



Development of an E-Module Adapted to the Independent Curriculum Informatics Subject on the Basic Elements of Technology and Information for Phase E Grade 10 Students

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Abstract: This study aims to develop an e-module for Informatics learning based on the Independent Curriculum, focusing on the Basic Elements of Technology and Information for grade X phase E students. The development employed the ADDIE model (Analyze, Design, Develop, Implement, Evaluate) to produce a systematic structure and contextual content. Validation results indicated that the e-module was in the valid category, while practicality tests from teachers and students showed it to be very practical and practical, respectively. Effectiveness testing also demonstrated improved learning outcomes in the experimental class compared to the control class. These findings highlight that the e-module effectively facilitates the understanding of abstract Informatics concepts, encourages higher-order thinking skills, and increases learning motivation. Therefore, the developed e-module is considered valid, practical, and effective for use, with potential adaptability to support learning in other subjects.

Keywords: Computer science; Effectiveness; E-module; Practicality; Validity

Introduction

Education plays a pivotal role in preparing young generations to face the challenges of the 21st century. The Independent Curriculum emphasizes learning that fosters critical reasoning, creativity, computational thinking, and problem-solving skills, particularly through Informatics (Rahma et al., 2023; Syuzita et al., 2023). However, the implementation of Informatics learning in schools still faces several obstacles, such as limited infrastructure, a lack of interactive teaching materials, and low student motivation (Bahrin et al., 2023). These issues result in conventional learning processes that are less able to stimulate higher-order thinking skills. Similar problems were also observed at SMK Negeri 1 Ampek Angkek, where students showed low interest in Informatics learning due to the absence of

sufficient practice facilities and the reliance on printed textbooks. The existing teaching materials do not provide multimedia integration such as text, images, videos, or interactive activities that could effectively facilitate students' understanding of abstract concepts (Oksila et al., 2025). This situation widens the gap between students' competencies and the demands of the workforce, which increasingly requires digital skills and adaptive problem-solving abilities (Alyusfitri et al., 2023; Arif et al., 2022; Pendit et al., 2022; Rahayu et al., 2024).

To address these challenges, it is necessary to develop innovative technology-based teaching materials (Fatimah et al., 2023). E-modules offer flexibility of use, ease of updating, and the integration of multimedia content that makes learning more engaging and interactive (Qurrotu'ain et al., 2024). Compared to

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printed modules, e-modules have the potential to enhance students' motivation, conceptual understanding, and critical thinking skills (Wu et al., 2023). The novelty of this study lies in the development of an Informatics e-module aligned with the Independent Curriculum, focusing on the Basic Elements of Technology and Information for grade X phase E students (Ismiranda, 2024). This e-module was designed not only to provide interactive learning resources but also to evaluate its validity, practicality, and effectiveness in improving student learning outcomes (Herlina & Abidin, 2024). Therefore, this research is significant as it offers a strategic solution to strengthen the quality of Informatics learning while responding to the urgent need for digital-based educational innovation in vocational schools (Fatimah et al., 2023; Fitri et al., 2019; Royhanin & Sungkono, 2022; Sukmayanti et al., 2024).

Furthermore, this study contributes to the broader discourse on digital learning by demonstrating how contextual and interactive e-modules can support the recovery of learning post-pandemic and prepare students for 21st-century competencies (Aldilla & Usmeldi, 2023; Nasution & Yerimadesi, 2025). The findings are expected to serve as a reference for the development of similar learning media in other subjects and educational levels, thereby expanding the impact of e-modules in enhancing teaching and learning practices (Aminah & Yusnaldi, 2021; Radović et al., 2020; Rodrigues et al., 2019).

Method

The development of this e-module followed the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Herdianti & Rosy, 2021). Each stage was adapted to the context of Informatics learning in the Basic Elements of Technology and Information for grade X phase E students (Abdullah et al., 2024; Alyusfitri et al., 2023).

Analysis

The analysis phase involved identifying students' needs, problems, and learning tasks. Observations and interviews revealed limited infrastructure, lack of interactive teaching materials, and low student motivation in Informatics learning at SMK Negeri 1 Ampek Angkek. These findings became the basis for developing an e-module that integrates text, multimedia, and interactive activities (Fatimah et al., 2023).

Design

In this stage, learning objectives were formulated based on the SMART criteria (Specific, Measurable, Achievable, Realistic, and Time-bound) (Aniati et al.,

2020). The module structure was mapped, including learning outcomes, assessments, and activities aligned with the Independent Curriculum (Puspitasari et al., 2021).

Development

The blueprint was transformed into an e-module by integrating multimedia elements (images, videos, interactive quizzes) (Rachmayani et al., 2023). After the draft product was completed, validation was carried out by two media experts and two subject matter experts. The validation focused on content accuracy, language, presentation, and media design. The validity index was analyzed using Aiken's V formula (Islami et al., 2024; Ramadhina & Pranata, 2022):

$$V = \frac{\sum S}{n(c - 1)}, \text{ where } S = R - L_0 \tag{1}$$

where V= Aiken's V index, R = score given by validator, Lo = lowest score, c = highest score, n = number of validators.

Implementation

The validated e-module was implemented in two classes: one experimental group (X TJKT1, 20 students) and one control group (X TJKT2, 20 students), as presented in Table 1. The experimental group used the developed e-module, while the control group received conventional teaching (Suppan et al., 2020). Teachers were also involved to assess feasibility and practicality (Fauzi & Habibah, 2025).

Table 1. Research respondents

Group	Number of Students
Experimental Class	20
Control Class (X TJKT2)	20
Total	40

Practicality Test

Practicality was measured through teacher and student questionnaires regarding ease of use, attractiveness, material suitability, and learning independence (Royhanin & Sungkono, 2022). The percentage of practicality was calculated using the formula (Fitri et al., 2019; Ramadhina & Pranata, 2022):

$$\text{Practicality} = \frac{\text{Obtained score}}{\text{Maximum score}} \times 100\% \tag{2}$$

The interpretation criteria are shown in Table 2.

Table 2. Practicality criteria

Achievement level (%)	Category
90.00–100.00	Very practical
80.00–89.99	Practical
65.00–79.99	Quite practical
55.00–64.99	Less practical
0.00–54.99	Impractical

Effectiveness Test

The effectiveness of the e-module was analyzed by comparing the post-test scores of the experimental and control classes using an independent samples t-test in SPSS (Fitri et al., 2019). If the significance value was less than 0.05, it indicated a significant difference between the two groups. The formula used was (Fadillah et al., 2023; Nilyani & Ratnawulan, 2023):

$$t = \frac{X_1 - X_2}{\sqrt{S \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \quad (3)$$

where t = t-test statistic, X₁ = mean of experimental group, X₂ = mean of control group, S = pooled standard deviation, n₁ = sample size of experimental group, n₂ = sample size of control group.

Evaluation

Evaluation was conducted formatively at each stage of ADDIE to revise weaknesses. Summative evaluation was carried out after the implementation stage to conclude whether the e-module was valid, practical, and effective for Informatics learning (Gusman et al., 2022; Nilyani & Ratnawulan, 2023).

Result and Discussion

Media Expert Validation

Table 3. Media design validation results

Indicator	Validation result	Category
Appearance	0.85	Valid
Ease of use	0.88	Valid
Consistency	0.79	Valid
Format	0.92	Valid
Graphics	0.83	Valid
Average	0.85	Valid

Validation by media experts was conducted to evaluate the design and visual quality of the e-module. Five aspects were assessed: appearance, ease of use, consistency, format, and graphics. The average score was 0.85, which falls into the “valid” category, indicating that the e-module meets the standards of good learning media design such as aesthetics, navigation, and layout consistency. This finding supports Arsyad (2020) principle that clarity, systematic structure, readability, and visual appeal are essential in educational media. The developed e-module successfully integrates these elements, making it visually suitable for Informatics learning.

Material Expert Validation

Validation by subject matter experts assessed content suitability, language, presentation, and

usefulness. The average score was 0.95 (valid), confirming that the e-module content aligns with the Independent Curriculum and is systematically presented using communicative language. This ensures that the module supports conceptual understanding in Informatics learning.

Table 4. Media design validation results

Indicator	Validation result	Category
Content suitability	0.95	Valid
Language	0.95	Valid
Presentation	0.95	Valid
Usefulness	0.95	Valid
Average	0.95	Valid

Teacher Practicality Test

Three Informatics teachers evaluated the practicality of the e-module based on ease of use, support for student independence, appropriateness of material, and influence on learning. The average score reached 93.00%, categorized as “very practical.” Teachers noted that the e-module facilitated material delivery, encouraged student autonomy, and supported more systematic learning processes.

Table 5. Teacher practicality results

Aspect	Average Score	Category
Ease of use	97.00	Very practical
Student independence	90.00	Very practical
Educator convenience	91.00	Very practical
Material suitability	97.00	Very practical
Influence on learning	90.00	Very practical
Average	93.00	Very practical

Student Practicality Test

Table 6. Student practicality results

Indicator	Score	Category
Ease of use	86.67	Practical
Comprehension	77.60	Practical
Attractiveness	81.60	Practical
Independent learning	82.00	Practical
Achievement of objectives	84.00	Practical
Average	82.37	Practical

Five students assessed the e-module based on usability, comprehension, attractiveness, independence, and achievement of objectives. The average score was 82.37% (practical). Students reported that the videos and interactive questions made Informatics learning more engaging and less monotonous. This indicates that the module encouraged active and independent learning.

Effectiveness Test

Effectiveness was evaluated through a post-test administered to the experimental and control groups.

The experimental class achieved an average score of 84.50, compared to 76.67 in the control class, with a mean difference of 7.83 points. Independent samples t-test results ($p < 0.05$) confirmed a significant improvement in learning outcomes for the experimental group. The higher standard deviation in the experimental class (6.34 vs. 4.79) suggests greater variation in student performance, possibly indicating that while most students benefited, some achieved particularly strong results. This finding highlights the differentiated impact of interactive learning media.

Table 7. Comparison of post-test scores

Group	Average	Std. deviation	Highest	Lowest
Control	76.67	4.79	85.00	70.00
Experimental	84.50	6.34	95.00	75.00

Discussion

The results confirm that the developed e-module is valid, practical, and effective for Informatics learning. In line with Arsyad (2020), the systematic design and visual clarity enhanced usability and learning engagement. The module also applied problem-based learning principles, as emphasized by Trianto (2018) by including real-world problem scenarios that encouraged critical thinking and collaboration. Teacher and student responses demonstrated that the module supported structured and independent learning, consistent with Wulandari (2022) findings on the role of visual media in increasing motivation.

The effectiveness test further supports Ramadhan & Hindun (2023), showing that problem-based and project-based approaches significantly improve student engagement and conceptual understanding. Interestingly, the greater variation in the experimental group's scores suggests that the e-module particularly benefited high-achieving students, while also raising overall performance. Beyond academic achievement, the module contributed to the development of 21st-century skills. Students practiced collaboration, communication, and critical thinking through group tasks and reflections. These findings demonstrate that e-modules can not only improve learning outcomes but also foster broader competencies required in the digital era.

Conclusion

Based on the results of this research, it can be concluded that the developed e-module for Informatics learning is valid in terms of content and media design, practical for use by teachers and students, and effective in improving students' conceptual understanding and critical thinking skills. The e-module has proven to enhance learning outcomes compared to conventional

methods, and it offers a promising alternative for supporting the implementation of the Independent Curriculum. Furthermore, the developed product can be adapted for use in other subjects to strengthen the quality of digital-based learning.

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Conflicts of Interest

The authors declare no conflict of interest.

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