, and disseminate. This research will be limited to the development stage. This research develops an interactive e-module based on the WordPress content management system (CMS) that is valid in terms of validity, practicality, and effectiveness.

Define

The defining stage serves to identify and formulate the needs in the learning process, as well as collect various information relevant to the product to be designed and developed. There are 5 points in this stage, namely: 1) Front-end analysis, 2) Learner analysis, 3) Task analysis, 4) Concept analysis, 5) Learning objectives analysis.

Front-end Analysis

The initial analysis was conducted to identify the main problems in the development of the learning website. At this stage, relevant facts and alternative solutions are presented, making it easier to determine the initial steps in developing the right interactive e-module to be developed.

Learner Analysis

Analyzing students is very important in the early stages of planning, so that the media developed can be appropriate. The analysis of the students is done by observing the characteristics of the students. The analysis of the students includes characteristics of academic ability, age, and motivation towards the subject matter.

Task Analysis

The task analysis is conducted on the learning objectives (TP) related to the chemical bonding material that will be developed through an interactive e-module..

Concept Analysis

The analysis of concepts aims to select, detail, and systematically organize the content of learning materials in the e-module to be developed. The concepts are obtained from the review of the chemical bonding material that aligns with the Merdeka curriculum.

Learning objectives analysis

The indicators for achieving the learning objectives of the chemical bonding material found in the independent curriculum are formulated.

Design

The design stage aims to design a moodle-integrated chemistry learning website on chemical bonding material. There are 4 stages, including:

Criterion-Test Construction

The preparation of instrument tests is based on the preparation of learning objectives which measure the ability of students in the form of products, processes, and psychomotor both during and after learning activities.

Media Selection

The e-module to be developed is chosen based on the analysis of the students, concept analysis, and task analysis that is beneficial for students in achieving the learning outcomes and educational goals that have been prepared by the teacher.

Format Selection

Format selection is done so that it is chosen in accordance with the learning material. Designing e-modules including layouts, images, animations, and text.

Initial Design

This design is Draft 1 of the wordpress-based interactive e-module.

Develop

This development phase aims to produce an integrated Moodle chemistry learning website that has been revised based on expert feedback and trials with students. This phase includes:

Study

The review of draft 1 of the learning website was conducted by two chemistry lecturers as material experts, covering the presentation of the learning website and the language used. The material review aims to provide feedback and assess the appropriateness of the material displayed on the learning website. Reviewers are asked to fill out the provided review questionnaire. The material experts will provide feedback on draft 1 based on the eligibility criteria related to design criteria, content eligibility, presentation eligibility, grammar, illustrations, and components of the interactive e-module.

Internal and External Validation

Internal validation in this study was carried out using a validation instrument given to each validator, consisting of 2 chemistry lecturers and one high school chemistry teacher. The validation results are used for the validity value obtained from the developed e-module.

Media validation instruments are used to measure the feasibility of interactive e-modules developed. The validation results that have been obtained, then analyzed using descriptive methods. The percentage of validation results is obtained based on the Likert scale calculation in the following table:

Table 1. Likert Scale Scores

Score	Assessment
1	Not bad
2	Bad
3	Moderate
4	Good
5	Very good

[8]

The data obtained from the validation questionnaire will be analyzed using the following formula:

Validation score = (questionnaire score) / (criterion score) x 100% (1)

Criterion score = (highest score per item x number of items x number of respondents). (2)

Table 2. Interpretation of Validation Scores

No.	Percentage of Validation Score	Validation Classification
1.	0% - 20%	Very invalid
2.	21% - 40%	Not valid
3.	41% - 60%	Moderately valid
4.	61% - 80%	Valid
5.	81% - 100%	Very valid

The developed interactive e-module can be considered appropriate and valid for use if it achieves a percentage of 61% in each aspect. If it has not yet reached that figure, the media must be revised until high validity is obtained.

The assessment of practicality is carried out through the analysis of student response questionnaires containing questions about the use of interactive e-modules. The percentage of learner response questionnaire data will be analyzed based on the following Guttman scale:

Table 3. Guttman Scale

Statement	Score
Yes	1
No	0

The data obtained from the practicality questionnaire will be analyzed using the following formula:

Validation score = (questionnaire score) / (criterion score) x 100% (3)

Criterion score = (highest score for each item x number of items x number of respondents). (4)

The percentage results are interpreted into the following criteria.:

Table 4. Interpretation of Practical Scores

No.	Percentage of practical scores	Practical classification
1.	0% - 20%	Very impractical
2.	21% - 40%	Not practical
3.	41% - 60%	Quite practical
4.	61% - 80%	Effective
5.	81% - 100%	Very practical

The interactive e-module developed must meet a percentage requirement of 61%.

The method used to see the effectiveness of this e-module is by analyzing the data from the pre-test and post-test results. The analysis used is descriptive quantitative using the n-gain score with the calculation formula as follows:

$$< g >= \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (5)$$

Then, the n-gain score obtained is interpreted as follows:

Table 5. Interpretation of N-Gain Scores

Score N-gain	Category
$g \geq 0.7$	High
$0.7 > g \geq 0.3$	While
$g < 0.3$	Less

Interactive E-modules are considered effective if they achieve an n-gain score increase of 0.7 in the high category.

Limited Trial

A limited trial was conducted on XI grade high school students who had received material on chemical bonds for one class with heterogeneous skill levels to empirically assess the feasibility of the interactive e-module using a prepared assessment sheet. The trial was conducted using a one group pretest-posttest design system.

O_1 X O_2 (6)

O_1 = Pretest of students' abilities before providing the Moodle-integrated chemistry learning website on chemical bonds by giving a test.
O_2 = Posttest of students' abilities after being provided with anintegrated moodle chemistry learning website on the topic of chemical bonds by administering a test.
X = The treatment given to students is the use of the integrated moodle chemistry learning website on the subject of chemical bonds.

The steps taken were that the students were given a pretest for 25 minutes, then an interactive e-module trial based on WordPress for about 60 minutes, after which the students were asked to take a posttest for 25 minutes. Next, a response questionnaire about the developed interactive e-module was given for about 10 minutes, so the total time required was approximately 120 minutes.

RESULT AND DISCUSSION

This study aims to develop an interactive e-module based on WordPress CMS, designed to improve student learning outcomes on the topic of chemical bonding. The subjects of this study were eleventh-grade students at the senior high school.

Before this e-module can be used, a validity test must be conducted. The purpose of this test is to obtain a valid product, so that the developed interactive e-module can be useful as intended. The validity was assessed by 3 validators. The validation sheet in this study includes content and construct validation. The results of the validity based on the assessment from the experts showed 86% for content validity, which falls into the very valid criteria, and 89.4% for construct validity, which also falls into the very valid criteria. The following is the validation result data based on both content and construct validation.

Table 6. Data of Content Validity Test Results

Aspects	Indicators	Percentages	Categories
Matter	The alignment of learning outcomes in the developed media with the independent curriculum	86,7%	Very Valid
	The suitability of the material in the media developed with the learning objectives to be achieved	73,3%	Valid
	The suitability of the chosen material in the creation of questions	93,3%	Very Valid
	The depth of the content in learning media	93,3%	Very Valid
Presentation Suitability	Learning objectives have been clearly formulated and are in line with learning outcomes	93,3%	Very Valid
	The material in the E-Module presented in the form of illustrations is displayed in a communicative, proportional, and consistent manner.	86,7%	Very Valid

Aspects	Indicators	Percentages	Categories
	The animations and images presented clarify the concept.	73,3%	Valid
	The E-Module includes complete identification (Material, Learning Outcomes, Learning Objectives, and Concept Map)	86,7%	Very Valid
	The E-Module guides students to understand the concept of chemical bonds	93.3%	Very Valid
	The menus available in the e-module are easy to understand.	80,0%	Valid

Table 7. Data of Construct Validity Test Results

Aspects	Indicators	Percentage	Categories
Matter	The media is presented with clear and relevant facts, concepts, and theories.	80,0%	Valid
	Having the accuracy of sentence structure	86,7%	Very Valid
	Having an understanding of messages or information	93,3%	Very Valid
Presentation Suitability	Relevance to the age of the learners	86,7%	Very Valid
	Suitability with the learning style possessed by the learners	80,0%	Valid
	Instructions for using the e-module	86,7%	Very Valid
	Ease of use of e-modules	80,0%	Valid
	Inviting students to learn systematically with success standards in the form of achieving minimum competencies	93.3%	Very Valid
	The use of colors that match the theme	73,3%	Valid
	The use of animation in the developed e-modules is	73,3%	Valid

Aspects	Indicators	Percentage	Categories
	appropriate and clear		
	The presentation of text, animations, and videos in the e-module is engaging and readable	86,7%	Very Valid
	The suitability of the background with the text color	73,3%	Valid
	The selection of menu colors and menu icons is good.	80,0%	Valid

After the validity test, a questionnaire was distributed to determine the practicality of the e-module developed. The results were 88% or included in the very practical category. And finally, to determine the effectiveness of the e-module, it can be seen from the n-gain score obtained from the pre-test and post-test scores with the n-gain result of 0.71 or in the high category.

Based on the results obtained, the interactive e-module based on WordPress CMS is declared feasible to be used as a supporting medium in learning, especially to improve student learning outcomes on chemical bonding materials.

CONCLUSION AND SUGGESTIONS

Based on the results of the research and the data that has been obtained, it can be concluded that interactive e-modules based on CMS wordpress to improve student learning outcomes on chemical bonding materials can be used as learning media to support chemistry learning, especially on chemical bonding materials. This can be seen from the results of the validation of the product validity assessment which received a validation of 86% on content validity and 89.4% on construct validity and both were in the very valid category. The results of the student response questionnaire obtained a value of 88% or included in the very practical category. And the effectiveness results obtained an n-gain score of 0.71 or in the high category.

SUGGESTIONS AND THANK YOU MESSAGES

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