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E-Module Development Based on Flip PDF Professional by Using Problem Solving Model in Wetland Context to Improve Stoichiometry Learning Outcomes

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Abstract. E-module development based on flip pdf professional is a systematically arranged instructional material. This research aimed to determine the impact of student learning outcomes when using the developed e-module. The research method used is R & D with a 4-D development model: define, design, develop and disseminate. The developed e-module trial was conducted offline for students at SMAN 10 Banjarmasin. The data analysis technique was descriptive statistics. The data collection techniques were validation sheets, response questionnaires and test assessments. The results showed that the developed e-module was stated to be very valid regarding the content feasibility, presentation, language and media. The developed e-module also fulfills practical aspects, seen from student response questionnaires and teacher activity sheets which get very good categories. The e-module also fulfilled the effectiveness aspect based on the N-gain of student learning outcomes included average category. The success of e-module in improving learning outcomes can also be seen from the increased average value pre-test and post-test, from 43.75 to 83.75. The results of the research show that the developed e-module is feasible to use and also improves learning outcomes.
Keywords: e-module, learning outcomes, stoichiometry, wetland

Introduction

Humans are in the industrial revolution 4.0 which brings many changes in everyday life (Isa et al., 2021). The industrial revolution 4.0 affects the world of education, especially on the learning styles of students. Student prefer to search for technology-aided information. A review from the Indonesian Internet Service Providers Association (APJII) in 2019 found that the most internet users were users aged 15-19 years, where as many as 91% of theseusers used the internet. This review from APJII shows that the era of the industrial revolution 4.0 prioritizes technology-based information. Technological developments produce various types of products ranging from computer, laptop, smartphone to the internet.

Students spend more than 6 hours per day using their smartphone. However, they use it to play games (Mulyani et al., 2019). Teacher must maximize the use of smartphone in learning so that students use technology properly. Technological progress is a challenge for teacher. Teacher are required to use technology in learning activities. Teacher are the

main figures in designing learning activities from teacher centered learning to electronics, videos and others (Karagoz & Ruzgar, 2020; Ibili et al., 2020).

One of the teaching and learning processes that can be applied with technology is learning media. Teacher themselves are required to distribute relevant learning media (Zhang et al., 2020). Learning media is a teacher effort in shaping teaching that gives meaning to students (Setiawan et al., 2018). Technological developments create innovative, effective and efficient use of learning media. The lack of use of interactive media in the classroom makes the class monotone.

Interview with SMAN 10 Banjarmasin students in November 2021 students were less interested in learning. Where 100% of students are not interested because the instructional materials are not colored. While 50% of students are not interested because the words are too dense so that it affects learning outcomes. Most schools find printed instructional materials rather than technology-based ones. According to Nurhidayati et al, (2018) learning using e-modules can provide a greater increase in learning outcomes compared to printed materials.

E-module is one of the media in technology-based learning. E-module is a instructional material media as an intermediary in the delivery of learning materials (Astalini et al., 2022). E-module is an independent instructional material with a coherent arrangement using easy to understand language, displayed in electronic form at which makes users more interactive when using it (Komikesari et al., 2020). E-module contain text, images, animations, symbols, video or audio that are helpful in teaching activities. E-module can be created with the flip pdf professional application. This application not only contains text and images, but can be added with videos and animations therefore, e-module make something abstract clearly understandable. Stoichiometry as an abstract chemical material. This is because stoichiometry studies something invisible in the form of particles that make up matter, where stoichiometry is a study related to various calculations in chemical reactions (Achmad & Tupamahu, 1991). Stoichiometric material whose characteristics are abstract needs to be related to real problems in everyday life so that students can easily understand related to learning. The environment is very closely related to everyday life. One of them is a wetland environment. Wetlands are areas formed by the meeting of water and soil. Examples of wetlands include peatland, swamps, rivers, mangroves and lakes. The compounds in the wetland can be linked to stoichiometric material in the e-module.

Interactive multimedia used in creating e-module to spark interest is flip pdf professional. Flip pdf professional as software used in convection pdf allows users to create interactive learning content. Flip pdf professional makes learning interesting because, it can insert images, videos from youtube and quizzes (Seruni et al., 2020). Flip pdf professional very practical to use in the learning process, it can also be used to create module and its operation is very simple so that it can be used by anyone (Parapat & Sagala, 2022).

Engaging of e-module is not enough to achieve the learning objectives. Learning models are also very necessary to achieve learning objectives (Nurhidayati et al., 2018). Achieving a goal will have many obstacles in learning that must be overcome in order for the learning goal to succeed. Therefore, it is necessary to integrate the learning model in the e-module. Learning model includes the approach that will be used in class, such as the goals to be achieved, levels in teaching activities and the study environment (Irviana, 2020). One of the models that is in accordance with the industrial revolution 4.0 is the problem solving model.

Problem solving is a basic activity in human life, because it relates the process of assuming in order to solve various problems experienced. Learning has a significant role in preparing students to be able to complete their own learning. The problem is very appropriate to what is needed now. Problem solving is learning based on the problem

(Rosbiono, 2007). This learning is based on the constructivism paradigm, where students are required to play an active role in constructing their own understanding of the knowledge learned. This is in accordance with research from Rahmatjati (2018) problem solving models on mole concept material affects student learning outcomes.

The purpose of this development research is to recognize changes in student learning outcomes in stoichiometry material with e-module development based on flip pdf professional by using problem solving model in wetland context to improve stoichiometry learning outcomes.

Methods

The design used R&D (research and development) by applying a 4D model. The product to be developed is instructional materials in the form of e-module on the stoichiometry material based on flip pdf professional grade X SMAN 10 Banjarmasin for the 2022/2023 academic year. Development model applied is a 4D model which includes four phase is, define, design, develop, and disseminate (Trianto, 2012). The first phase, namely define, setting learning requirements begins with an analysis of the objectives of the developed material boundaries. The second phase is design where at this phase the researcher designs the content framework of the product that wants to be developed (Arum, 2020).

Third phase is development, which is to produce the final product of the e-module after going through several revisions. The development phase resulted in validation by experts followed by revision and limited trials with real students (Arum, 2020). The last phase in the 4D model is dissemination, where the dissemination is carried out reports with the results of the findings in the form of scientific articles.

E-module trial design used in this study is one group pre test-pos test design, because it is only carried out in one class. The technique of analyzing data used is descriptive statistics to describe data which described to find out how the results of the research carried out (Rosana & Setyawarno, 2017). Validity analysis used a validation sheet which was assessed by 5 validators, 4 material experts and 1 media expert. Next analyze practicality. The practicality analysis was measured by a response questionnaire that was handed out to students and teachers in a limited trial. Criteria for analysis of validity and practicality can be seen in Table 1 and Table 2.

Table 1. Validity Criteria

Score	Explanation
$4.25 < V \leq 5.00$	Very valid
$3.50 < V \leq 4.25$	Valid
$2.75 < V \leq 3.50$	Quite valid
$1.75 < V \leq 2.50$	Deficient valid
$1.00 < V \leq 1.75$	Invalid

(Source: Syahmani et al., 2017)

Table 2. Practicality Analysis Criteria

Score	Explanation
4.25 < P ≤ 5.00	Very Practical
3.50 < P ≤ 4.25	Practical
2.75 < P ≤ 3.50	Practical Enough
1.75 < P ≤ 2.50	Less Practical
1.00 < P ≤ 1.75	Impractical

(Source: Syahmani et al., 2017)

Last phase, the effectiveness analysis. Effectiveness analysis using cognition tests, where this test is used after learning to recognize the level of understanding of students after using e-module. The test questions used consist of 5 questions that are adjusted to the indicators achieved. The results of the student test are then analyzed by calculating N-gain. N-gain is calculated using a formula developed by Hake (Cohen & Swerdlik, 2010).

Results and Discussion

Research conducted place at SMAN 10 Banjarmasin with the subject of research for class X MIPA 2 students. Based on conservation, no electronic instructional materials were found in the school. Instructional materials are only in the form of module, so the class feels monotonous. Based on observations, the e-module was developed based on flip pdf professional by using problem solving model in wetland context. Based on the explanation of the development procedure that has been explained, in the development of this e-module, the results obtained.

Development Results

Products developed in this research include learning media, namely e-module based on flip pdf professional by using problem solving model in a wetland context. E-module are arranged systematically according to the steps of the problem solving model in the context of wetland with short and clear concept. The e-module developed consists of five main pages, namely the cover page, opening page, content page, closing page and back cover page. E-module are created consistently using the same font, spacing and layout. Therefore, the use of e-module is easy for students to understand.

The purpose of developing this e-module is to provide a variety of technology-based learning media that are easy for students to use to learn independently at home and also guided by education in the classroom. The advantages of the product that has been developed are e-module on the stoichiometry material based on flip pdf professional that utilize technology. Flip pdf professional can turn what was originally a module into an e-module that can be operated online (Aprilia et al., 2022). Flip pdf professional software allows students to read e-module like reading books physically (Belia et al., 2022). Stoichiometric e-module can be opened via computer or smartphone so that students access it anytime and anywhere. Use of e-module makes it easy for students to learn better even though online learning activities (Puspita et al., 2021).

Another advantage of the e-module developed is that it has a wetland context. This, making this e-module interactive because it not only contains stoichiometric material, but also in it is equipped with wetland context problems accompanied by pictures, videos and problems. The existence of problems related to wetlands allows students to live their daily

lives and then get information related to stoichiometry material. Wetlands are ery strong in relation to daily life, especially in Banjarmasin. Examples of wetlands are peatland, rivers, swamps and lakes.

Wetlands are found in Banjarmasin, especially peatland. Kalimantan island alone has 6.3 million hectares of peatland (Ghofur & Mursadin, 2018). The questions presented in the e-module are related to wetlands. For example, in swamps, soil minerals are found, namely pyrite and methane gas. Cultivation in wetlands can also be used as problems. Examples of cultivation in wetlands are siamese orange banjar and durian. Siamese oranges contain ascorbic acid, where ascorbic acid is good for antioxidants. Then, durian which has a distinctive and pungent smell because it contains thiol compounds. These wetland context problems are then connected to stoichiometric materials, such as calculating relative molecular mass, calculating mass percent and calculating moles of substances.

E-module in a wetland context makes students not get bored quickly and understand more, thus affecting learning outcomes. According to the representation of the content of the e-module itself, which not only displays text, but is accompanied by images, animations, videos, simulations and demonstrations, thus making the quality of student learning outcomes increase (Linda et al., 2021). Besides there innovative e-module, learning models are also influential in increasing one's interest in learning in the classroom (Iriana et al., 2018). Syntax used in class and presented in the e-module is a problem solving model. First stage, students are immediately asked questions related to wetlands. For these answers questions they should use problem solving, namely: 1) students must identify the problem first, 2) search for data, 3) students test hypotheses and 4) at the end students provide conclusions.

Problem solving learning model trains students to find solutions to matter around them. This learning model also trains students to find information on their own, analyze situations and identify matter that are around. E-module based on problem solving have the potential to develop constructivist thinking skills because students are required to think in understanding the question that occur so that the right solution is obtained (Permana et al., 2021). Using this model on stoichiometric material affects student learning outcomes (Putri et al., 2019). Figure 1 shows the display design of the e-module that has been developed. Figure 2 shows the display of the e-module on a computer.

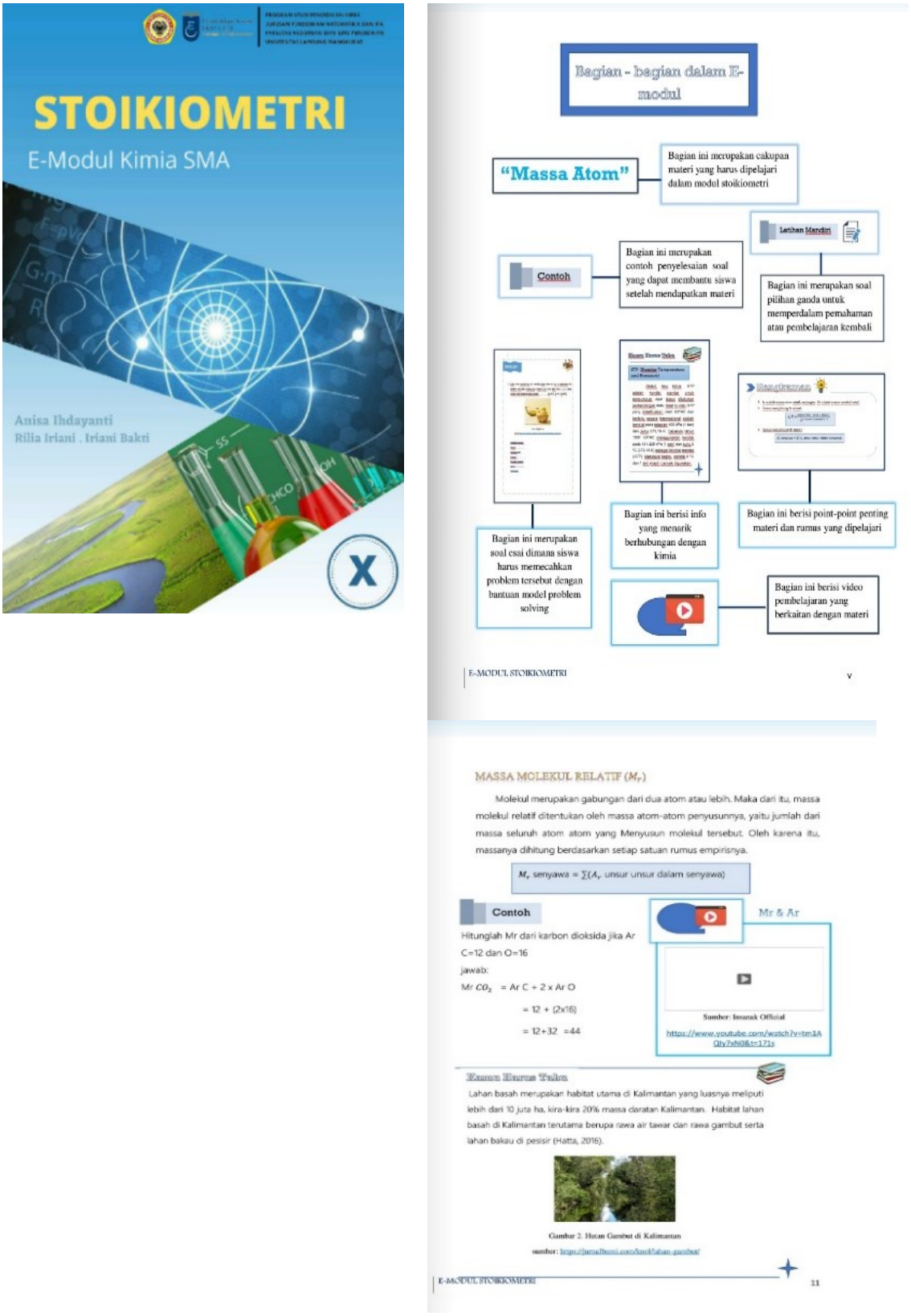


Figure 1. Developed E-Module Design

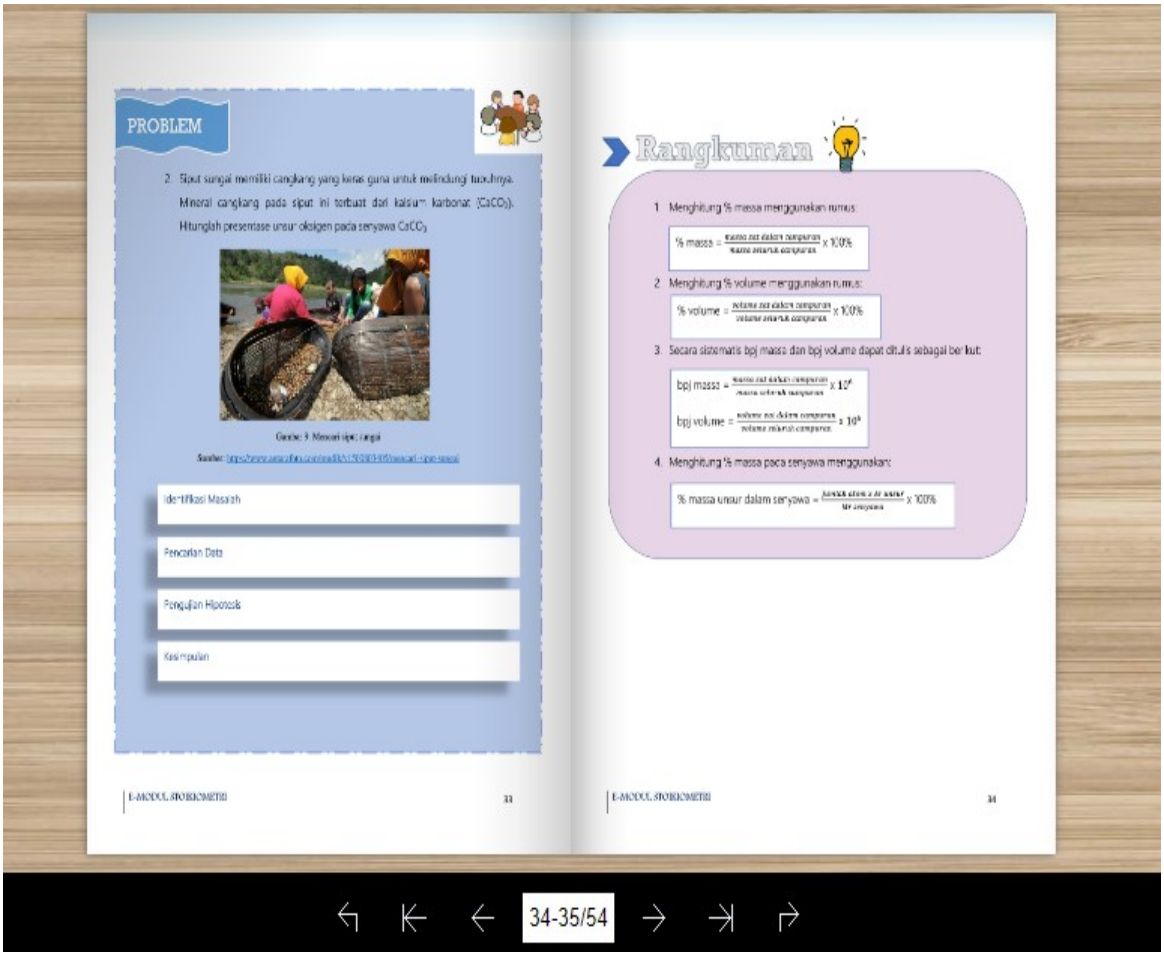


Figure 2. Display of E-Module on Computer

Result Validity Test

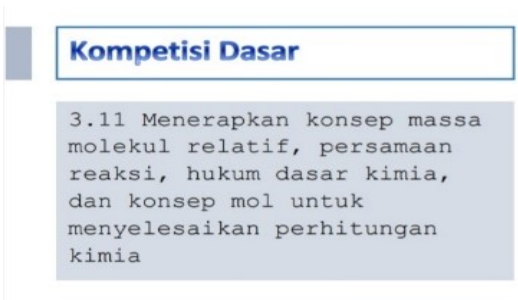
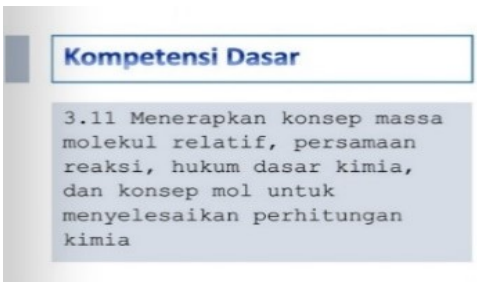
E-module developed tested for validity first by validators. Validity test aims to recognize the feasibility of the e-module carried out by development referring to the results of validation by validators. Validation is carried out by 5 individuals as validators, namely 4 material expert validators and 1 media expert validator. Evaluation and suggestions given by validators are used in improving e-module that are developed before being tested. The feasibility of the e-module developed can be known through an assessment conducted by validators using a validation sheet consisting of four components of feasibility aspects, namely content, presentation, language and media.

Table 3. E-Module Validation Results

No	Assessment Aspect	Validation Score	Explanation
1.	Content	4.94	Very Valid
2.	Presentation	4.92	Very Valid
3.	Language	5.0	Very Valid
4.	Media	4.98	Very Valid

When validating, there are inputs suggestion and criticisms from validators which are used as material to improve the e-module before being tested on students (Sari & Sutihat, 2022). In the aspect of presentation, it gets a lower score than other aspects because, the initial presentation of the back cover of the e-module contains a slogan that should contain a general summary of stoichiometry. Therefore, the back cover of the e-module was replaced according to the validator's suggestion. Another suggestion given by validators on the content aspect where it is necessary to note again typos and the use of terms in e-module. The description of the presentation improvements before and after the revision can be seen in Table 4.

Table 4. Revised Results from the Validator

Before Revision	After Revision
	
	

Based on the table above there are several revisions. The first revision contained a typo in the writing. Apart from that, the back cover of the e-module which originally contained the word motivation was replaced with a general summary of the e-module. Validation scores on the aspects of content, presentation, language and media were 4.94; 4.92; 5.0 and 4.98. Based on these scores, the e-module developed are categorized as very valid and feasible to be used for the next stage. Result of electronic instructional materials materials by using flip pdf professional valid (Rochsun & Agustin, 2020; Sriwahyuni et al., 2019).

Practicality Test Results

E-module that have been validated by validators are then tested for practicality through questionnaires for teacher and students with the aim of recognizing the practicality of e-module developed in learning activities. The practicality analysis of the e-module was measured through student response questionnaire and the teacher response questionnaire. Questionnaires of teacher and student responses are given at the end of learning containing statement items regarding the use of e-module in the learning process. The results of the practicality test can be seen in Figure 3.

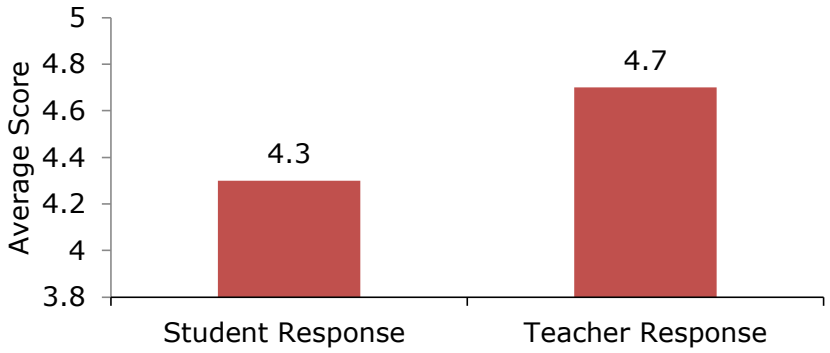


Figure 3. Practicality Test Results

Learning using e-module and videos is considered very supportive of learning, especially if the learning time in class is very limited (Puspita et al., 2021).

Student Response

Student response questionnaires were conducted on limited trials. Response questionnaires were given of class X MIPA 2 SMAN 10 Banjarmasin, 16 students responded to the questionnaire. The aim is to determine the response of students to the use of e-module developed after being used during learning. The student response questionnaire contains 10 points of statements and is submitted after the students carry out the post-test and after the limited trial ends. Based on the research results, got score 4.3 was obtained in the very practical.

Response results mostly showed a positive response where the overall average score was 4.3 with a very practical, because the e-module applies examples of daily life related to wetlands so as to make students interested in learning. In addition, this e-module utilizes technology, so it can be opened using a smartphone or other computer device. This e-module can be accessed anywhere, giving rise to reading interest in learners in stoichiometry material. According to Mahardika et al. (2021) stated that e-module increase reading interest in students, because e-module make students enthusiastic about learning. When students have a high interest in reading then it will affect learning outcomes. Research that examines the development of e-modules in learning on student learning outcomes, where in the practicality test e-modules get very practical categories (Rahmadani & Yudiono,2020; Komikesari et al., 2020).

Teacher Response

Teacher responses using e-module are measured using teacher response questionnaires to determine the practicality of e-module used during the learning process. The results of teacher responses to the use of e-module during learning obtained positive results with an average score of 4.7 which was included in the very practical category, meaning that the e-module developed were very practical categories. Research on the use

of flip pdf professional based e-module has received very good responses from teacher, so that it is comfortable and very practical (Ellysia & Irfan, 2021; Parapat & Sagala, 2022).

Effectiveness Test Result

This trial was carried out using e-module that had passed validity test and were revised beforehand, then limited trials were carried out in class X MIPA 2 SMAN 10 Banjarmasin consisting of 16 students. The aim is to test the effectiveness of the developed e-module. The effectiveness test in this development research was carried out in the cognitive realm only. The results of cognitive domain tests carried out in limited trials. Were analyzed by calculating N-gain.

Learning in limited trials begins with giving pre-test questions to students then given a post-test to find out how stoichiometric learning outcomes use e-module. The test contains 5 stoichiometric multiple-choice questions.

Pre-test Data and Post-test Learning Outcomes

Before starting learning, students are given pre-test questions to find out the initial ability of students on stoichiometry material using e-module. After two gathering, at the end of the learning students were given a post-test to determine the results of learning stoichiometry using the e-module.

Test contains 5 questions in the form of multiple choice. This test is adjusted to the indicators on stoichiometric material in Senior High School. The learning outcomes of students per indicator can be seen from the average percentage of question scores. The percentages for multiple choice question indicators 1 to 5 can be seen in Table 5.

Table 5. Proportion of the Average Score of Indicator Items

No	Indicator	Pre-test	Post-test
1.	Calculate relative molecular mass	100	100
2.	Calculate the levels of substances in a compound	56.35	100
3.	Analyze the connection between mass and moles of a substance	6.25	31.25
4.	Analyze the connection between molarity and moles of a substance	37.5	93.75
5.	Calculating chemical formulas	18.75	93.75

Based on Table 5, the first indicator obtained the same average result, both between pre-test and post-test there was no change. This means that students are able to calculate relative molecular mass. This is because students already understand the material relative atomic mass and relative molecular mass. The third indicator has the lowest change between the pre-test average and the post-test average. Means that some students have not been able to answer the questions, because of the lack of accuracy in answering the questions. Where this problem is deceptive if not understood correctly, because the difficulty level is C4 which is analyzing. The average scores of pre-test and post-test learning outcomes in the cognitive realm are presented in Figure 4.

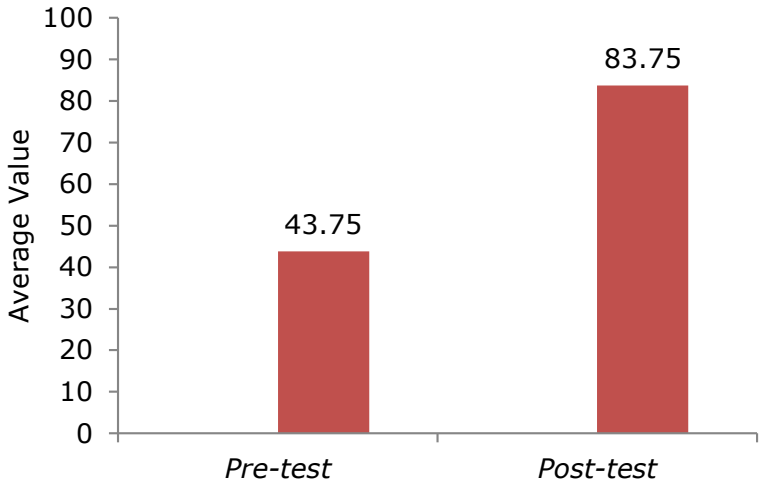


Figure 4. Average Value of Pre-test and Post-test Learning Outcomes

The picture above reveals the average pre-test obtained of 43.75 and post-test of 83.75 through these scores can be seen an increase in student learning outcomes, meaning that the e-moduls developed affect student learning outcomes. According to Nisa et al. (2020) explained that e-module with flip pdf professional affects student learning outcomes.

N-gain Analysis

Data obtained from pre-test and post-test results are processed into data with N-gain. N-gain aims to recognize the improvement of student learning outcomes from pre-test to post-test after using e-module. The improvement is considered as high if N-gain > 0.7 or medium if 0.30 ≤ N-gain ≤ 0.70 (Gunawan et al., 2020). The N-gain value obtained in the trial was limited to 0.74. The value is included in the medium criteria, so that the stoichiometry e-module developed contributes well to the learning outcomes of learners. In line with research from Afriani et al. (2022) which states that chemistry electronic modules can affect student learning outcomes and are effectively used by students.

Overall, the e-module proved to be able to improve student learning outcomes, observed through the results of limited trials, the average post-test score is greater than the pre-test average score, with a high N-gain category. This positive result is because the developed e-module media can be easily accessed anywhere.

E-module based on flip pdf professional as a whole improves learning outcomes that can be observed in the results of limited trials. Which means the learning objectives are achieved. The achievement of learning objectives in terms of the high value of student learning outcomes is a sign that the media used is effective (Pradilasari et al., 2019). E-module itself involves learners in its use during learning.

This e-module also uses problem solving which involves students to be active in learning. Learning activities by involving students means placing them as active subjects in learning and having readiness to follow the learning process (Febriyanti & Maryani, 2022). Problem of this e-module is in the context of wetland materials. Problem solving can improve student learning outcomes (Shadreck & Enunuwe, 2017). So it can be concluded, e-module based on flip pdf professional by using problem solving model in wetland context improve stoichiometry learning outcomes.

Conclusion

Based on the results of research has been done, it can be concluded that, e-module based on flip pdf professional by using problem solving model in a wetland context is able to improve student stoichiometry learning outcomes. This can be seen from the change in the average pre-test to the average post-test, which was originally at 43.75 to 83.75. So, e-module get the medium category in the N-gain. This study concluded that the e-module can be used in special learning on stoichiometry material for class X senior high school students.

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