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Development of Electronic Module (E-Module) Based on Case Method in Science Subjects at Junior High School

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Abstract: This study was conducted with the objective of creating an electronic module (E-Module) using the case method for the Science subject, specifically focusing on the topic of Force and Motion. The E-Module is structured in alignment with an independent curriculum, aiming to enhance students' academic achievements. The research methodology employed in this study is Research and Development (R&D), following the Analysis-Design-Development-Implementation-Evaluation (ADDIE) model. Expert evaluations of the content of the electronic module (E-Module) based on the case method reveal that the module falls within the "Highly Valid" category, with an average score of 92.14%. Assessments by media experts on the electronic module (E-Module) using the case method also classify it as "Highly Valid," with an average score of 92.14%. Similarly, language experts' evaluations, categorizing it as "Highly Valid," yield an average score of 90.90. These findings indicate that each aspect of the electronic module (E-Module) is deemed valid and meets the criteria for high validity. Consequently, it can be inferred that the electronic module (E-Module) based on the case method is well-suited for use as a teaching tool incience instruction for seventh-grade junior high school students.

Keywords: ADDIE development model; Development; Electronic module (E-module); Science subject

Introduction

Curriculum is crucial in accompanying the progress of a nation. It determines the future builders of the country (Mensah, 2019). Merdeka Curriculum is an innovative educational framework implemented in Indonesia. It is a government policy as a strategic initiative to reform and enhance the education system in the country (Utami et al., 2022). The primary goal of the Merdeka Curriculum is to create a self-reliant, innovative, and creative learning environment to boost students' self-confidence and enthusiasm for learning, particularly in the fields of science, technology, engineering design, and mathematics (Haleem et al., 2022; Kelley et al., 2020; Roberts et al., 2018).

Differentiated approach is the solution to facilitate differences in students' backgrounds with the aim of improving conceptual understanding (Eikeland et al., 2022; Gheyssens et al., 2023; Langelaan et al., 2024). This approach is designed to achieve learning goals through diverse assessments. The Merdeka Curriculum emphasizes the creation of a fun, safe, and bullying-free learning environment, using various teaching methods that consider the diversity of students (Hadi et al., 2023). To address the challenges of learning Natural Sciences, technology becomes a key factor. The use of electronic modules (E-modules) is considered a solution to create more engaging and effective learning. E-Modules are digital learning resources that assist teachers and students in easily accessible self-directed learning (Amandu et al., 2013; Diansah et al., 2020). This module contains material in digital format and is expected to be a systematic and engaging learning medium (Marlena et al., 2022).

Innovation in learning with case method is considered a new step in enhancing students' creativity

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and critical thinking skills. Research shows that this approach can stimulate critical thinking and improve collaboration among students, enabling them to think holistically and connect concepts across disciplines (Mebert et al., 2020). The Merdeka Curriculum creates a learning ecosystem that integrates technology and media, providing flexibility for educational units to connect interdisciplinary concepts (Ho et al., 2023; Kwangmuang et al., 2021).

SMPN 2 Suliki Sub-district UPTD has implemented the Merdeka Curriculum for two years, but the implementation of learning has not yet reached an optimal level, especially in applying differentiated learning. To achieve optimal learning goals, teachers must be skilled in choosing and using appropriate models or approaches to teaching, not just conventional approaches (Darling-Hammond et al., 2024). Observations and interviews in August 2023 indicate the need for innovation in teaching natural science subjects. The use of IT-based media by teachers is also lacking, and they are still minimal in creating teaching materials or Student Worksheets (LKS) to support students in learning science. Currently, teachers are required to utilize technology in the learning process to capture students' interest so that they are actively engaged in the learning activities in the classroom (Azhar et al., 2022).

On the student side, many are passive, show low interest, focus on themselves, joke with friends, indifferent to the material, and some even frequently ask for permission to leave the class. Moreover, all these factors significantly affect the students' learning outcomes. Another supporting factor is the low motivation for independent learning at home, as seen from the low number of successfully submitted homework assignments. Teachers need to measure students' self-learning independence to determine the extent of students' self-learning independence or whether there is an influence of teacher-led learning on students' self-learning independence (Scheel et al., 2022; Tekkol et al., 2018; Tong et al., 2022). All of this indicates the challenges in providing adequate motivation and support for students to develop self-learning independence and achieve optimal learning outcomes.

Method

This research is a Research and Development (R&D) study designed using the ADDIE model analysis, design, development, implemetation, evauation. The research process involves several stages, namely: The purpose of the validation process is to scrutinize the legitimacy of the developed product through a systematic approach. The research unfolds through distinct stages, each with its own set of intricacies. The initial stage is the Analysis Stage, encompassing: Needs Analysis, Curriculum and Material Analysis, and Learner Analysis. Here, the researcher delves into the essential requirements, scrutinizes the curriculum and materials, and assesses the characteristics of the learners. Moving on to the Design Stage, the emphasis is on crafting the product design. The researcher employs the Canva application to design an e-module integrated with the case method. The style and motion elements of the material are meticulously curated during this phase. The Development Stage follows, where the actual production of case method-based modules takes place using the Canva application and laptop assistance.

The material is crafted with a specific focus on science (IPA). Subsequently, the Implementation Stage comes into play. Here, the developed product design undergoes scrutiny by validation experts to ensure its feasibility. The product is then tested with a small group, aiming to evaluate its practicality by observing user responses, particularly from the students. The final stage is the Evaluation Stage, where measurements are taken to assess the achievement of development objectives. Revisions are implemented based on the suggestions provided by validation experts, ensuring a continuous refinement process for the developed product. This comprehensive flow ensures a thorough and structured approach to product development and validation.

Figure 1. ADDIE development procedure

The ADDIE Development Procedure involves data analysis for expert validation sheets and student responses, presented in the form of a rating scale. In this measurement scale, responses are expressed explicitly through numerical symbols: highly appropriate (4), appropriate (3), less appropriate (2), and not appropriate (1). The analysis of media validity testing is conducted by referring to the validity test sheets that have been carried out. The raw scores provided by the validators

are then summed and subsequently analyzed using a specific formula.

$$P(s) = \frac{S}{N} \times 100\% \quad (1)$$

Information:
P(s) : Percentage of the score
S : Total score for each sub-variable
N : Maximum score

After obtaining the validity scores, the results are then categorized based on their levels of validity, as outlined in the following table.

Table 1. Validity Category (Riduwan, 2015)

Validity Score (%)	Category
81-100	Very valid
61-80	Valid
41-60	Fairly Valid
21-40	Invalid
0-20	Very Invalid

Result and Discussion

The impact of these factors creates gaps, including the lack of motivation for students to learn and their inactivity in the learning process. This passiveness makes it challenging for students to understand the material presented by teachers, while a decrease in self-directed learning leads to a lack of enthusiasm for reviewing materials at home. During the observation of learning activities, it was found that classroom learning was more focused on the teacher's role, with lectures and students being passive in receiving explanations. Some students are less enthusiastic, evident from their minimal attention to the teacher's explanation, engagement in activities outside of science learning, or conversations with fellow students unrelated to the lesson.

Interviews with science teachers and seventh-grade students revealed various obstacles, including teachers' difficulties in preparing teaching materials in line with Learning Achievement (CP) requirements, the minimal utilization of learning media, and a lack of examples in textbooks, especially those involving calculations. Students also face difficulties in understanding abstract and mathematically intensive science material. The decline in science learning outcomes, especially in the Forces and Motion topic over the past two years, indicates the need for effective action to address these issues. Based on the information obtained from observations and interviews, it was decided to develop an electronic module (e-module) based on the case method for the Forces and Motion topic as a solution to overcome challenges in science learning, specifically in Forces and Motion. This module not only presents information narratively but also provides additional elements such as animations, videos, and relevant example problems to achieve learning objectives. This electronic module (e-module) based on the case method can be used both online and offline, allowing independent use by students according to their needs.

The Design Stage

The design stage involves the creation of an electronic module (e-module) based on the case method. This activity encompasses media selection, e-module creation, and gathering teaching materials in line with Learning Achievement and Learning Objectives in the independent curriculum. The process involves typing materials, creating images, selecting instructional videos, and organizing content in accordance with testing standards as an evaluation tool. The development of the e-module based on the case method is carried out by considering format selection, creating initial designs (flowcharts and storyboards), and implementing them according to the established module framework. The trial design of the electronic module (e-module) based on the case method can be seen in Figure 2.

Figure 2. The design of the electronic module

The Development Stage

In the development phase, the electronic module (e-module) based on the case method is produced according to the previously made design until the electronic module based on the case method is completed. Validation is conducted based on the aspects of media, content, and language. After the validation process, the researcher also undergoes a series of revision processes for the developed product based on improvements and suggestions from expert validators. The electronic module based on the case method is validated by three validators: media expert, content expert, and language expert. The resulting product is then validated by expert validators involving the testing of the electronic module (e-module) based on the case method to evaluate the product's benefits in the learning

process. The module is produced according to the pre-established design and is tested (Jilcha Sileyew, 2020). The production results of the electronic module based on the case method are then validated by expert validators, in this case, professors from Universitas Negeri Padang (UNP).

Validation is carried out regarding the aspects of media, content, and language with the aim of assessing the module's feasibility in terms of content, presentation using technology, and success in achieving learning objectives. The validation process also involves revisions based on input and suggestions from expert validators, ensuring that the module meets the expected quality standards. Material validation includes an assessment of the use of interactive videos in learning, especially the alignment of the format with the Learning Objectives Flow (ATP). Media validity assesses the completeness of e-module components, suitability for student characteristics, ease of use, as well as the resolution and quality of videos and images. Language validation is performed to assess language suitability according to language rules, sentences, and the target users, the students. Overall validity tests the module's usability in the impact of learning and additional benefits that can be obtained after using the electronic module based on the case method in learning.

Table 2. Results of Content Expert Assessment

Aspect	Maximum Score	Obtained Score	Validation Score%
Content Components	45	39	87
Language Components	30	28	93
Presentation Components	30	30	100
Graphic Components	35	32	91
Average Validity Score			92

Table 3. Results of Media Expert Assessment

Aspect	Maximum Score	Obtained Score	Validation Score%
Components	30	28	93
Content	50	46	92
Interface	40	37	96
Interactivity	10	10	100
Technology	10	8	80
Average Validity Score			92

Table 4. Results of Language Expert Assessment

Aspect	Maximum Score	Obtained Score	Validation Score%
Adherence to Language Rules	10	8	80
Sentence Coherence	20	19	95
Relevance to Learners	25	23	92
Average Validity Score			90

From the evaluation results presented in Table 2 by media experts, the evaluation phase yielded a score of 92% for the developed case method-based electronic module (e-module). In the implementation stage, after completion, a small-scale trial obtained a score of 88%, falling into the highly effective category. Table 3 indicates that content experts gave a score of 92% for the content of the case method-based electronic module. Meanwhile, in Table 4, language experts awarded a score of 90%, categorizing the language suitability used in the electronic module as highly valid. Based on these three tables, it can be concluded that the validity category for the developed case method-based electronic module (e-module) falls into the highly valid category.

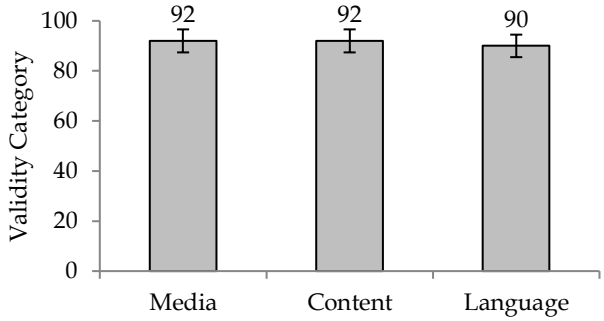

Figure 3. E-module validity results chart

The Implementation Stage

This step represents the testing process of the electronic module (e-module) based on the case method, which has successfully passed the validation test by experts (Alzubaidi et al., 2021). The trial is conducted by testing the product with six students to assess the practicality of the product. Students are asked to use the electronic module (e-module) based on the case method and then fill out a questionnaire regarding the ease or practicality of its use (Gopal et al., 2021; Lestari et al., 2022; Smeda et al., 2014; Stoian et al., 2022). The questionnaire consists of 20 statements divided into several aspects, such as attractiveness, appearance, material presentation, exercises and evaluations, as well as benefits (Petropoulos et al., 2022). A summary of the results of the small-scale trial can be seen in the table 5.

Table 5. Results of the Small-Scale Trial

Indicators	Maximum Score	Obtained Score	Validity%
Attractiveness	20	18	90
Display	40	36	90
Material Presentation	15	13	87
Exercises and Evaluation	10	9	90
Benefits	15	13	87
Average Score			89

Based on this table, it can be observed that the small-scale trial resulted in a score of 89%, which falls into the highly effective category.

The Evaluation Stage

After the implementation phase is completed, the next step is evaluation (Saldana, 2014). Previously, the electronic module (e-module) based on the case method had undergone a validation process by three validators (Farida et al., 2020; Paul et al., 2019). Each validator provided assessments: 92% for the e-module media, 92% for the content within the e-module, and 90% for language suitability according to the applicable guidelines. Based on these three assessments, it can be concluded that the developed electronic module (e-module) based on the case method falls into the highly valid category (Firdausi et al., 2021; Makhroji et al., 2023; Scarfe et al., 2024).

Subsequently, it continued with a small-scale trial, where the electronic module (e-module) based on the case method was tested on six students, and the trial results achieved a score of 89%. Therefore, it can be concluded that the developed electronic module (e-module) based on the case method is highly practical to use (Gistituati et al., 2022; Hastuti et al., 2022). However, this trial was conducted on a small scale, and it is hoped that in the future, the electronic module (e-module) based on the case method can undergo testing on a larger scale (Hairishah et al., 2024; Handayani et al., 2023; Kelana et al., 2023; Syafitri et al., 2023).

Conclusion

The development process of electronic modules (e-modules) based on the case method for the topic of Force and Motion in the Science subject for 7th-grade junior high school (SMP) students using the ADDIE model consisting of five steps, namely Analysis, Design, Development, Implementation, and Evaluation. The results of the validity of the electronic modules (e-modules) based on the case method for the Science subject in the 7th-grade junior high school indicate highly valid criteria after validation by experts in media, content, and language. Based on the media aspect, it scored 92% with a highly valid category, content scored 92% with a highly valid category, and language scored 90% with a highly valid category. It is important for students to understand concepts not only for comprehension but also for applying the concepts to solve problems and think critically about these issues during the learning process. This indicates that learners can use electronic modules (e-modules) based on the case method to enhance learning outcomes according to their needs, allowing for optimal implementation of differentiated learning.

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Conflicts of Interest

The authors declare no conflict of interest.

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