E-Modules Based on Contextual Wetlands to Improve Mastery of Physics Concepts of High School Students

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Abstract - *E-modules based on the wetland context represent one of the alternative teaching materials that can support the learning process. This study aims to develop a physics e-module contextualized with wetlands using Adobe Captivate software, with the goal of enhancing its effectiveness in classroom instruction. The research employed a Research and Development (R&D) approach conducted at SMA Negeri 1 Lempuing. The e-module was designed following the ADDIE development model, specifically for the topic of Archimedes' Principle. The feasibility of the e-module was evaluated in terms of validity, practicality, and effectiveness. Validation results from media, content, and language experts yielded an average total score of 90.37%, categorized as very valid. Product trials with students resulted in a practicality score of 89.9%, indicating that the module was well-received. In terms of effectiveness, the e-module achieved an N-gain score of 0.64, which falls within the moderate category. These findings demonstrate that the developed e-module is valid, practical, and effective in improving high school students' mastery of physics concepts.*

Keywords*: E-Modules; Contextual wetlands; Concept mastery.*

INTRODUCTION

Education is the process of teaching and learning and all the elements that influence and are related to it. To achieve learning objectives, teaching and learning activities must be carried out optimally and maximally. Thus, a good learning process will have an impact on the achievement of student learning outcomes (Novianto, Abdi & Diana, 2019).

Physics is one of the branches of science that studies natural phenomena from the perspective of matter and energy. Physics learning is often considered less interesting by students, so in the physics learning process, students should not only focus on memorizing formulas to be able to understand the material (Ishaq et al., 2022). One of the important abilities that every student must have is the ability to understand physics concepts, because understanding concepts in physics is the basis for studying physics (Suhartin, 2017).

Concepts are crucial elements in solving problems, so good mastery of concepts is needed. In solving problems and their application in everyday life, students who have low mastery will affect these activities (Ipek et al, 2020). Concept mastery is the ability to understand a material scientifically, both in terms of theory and application (Jannah & Yuliati, 2016).

Concept mastery indicators consist of *remember*, *understand*, *apply*, *analyze*, *evaluate*, and *create* (Krathwohl. D. R, 2002). In explaining the concept of Archimedes' law, this ability is needed. Therefore, learning with a contextual approach is needed that is able to build student motivation by linking the material learned with a more relevant context (Apriani, H., Murniati, & Pasaribu, 2016).

Therefore, students need electronic-based learning materials that can help them increase their interest in learning during the learning process (Tyas, L., 2020). One of the relevant electronic teaching materials in this

context is electronic modules or e-modules. E-modules designed with a contextual approach using easy-to-understand and interesting language will increase students' interest and make it easier for them to understand the physics concepts contained in the material studied (Suastika, I. ketut, & Rahmawati, 2019). In this case, teaching materials in the form of e-modules can be developed with a contextual-based wetland.

The area of wetlands in South Sumatra province reaches 3.04 million hectares and occupies the fifth position as a province with a large area of wetlands in Indonesia. So it cannot be denied that there are so many community activities, phenomena and actual objects in the wetland environment around us. The actual situation in this wetland environment can be used as a source of learning physics, especially the material of Archimedes' law through the development of teaching materials in the form of contextual wetland-based e-modules. Contextually oriented e-modules have the advantage of facilitating students to understand the material better, because the material is connected to situations they face every day.

Based on interviews with physics teachers at SMA Negeri 1 Lempuing, it was revealed that students face difficulties in understanding the concept of buoyancy force due to the lack of contextual learning media that connects with the surrounding environment, such as wetlands in the school area.

Some previous studies have not specifically discussed Archimedes' law material and have not evaluated the effectiveness of e-modules in improving mastery of physics concepts. This research has its own novelty by developing a wetland-based contextual e-module that directly links the concept of buoyancy force in Archimedes' law with local phenomena, such as boats in swamps or objects that float in wetland ecosystems.

The main focus in this research is on the contextualization of the material and the improvement of students' concept mastery, which is measured through pretests and posttests as an indicator of the effectiveness of e-modules.

RESEARCH METHODS

This study uses a Research and Development (R&D) research approach, to create and test contextual wetland-based e-modules in physics learning. The research design used uses the ADDIE (*analysis*, *design*, *development*, *implementation*, and *evaluation*) model which includes needs analysis, design, e-module development, implementation, and evaluation of the effectiveness of e-modules in improving students' mastery of physics concepts.

This research focuses on students in grade XI of high school who study physics, especially about Archimedes' law. Respondents in this study were students who had studied Archimedes' law. This research also emphasizes on students' needs for contextual-based e-modules on wetlands to improve understanding of the material, as well as teachers' needs in developing more innovative learning media (Mulyani, 2019).

The subjects in this study were e-modules based on contextual wetlands to improve the mastery of physics concepts of high school students and 35 students of class XI MIPA.3 at SMA Negeri 1 Lempuing, Sumatera Selatan. The sample selection is done by purposive, which is a non-random sampling method in which the researcher intentionally selects subjects that are considered most relevant to the research objectives (Al Gharsi et al, 2024). Data collection in this study used several techniques, namely expert validation sheets, questionnaires, tests, and interviews.

The instruments in this study were validated by three experts, namely material experts, media experts, and linguists. In the material expert validation instrument grid, there are 18 statement items covering four aspects, namely: aspects of the curriculum field, material coverage, contextual wetlands, and concept mastery. In the media expert validation instrument grid, there are 18 statement items covering aspects: visual appearance or design, user convenience, consistency, and benefits. Furthermore, the language instrument grid has 15 statement items covering aspects: grammar, language effectiveness, vocabulary accuracy, and readability. The scale used for the assessment criteria is 1-0. Where 1 (Agree) and 0 (Disagree).

Data analysis in this study, namely validity analysis, practicality analysis, and effectiveness test. The data analyzed is quantitative data collected using validation sheet instruments, questionnaire sheets, and pretest and posttest questions. Pretest and posttest questions in the form of multiple choice totaling ten questions.

This research follows the stages of the ADDIE model, which consists of: 1) Analyze: Identifying student needs through teacher interviews and curriculum review to determine material that is difficult to understand, namely (Archimedes' Law), 2) Design: Designing the e-module structure, 3) Development: Developed e-modules and evaluations from experts (material, media, and language) and conducted limited trials with 10 students, 4) Implementation: A broad trial was conducted with 35 students, 5) Evaluation: Conduct formative evaluation through expert validation and analysis of student learning outcomes to assess the effectiveness of e-modules.

Furthermore, to assess the quality criteria of e-modules based on the validity aspect, the formula used is:

$$x = \frac{score\ obtained}{maximum\ score}\ x\ 100 \quad (1)$$

x = percentage of validity

Table 1. Criteria for Product Validity

Percentage (%)	Criteria
$P \geq 80$	Very Valid
$60 < P \leq 80$	Valid
$40 < P \leq 60$	Valid Enough
$20 < P \leq 40$	Invalid

On the practicality of e-modules using the assessment criteria and formula below:

Table 2. Criteria for Product Practicality

Percentage (%)	Criteria
$P \geq 80$	Very Practical
$60 < P \leq 80$	Practical
$40 < P \leq 60$	Enough
$20 < P \leq 40$	Impractical

Adaptation of (Copriady et al, 2020)

$$(P) = \frac{Number\ \ scores\ given\ by\ students\ x\ 100}{total\ number\ of\ students}$$

$$(P) = percentage\ of\ practicality$$

Furthermore, the effectiveness of the e-module was analyzed by increasing student learning outcomes through pretest and posttest with N-gain values. The purpose of this test is to find out how effective the e-module developed by using the N-gain effectiveness reference according to the N-gain value (Hake, 1998). N-gain analysis uses the normalized gain equation:

$$N - gain\ (g) = \frac{S\ post - S\ pre}{S\ max - S\ pretest} \quad (2)$$

Table 3. N-gain Criteria

N-gain Value	Criteria	Category
$g \geq 0{,}7$	High	Very Effective
$0{,}7 > g \geq 0{,}3$	Medium	Effective
$g < 0{,}3$	Low	Less Effective

RESULTS AND DISCUSSION

Results

The results of this study showed the development of contextual-based e-modules for wetlands at SMA Negeri 1 Lempuing in

class XI MIPA. The model used in this research is the ADDIE development model.

1. Analyze

Researchers conducted a needs analysis which was used as a reference and consideration in making e-modules. The needs analysis of this e-module was carried out by distributing questionnaires to 35 students of class XI MIPA SMA Negeri 1 Lempuing, as well as interviews with one of the physics teachers at SMA N 1 Lempuing. The needs analysis included: a) student needs analysis, b) teacher needs analysis, c) learner characteristics, d) learning analysis, e) learning outcomes and objectives.

2. Design

This design stage includes the preparation of an e-module framework consisting of e-module elements such as: (cover, introduction, learning activities, summative test, glossary, and bibliography). Then determining the appearance of the e-module design. The appearance of the e-module includes the design of the cover, font type, font size, e-module background color, reference collection, and preparation of e-module assessment instruments.

3. Development

At this stage, the e-module development process is carried out through several steps, namely product design, expert validation, revision, and limited trials for students. Product design was carried out by referring to the syntax of the ADDIE model at the design stage. The e-module was developed using Adobe Captivate and Canva software with a contextual wetland approach integrated into Archimedes' Law material. The e-module structure includes an introduction, presentation of material, practice questions, interactive simulations, and evaluation.

Furthermore, the validation of the e-module. Validation was conducted by three experts, namely material experts, media experts, and linguists. The purpose of validation is to assess the feasibility of content, appearance, and language use in the e-module before it is used in the pilot test. The results of validation by material experts showed a score of 86.11% with a very valid category, with input to clarify the explanation of the concepts of floating, drifting, and sinking. Media experts gave a score of 91.66% in the highly valid category, with suggestions that all videos can be played directly in the e-module and improvements to text structuring. Meanwhile, the linguist gave a score of 93.33%, also in the highly valid category, and suggested rearranging some sentences to make the flow of material delivery more systematic and easier to understand. Overall, the validation results show that the e-module is feasible to use with minor revisions according to the experts' suggestions. Furthermore, revisions were made according to the suggestions from the experts before the limited trial was conducted. This revision aims to ensure that the e-module is feasible and ready to be used in the limited trial stage.

The next step was to conduct a limited trial. The questionnaire contains 15 items of e-module practicality statements. The following are the results of data analysis from filling out student response questionnaires obtained from small group trials.

Table 4. Small trial response results

Aspect	Score max	Score obtained	(%)	Category
Material content, ease of use, benefits	150	139	92,67%	Very practical

Each statement is rated using a scale of 1 (agree) and 0 (disagree). From the total maximum score of 150, a score of 139 was obtained, so the percentage of positive responses reached 92.67%. Based on the interpretation criteria, the value is included in the "very practical" category which indicates that this e-module is feasible to use and can support the physics learning process well.

4. Implementation

At At this stage, a broad trial was conducted to 35 students of class XI MIPA SMA N 1 Lempuing as e-module users. This trial was conducted after the product was declared valid and had been revised. The practicality assessment of the e-module was obtained through filling out questionnaires by students after they used the module. The results of the pilot test showed a practicality score of 89.9%, which is included in the very practical category. This shows that the e-module is easy to use, interesting, and helps students in understanding Archimedes' Law material contextually.

The effectiveness of the e-module was measured through concept mastery tests before and after use (pretest and posttest), which were then analyzed using the N-gain value.

Table 5. N-gain Score

Class	Number of students	Pre Test	Post Test	N-gain
XI	35	31,76	75,56	0,64

The average pretest score was 31,76 which increased to 75,56 in the posttest. The result of the N-gain calculation is 0.64, which is included in the moderate category. This shows that the use of contextual wetland-based e-modules is effective in improving students' concept mastery on Archimedes' Law material.

5. Evaluation

This evaluation stage is carried out comprehensively to assess the quality and effectiveness of the e-module after going through the validation and testing process. This evaluation is formative, including assessments from experts (material, media, and language), user responses through a practicality questionnaire, and student learning outcomes analyzed using N-gain. The evaluation results showed that the e-module was categorized as highly valid, highly practical, and moderately effective in improving students' concept mastery. These findings indicate that the e-modules that have been developed are feasible to use as learning media for Archimedes' Law material at the high school level.

Discussion

This research was conducted up to the effectiveness testing stage to see the effect of e-module learning on concept mastery. The test results show that the material presented in the e-module can be well received by the experts. E-modules can facilitate access to learning anytime and anywhere, without having to always depend on the teacher directly. Thus, the utilization of e-modules in the physics learning process is very necessary.

In connection with the research by (Azhari & Sahputri 2021) suggests that learning facilities have a significant influence on learning processes and outcomes. A good process will produce good results too. Vice versa, so that the learning process and results can be optimized.

The results of the development of contextual wetland-based e-modules on Archimedes' law material showed a significant increase in concept mastery by students. Based on the learning outcomes data, the students' pretest average score was recorded at 31,76 while the posttest score

reached 75,56. This increase of 43,8 points shows that the e-module that has been developed is effective in helping students understand the concept of buoyancy force and its application in everyday life. Qualitatively, the results of questionnaires and interviews with students show that e-modules that present simulations, images, videos, and problems based on real contexts are very helpful in building a deeper understanding of concepts.

Contextual-based e-modules that have been developed can help improve students' mastery of physics concepts. This can be seen from the results of the pretest and posttest of students who experienced an increase in the ability to understand physics concepts in the medium category.

Furthermore (Widiastuti, 2023) stated that contextual e-modules in science learning contributed significantly to the attractiveness and effectiveness of student learning. E-modules that have been validated using the ADDIE model show a high level of feasibility, both in terms of material, presentation, and language use.

Compared to similar e-modules that do not have a local context, this e-module based on the wetland context is considered more "*meaningful*" because students not only learn Archimedes' law as an abstract theory, but also observe its application in everyday life around them. In line with research (Martin et al, 2021) and (Widyasari, 2021) also stated the same thing that contextual-based e-modules can be utilized to support the development and increase students' interest in learning physics.

Some previous studies have developed contextual-based e-modules with wetland themes as local content. (Pertiwi, 2022) developed contextual e-modules for static fluid material in high school and showed valid and practical results based on validation from experts and student responses. On the other hand, (Maya alviana, 2024) developed a wetland contextual flipbook-based e-module for junior high school level. Furthermore, research by (Rilia Iriani, 2019) that developed a wetland-based problem-based learning module to prepare future educators with a wetland environmental perspective. The three studies have not specifically discussed Archimedes' law material and have not evaluated the effectiveness of e-modules in improving mastery of physics concepts. This research has its own novelty by developing a wetland-based contextual e-module that directly links the concept of buoyancy force in Archimedes' law with local phenomena, such as boats in swamps or objects that float in wetland ecosystems.

Where the main focus in this study is on the contextualization of the material and the improvement of students' mastery of concepts, which is measured through pretests and posttests as an indicator of the effectiveness of e-modules.

Although the results show that e-modules have a very high level of validity and practicality as well as effectiveness in the medium category, it is important to realize that there are several external factors that can affect these achievements. Factors such as learners' level of digital literacy, variations in individual learning styles, as well as the limitations of direct interaction between students and learning resources can contribute to the results obtained. In addition, the learning environment at home and at school, including parental support and internet network access, can also be a determining factor in optimizing the use of e-modules.

Therefore, these findings are contextual and need to be further investigated on implementation in various learning environments to ensure

sustainability and generalizability of the results.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the development of e-modules based on contextual wetlands with the ADDIE development model affects the mastery of student physics concepts on Archimedes' law material. There is an increase in the average post-test score of 75,56 from the average pre-test score of 31,76 and the N-Gain value of 0.64 which is included in the moderate category. This e-module contributes scientifically to the development of physics learning media based on local contexts and practically facilitates teachers and students in the learning process. In the future, this module can be further developed through trials in a wider context.

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