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E-module innovation: a product-based approach to database practicum

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ABSTRACT

Learning media is a crucial component in supporting the educational process. However, the practical learning process for the database subject at SMK Negeri 1 Sintuk Toboh Gadang has not fully prepared students to be independent and work-ready. This study aims to develop a product-based practicum module for the database subject, which is expected to enhance students' creativity, independence, and learning outcomes. The research method used is Research and Development (R&D) with the 4D model (define, design, develop, disseminate). Validation was conducted by media and content experts, followed by field trials involving 23 students. The research results show that the developed product-based e-module is valid with an average score of 0.85. The practicality of the module was rated very high, with a Reproducibility Coefficient of 0.98 and a Scalability Coefficient of 0.95. Its effectiveness was demonstrated through an improvement in student learning outcomes, with an N-Gain score of 0.73, categorized as high. Based on these findings, the module is considered valid, practical, and effective in improving student learning outcomes while promoting creativity and independence in database learning.

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Introduction

Learning media is a crucial and fundamental component in supporting the educational process (Amani et al., 2021; Muskhir et al., 2023; Waskito et al., 2024). Therefore, enhancing its utilization is essential to achieving the desired objectives. One of the effective media that can facilitate the learning process is a module. A module is a cohesive program designed to assess learning objectives (Medina et al., 2023; Putri et al., 2020). A module consists of a series of teaching and learning activities organized to help learners achieve specific and clear objectives (Cagomoc, 2022). Modules are a form of instructional media that effectively support the learning process and contribute to the development of competencies in learners.

A teaching module is a structured framework of the learning process, developed with attention to the developmental stages of learners to ensure that content is aligned with their growth (Dapat et al., 2023; Sahaat., 2020). owever, in the context of database learning, many existing modules fall short in addressing the practical needs of students, especially in fostering creativity and real-world application. While teachers are given the flexibility to select and adapt e-teaching modules provided by the government to suit the characteristics of their students, the current modules often emphasize theory without guiding students through

the process of creating tangible products (Lucchi, 2023). This gap highlights the need for modules that not only meet curriculum demands but also support problem-solving and hands-on skills in the learning process (Alturki et al., 2023; Amalu et al., 2023). Although instructional materials allow for some level of modification, certain constraints limit teachers' ability to fully tailor these resources to meet practical needs (Al Mamun et al., 2020; Bremner et al., 2023). The true value of developing teaching modules lies in making education not only more effective and efficient but also in facilitating independent learning and enhancing students' practical skills and competencies(Charokar & Dulloo, 2022; Saienko & Lavrysh, 2020). In the context of database learning, a more product-based approach to module development is essential to address these challenges effectively.

The rapid advancement of science and technology has significantly impacted the field of education, particularly in vocational training, demanding both teachers and students to proactively adapt and prepare to produce competent graduates who meet the needs of the modern workforce (Daminov., 2020; Purwanto., 2023). This shift has underscored the importance of integrating technology into the curriculum, specifically in areas like database management, where practical skills are essential (Aithal et al., 2024). One critical area of growth in this regard is the development of database materials that are both comprehensive and practical, particularly those designed for use on web platforms. These materials serve as essential resources for teaching and learning, allowing students to engage with real-world applications of database systems (Cirneanu et al., 2024; Prakash et al., 2024).

In the context of database practicum, the creation of these materials is vital because they provide students with the technical knowledge and hands-on experience needed to master database systems—skills highly demanded in industries today. However, traditional teaching methods that rely on static code examples fall short in preparing students for the complexities of real-world database management (St John & St John, 2024; Wikle & Williamson, 2024). To address this, educators need to adopt innovative learning systems that incorporate product-based modules, which not only present theoretical knowledge but also guide students through the entire process of developing functional database products (Anderson., 2024). This type of learning system bridges the gap between theory and practice, providing a more holistic approach to learning by integrating tasks such as software installation, database design, and implementation.

By utilizing product-based modules, students are allowed to develop and apply their skills in a more structured, practical manner that aligns with the social contexts and professional demands they will face after graduation (Kurniasih & Sunandi, 2023; Triyanto et al., 2022). Unlike traditional modules that are often limited to code examples without practical applications, these new modules allow students to follow a step-by-step approach from the basics of setting up a database environment to producing fully functional database systems. This hands-on experience is crucial for ensuring that students not only understand theoretical concepts but are also capable of applying them in practical scenarios (Blyznyuk & Kachak, 2024; Malik & Zhu, 2023). The result is a more competent and job-ready graduate, equipped with the practical tools needed to thrive in the competitive and ever-evolving technological landscape.

The current practical learning process for database subjects at SMK Negeri 1 Sintuk Toboh Gadang faces significant challenges in preparing students to be fully work-ready and independent. While students may achieve a basic level of training, they lack the necessary skills to confidently enter the workforce. Specifically, the practical learning component of the Software Engineering curriculum does not yet foster creativity or independent problem-solving, which are critical for success in the field. The database subject, in particular, requires students to be actively engaged and innovative in applying the skills they learn. However, the limited availability of comprehensive, hands-on learning resources—such as detailed modules that guide students through real-world projects—has hindered their ability to fully develop these competencies.

The current modules provided for the database practicum primarily focus on basic coding exercises, which fail to support the development of complex problem-solving skills or the creation of functional database systems. As a result, students often struggle to translate theoretical knowledge into practical applications, leading to suboptimal academic outcomes. Furthermore, the lack of interactive, product-based learning tools means that students are not challenged to think creatively or independently, which are essential attributes for software engineers. By introducing a product-based learning module, this gap can be addressed effectively (Matere et al., 2023; Suryani et al., 2024). Such a module would go beyond basic coding exercises by guiding students through the entire process of database creation, from conceptualization to implementation. This approach will not only enhance technical skills but also promote creativity and independent learning, better aligning the practical learning experience with industry demands and improving overall student preparedness for the workforce.

Based on the researcher's observations, one contributing factor is that the current practice module does not adequately support the database practical learning process. The existing module focuses solely on coding without producing tangible products, and the learning process remains centered on fragmented exercises rather than a holistic, productive approach. Consequently, the implementation of knowledge in practice has not been fully realized. Additionally, during practical sessions, students tend to merely follow the material without engaging in challenging, product-oriented activities, leading to a learning experience that is unengaging and monotonous. This situation has adversely affected students' learning outcomes, with very few students scoring above 80, while the majority score below 70 in the database subject.

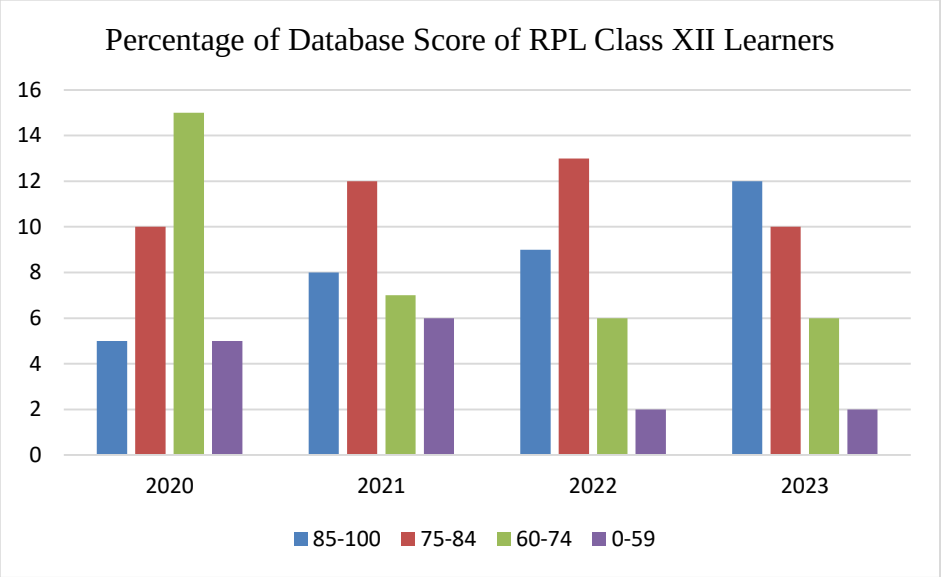

Figure 1. Percentage of Database Score

The table and graph demonstrate a steady increase in the percentage of students achieving high scores between 2020 and 2023. For example, in the 85-100 score range, 14.28% of 35 students in 2020, 24.24% of 33 students in 2021, 30% of 30 students in 2022, and 40% of 30 students in 2023 achieved high scores. Conversely, the percentage of students with low scores (0-59 range) remained relatively low, with 14.28% of 35 students in 2020, 18.18% of 33 students in 2021, 6.67% of 30 students in 2022, and 6.67% of 30 students in 2023. While these improvements indicate progress, the rate of advancement has been slow, possibly due to the lack of effective and engaging learning media. To accelerate improvements in student performance, the development of a product-based learning module is crucial.

In addressing these challenges, this research aims to develop a product-based module that will not only provide a structured learning experience but also support teachers in implementing more effective and engaging teaching strategies. The module will include detailed guidelines for educators on integrating the content into their lessons and promoting student creativity and independence. By offering a hands-on, practical learning experience, this module is designed to move beyond the basic theoretical focus of existing resources. What sets this product-based module apart is its focus on guiding students through real-world applications of database practice, encouraging them to actively create and solve problems rather than passively completing exercises. Key features will include step-by-step project development tasks, interactive components, and assessments that challenge students to think critically and independently. Ultimately, the module will foster deeper engagement, enhance learning outcomes, and equip students with the skills they need for success in software engineering and related fields. This approach is expected to directly address the gaps in current learning resources and offer a practical, innovative solution to the challenges identified.

Method

The research method employed in this study is Research and Development (R&D) using the 4D model, which comprises four key stages: Define, Design, Develop, and Disseminate. The decision to use the 4D model, as opposed to other instructional design frameworks such as ADDIE or the Dick and Carey model, is based on its structured yet flexible approach, making it particularly suitable for the iterative development of educational products like e-learning modules (Yusuf, 2023). Unlike other models, the 4D model emphasizes a more

streamlined process with a focus on the dissemination phase, ensuring that the final product can be effectively implemented and scaled in real-world educational environments.

Furthermore, the systematic nature of the 4D model aligns directly with the specific needs identified in this research, such as addressing gaps in student engagement and learning outcomes in database practice. Through comprehensive needs analysis, which includes curriculum and student assessments, the 4D model allows the researcher to accurately define core challenges and objectives. This structured methodology is expected to lead to the development of a valid, practical, and effective e-learning module that not only enhances student engagement but also improves their overall performance in database-related subjects. By offering a clear progression from design to dissemination, the 4D model ensures that the module is both applicable and scalable across various educational settings. The stages or procedures followed in this study are illustrated in Figure 2.

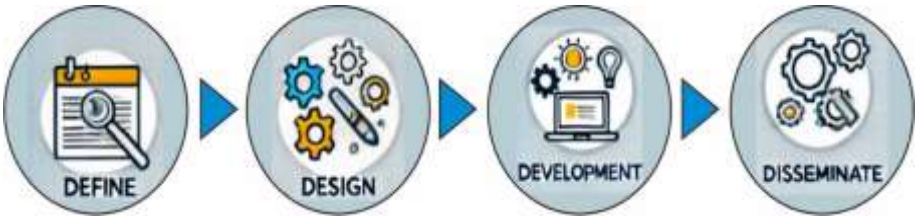

Figure 2. The Stage of The Research

The subjects of the trial are students who will receive practical instruction using a product-based e-module. A total of 23 students will participate in the trial of this product-based e-module development. The trial will follow a one-group design, involving a single class of 12th-grade students from SMKN 1 Sintuk Toboh Gadang, specifically class XII RPL3, during the first semester of the 2024/2025 academic year. The type of data used in the development of this product-based e-module is primary data, meaning it is directly obtained from the research subjects. This includes data from media experts (in the form of completed validation sheets), content experts, students (pretest and posttest scores, and responses on practicality sheets), and teachers (observation sheet responses) who are implementing the product-based e-module in their teaching. The data referenced here are qualitative research results gathered from experts, teachers, and students through questionnaires, with the findings analyzed using statistical formulas. The instruments utilized in this study include those for assessing validity, practicality, and effectiveness. The research follows a one-group pretest-posttest design, where the experiment is conducted on a single group without a control group for comparison (Chang, Lee, Yang, & Ryu, 2022). The effectiveness was evaluated by administering objective questions twice—once before the experiment (pretest) and once after (posttest) using the same set of questions with the same group of subjects. The product trial design is illustrated in Table 1.

Table 1. Product Trial Design

Pretest	Treatment	Posttest
O1	X	O2

Description:
X: Treatment (e-modul)
O1: Pretest (before treatment)
O2: Posttest (after treatment)

The analytical methods utilized in this study include analyses of product validity, practicality, and effectiveness. A Likert scale was used to assess media validity. The results of the product validity analysis, calculated using Aiken's V statistics, are presented below.

$$V = \sum s/[n(c-1)] \quad (1)$$

Description:
V = Index validated
S = r – Io
n = Number of validators
Io = The lowest validity score (in this case = 1)
c = The highest validity score (in this case = 5)
r = The number given by a validator

The V values obtained will range between 0 and 1.00. A value of ≥ 0.667 is considered sufficiently high and can be categorized as valid within the valid category. In analyzing the practicality of using the product-based module for students, the Guttman scale was employed with the following steps: (1) a) Organizing respondents' answers in a Guttman table. (2) b) Arranging respondents in order of their scores, from those who answered "Yes" most frequently to those who answered "Yes" the least, then arranging the items based on the number of "Yes" responses they received. (3) c) Calculating the number of errors in the scale, which are "No" responses that are interspersed with "Yes" responses. (4) Calculating the Reproducibility Coefficient to indicate the accuracy level of the measurement instrument.

$$\text{Kr} = 1 - \frac{\text{Number of Errors (e)}}{\text{Number of questions x number of respondents}} \quad (2)$$

Once Kr is known, the next step is to calculate the scalability coefficient

$$\text{Ks} = 1 - \frac{\text{Jumlah Kesalahan (e)}}{\text{Jumlah kesalahan yang diharapkan}} \quad (3)$$

$$\text{Ks} = 1 - \frac{\text{Jumlah Kesalahan (e)}}{\text{0,5 (Jumlah pertanyaan x jumlah responden)}} \quad (4)$$

Determining the level of practicality through calculation. If the Kr result obtained is 0.90 and Ks is 0.60 and above, then the product-based practical learning e-module can be said to be practical. The effectiveness of this study was also evaluated through the gain score analysis, which measures the improvement in student learning outcomes by comparing the differences between pretest and posttest results. Initially, students were administered a pretest, and following the completion of the learning process, a posttest was conducted. After collecting the data on individual student achievement, the total number of students who achieved mastery was determined. The pretest and posttest scores were then compared and the improvement in learning outcomes was analyzed using the N-Gain score as follows.

$$N - Gain = \frac{Spost - Spare}{Smaks - Spare}\ x\ 100\% \quad (5)$$

Description:
Spost = The average posttest score
Spare = The average pretest score
Smaks = The ideal maximum score

Table 2. Gain Score Categories

Gain Score	Category
N – gain > 70	High
30 ≤ N – gain ≤ 70	Medium
N – gain < 30	Low

In evaluating effectiveness using the t-test, the researchers used both descriptive and inferential quantitative analysis to identify any differences between the average results before and after the intervention, thus determining the impact of the treatment. Before proceeding with the analysis, a normality test was performed to confirm that the data were suitable for parametric statistical analysis, specifically utilizing a t-test.

Results and Discussions

Results of the Defining Stage

The curriculum analysis focused on the data practice subject, which is directly related to the developed learning media. The expected learning outcomes for this subject include students understanding database fundamentals, conducting practical work, and analyzing their results. Specifically, students should be able to explain the concepts of database hierarchy, rules, components, and installation, as well as database administration basics. They should also apply DDL, DML, and DCL commands, use advanced SQL commands, functions, stored procedures, and triggers in contextually relevant problems, and ultimately produce a product using the product-based e-module. This e-module guides students to create a product aligned with database practicum material and helps them plan a business plan that meets industry needs.

The study's subjects are 12th-grade Software Engineering students in the first semester of the 2024/2025 academic year, aged 17-18 years. At this age, students are generally capable of analyzing problems and forming hypotheses independently. According to Lorin (2001), in the revised Bloom's Taxonomy, students at

this stage are in the "create" category, where they can design, build, plan, produce, and improve their understanding and skills. This developmental stage allows them to learn independently and better explore how educational technology works, enhancing their self-directed learning and technological competence.

Results of the Design Stage

During the design phase, a product-based e-module for database practicum material was developed. This phase resulted in the creation, validation, and testing of the e-module, designed to meet the specified product requirements. The e-module includes a detailed structure with learning outcomes, soft skills, and learning objectives. The components of the e-module consist of a cover, preface, table of contents, introduction, brief description of the module, learning map, and specific topics, each with its learning outcomes and practical exercises. The e-module covers seven key practicum topics, ranging from downloading and installing Xampp to working with SQL commands and web display. Each topic is designed to build specific competencies in database practice. The module also includes practice questions, answer keys, and a bibliography to support further learning and ensure that students and teachers have the necessary resources to explore the material in depth.

Results of the Development Stage

The results of the validator's assessment of the product-based e-module focused on evaluating its content/material validity. Below is the data from the validator's evaluation based on the content/material.

Table 3. Item Total Statistics

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
x1	57.71	6.571	0.393	0.652
x2	57.00	6.000	0.720	0.610
x3	57.71	9.238	-0.829	0.776
x4	57.14	7.143	0.037	0.701
x5	57.43	5.952	0.475	0.633
x6	57.00	6.000	0.720	0.610
x7	57.86	6.476	0.227	0.677
x8	57.14	7.143	0.037	0.701
x9	57.43	5.619	0.620	0.606
x10	57.86	7.476	0.000	0.683
x11	57.00	6.905	0.216	0.672
x12	57.14	5.476	0.772	0.584
x13	57.71	6.571	0.393	0.652
x14	57.29	5.905	0.495	0.629

The output table provides statistical values for the 14 questionnaire items. In the "Cronbach's Alpha if Item Deleted" column, it is shown that the alpha value for all 14 items is > 0.6, indicating that the items are reliable. Since the Cronbach's Alpha value of 0.679 is greater than 0.63 (r table) for 7 samples, it can be concluded that the questionnaire format is reliable and trustworthy as a data collection tool in this research. Since the content validity coefficients obtained range from 0.75 to 0.96, with an average of 0.86, this indicates that the items possess strong content validity, supporting the overall content validity of the test.

The output table 4 presents statistical values for the 12 questionnaire items. In the "Cronbach's Alpha if Item Deleted" column, it shows that the alpha value for all 12 items is > 0.6, indicating that the items are reliable. Since the Cronbach's Alpha value of 0.807 is greater than 0.63 (r table) for 7 samples, it can be concluded that the questionnaire format is reliable and trustworthy as a data collection tool in this study. Since the presentation validity coefficients obtained range from 0.75 to 0.93, with an average of 0.83, it indicates that these items have strong presentation validity, thereby supporting the overall validity of the test presentation.

Table 4. Item Total Statistic (Validation of the E-module Presentation)

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
x1	47,57	10,286	0,091	0,825
x2	47,29	6,905	0,795	0,751
x3	47,86	7,81	0,826	0,751
x4	47,86	10,81	0	0,814
x5	47,29	9,905	0,184	0,82
x6	47,57	8,619	0,681	0,772
x7	47,71	9,905	0,32	0,804
x8	47,14	8,476	0,737	0,766
x9	47,86	10,81	0	0,814
x10	47,14	8,476	0,737	0,766
x11	47,57	10,286	-0,091	0,825
x12	47,57	8,619	0,681	0,772

Table 5. Item Total Statistic (Validation of E-module Format)

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
x1	62,43	27,619	0,446	0,912
x2	62,86	28,476	0,274	0,917
x3	62,86	28,143	0,34	0,915
x4	62,43	27,286	0,514	0,91
x5	62,29	26,238	0,972	0,899
x6	62,86	28,143	0,34	0,915
x7	62,43	22,619	0,967	0,891
x8	63,29	26,238	0,972	0,899
x9	62,43	22,619	0,967	0,891
x10	62,57	23,952	0,723	0,904
x11	62,29	26,238	0,972	0,899
x12	62,86	28,143	0,34	0,915
x13	63	29	0,246	0,916
x14	62,43	27,286	0,514	0,91
x15	63	24,333	0,783	0,9

The output of table 5 provides statistical values for the 15 questionnaire items. In the "Cronbach's Alpha if Item Deleted" column, it is shown that the alpha value for all 15 items is > 0.6, indicating that the items are reliable. Since the Cronbach's Alpha value of 0.912 is greater than 0.63 (r table) for 7 samples, it can be concluded that the questionnaire format is reliable and trustworthy as a data collection tool in this research. Based on the validation analysis and reliability testing, the results indicate that the e-module validation from the seven validators places the developed database practice e-module in the valid validity category. The table shows that the e-module has met the content aspect with a validity score of 0.86, the presentation aspect with a validity score of 0.83, and the format aspect with a validity score of 0.86. When these three aspects are combined and averaged across the validators, the overall validity score is 0.85, which falls within the valid validity category.

The product-based e-module for database practicum material, which has been refined based on expert testing, was taken to the field for trial. The trial began by allowing students to use the product-based e-module. After the students completed the practicality questionnaire, the responses were organized into a Guttman table. The Practicality Coefficient was then calculated to indicate the level of practicality in using the e-module. The following are the results of the calculation of the practicality coefficientThe practicality coefficient, or Kr = 0.982, indicates that the developed product-based e-module is practical, as it exceeds the validity threshold of 0.98.The Scalability Coefficient, or Ks, is 0.95. This reinforces the Practicality Coefficient, indicating that the e-module is practical, as it surpasses the standard threshold of 0.60. Therefore, it can be concluded that the product-based e-module for database practicum is considered practical by the students.

Based on the data analysis, the effectiveness of the implemented method was evaluated using N-Gain analysis and a paired sample t-test to identify significant improvements between pre-test and post-test scores. The results, as shown in Table 6, indicate that the mean N-Gain score is 0.73, which falls into the "high" category. This suggests that there was a substantial improvement in student learning outcomes after the

intervention. Additionally, the N-Gain percentage of 72.82% further confirms that a significant proportion of the students demonstrated considerable progress in their learning.

Table 6. N-Gain Score Test Results

N	Minimum	Maximum	Mean	Std. Deviation
N_Gain	23	0.63	0.93	0.7282
N_Gain_Persen	23	63.16	93.33	72.8210
Valid N (listwise)	23	-	-	-

Although the t-test results are not displayed in the table, this test would typically be used to determine if the difference between pre-test and post-test scores is statistically significant. If the t-test yielded a p-value of less than 0.05, it would indicate that the improvement observed in student performance is not due to random chance, but rather to the effectiveness of the teaching method. These results imply that the implemented teaching tool, likely the e-module, had a significant impact on student engagement and learning outcomes. The high N-Gain score indicates that the intervention successfully enhanced students' understanding of the subject matter, and such approaches could be beneficial if applied to similar educational settings. To provide a more comprehensive interpretation, additional details such as the effect size and statistical significance would further reinforce the strength of these findings, offering valuable insights into how such educational strategies can improve learning outcomes more broadly.

The curriculum of the Software Engineering concentration at SMK Negeri 1 Sintuk Toboh Gadang is designed to meet the demands of the industrial world. The teaching process involves both theoretical and practical components, which are essential for equipping students with the skills they need after graduation. Practical learning, in particular, is a process aimed at enhancing students' skills through various methods that align with the specific competencies being taught and the equipment being used. Moreover, practical learning serves as an educational process that systematically and purposefully guides students to acquire and perform specific skills. This approach is also applied in the teaching of database practice.

Given the unique and comprehensive nature of the practical learning process, the development of a product-based e-module for database practice is highly promising in addressing these educational needs. The advantages of a product-based e-module include supporting existing teaching materials, providing students with the opportunity to engage in market-oriented practical work, enhancing students' competencies, and fostering an entrepreneurial spirit among them. Additionally, the current lack of product-based modules in the database practice course within the Software Engineering concentration highlights the need for such development. This development can also accommodate various levels of student ability, offering flexibility in teaching, and encouraging more independent and interactive learning, in line with the demands of modern, increasingly digital education. Thus, the product-based e-module is expected to address educational challenges in the digital era while simultaneously improving students' readiness to face a dynamic and competitive workforce.

The development process of this e-module follows the 4D model, which comprises four main stages: Define, Design, Develop, and Disseminate. The development of the e-module begins with a needs analysis, followed by the design, evaluation, and revision stages. During the defining stage, activities such as curriculum analysis and student analysis are conducted. This stage serves as the foundation for developing a product-based e-module for the database practice subject, enabling students to engage in self-directed learning. Following the defining stage, a product-based e-module comprising seven interconnected learning topics is developed, each designed to guide students in producing a product or tool that aligns with the Learning Outcomes and competency standards of the Software Engineering curriculum.

Topics 1-3 of the e-module focus on the software used in creating databases. These initial topics aim to familiarize students with the software and the scope of database creation, as well as the various fields involved in database management. By understanding these foundational aspects, students can bewtter visualize what they are capable of creating or producing in the field of databases, thereby fostering their creativity. Topics 4-6 delve into the process of creating database products, while Topic 7 covers the creation of database products and how to display them on a web page. The product-based e-module not only guides students through systematic and standardized work procedures for creating or completing a product (goods or services) but also fosters an entrepreneurial spirit among them. After the development of the product-based e-module is completed, it undergoes tests for validity, practicality, and effectiveness. According to Nurhikmah H, Hakim, Kuswadi, Sulfianti, & Sujarwo (2021), "an instructional material that has been developed can only be used in practical learning after it has passed validity, practicality, and effectiveness tests.

The results of the research indicate that the validated e-module meets the criteria for a good e-module, including the organization of components according to indicators, content alignment within the e-module,

clarity of instructions, organization of material, format appropriateness, visual appearance, and language used. These elements make it easier for students to understand database practice and apply their knowledge. According R. R. R. R. Putri, Kaspul, & Arsyad (2022), a study titled "Development of Electronic Learning Media (E-Module) Based on Flip PDF Professional for Human Circulatory System Material in 11th Grade High School" was conducted. The results indicate that the electronic learning media (e-module) based on Flip PDF Professional achieved a validity score of 89.33% and a practicality score of 92.39%. It can be concluded that the validity and practicality of the developed electronic learning media (e-module) based on Flip PDF Professional fall into the category of highly valid and highly practical. The validators confirmed that the product-based e-module aligns with the curriculum, Learning Outcomes, and Soft Skills objectives for students. The e-module's content validity was rated at 0.86, indicating that it is highly appropriate for the current curriculum. Content validity ensures that the concepts presented are accurate and aligned with the curriculum. The high content validity score suggests that the developed product-based e-module is well-suited to the curriculum.

Presentation validity, which pertains to the use of language, writing, images, and overall appearance in the e-module, received a validity score of 0.83, placing it in the valid category. This high score indicates that the developed e-module meets the technical requirements for an instructional e-module. The format validity, with a score of 0.83, also fell within the valid category. Format validity refers to the alignment of the e-module's components with the established standards. Based on the validation results, it can be concluded that the product-based e-module is consistent with the construction requirements of an instructional e-module. The practicality of the product-based e-module was tested through a student response questionnaire administered to 23 students who participated in seven practical activities using the e-module. The results showed that the instructional material is practical, with a Reproducibility Coefficient (Kr) of 0.98 and a Scalability Coefficient (Ks) of 0.95. All statements regarding the ease of use of the product-based e-module received positive feedback from the students, indicating that the e-module can be easily used by students during practical sessions.

A practical e-module simplifies students' understanding of database practice. According to Khotimah, Giyanti, & Fajriani (2022), the study titled "Development of an E-Module Based on the CORE Learning Model to Facilitate Students' Mathematical Communication Skills" demonstrates that the E-Module is suitable for use based on expert validation tests. The media expert validation yielded an average score of 91.67%, while the feasibility assessment from mathematics education experts scored 75.76%, and the average score from the mathematics expert validation was 98.33%. Student responses in the field test indicated that the completeness aspect of the E-Module was rated as "very complete" with a score of 60%, the design was found to be attractive (53.33%), the color combination was appropriate (53.33%), the language used was effective (53.33%), the illustrations helped in understanding the social arithmetic material (63.33%), and the E-Module supported independent learning for students (70%). Keywords: E-Module, CORE, Mathematical Communication.

The observation sheet analysis revealed that the student activity achievement score was 86.43, which falls within the "achieved" category. This indicates that the product-based e-module effectively activates or enhances student participation in the database practice subject. The learning outcomes test measures the effectiveness of the learning process. Learning outcomes refer to the skills that students acquire after experiencing the learning process. Effective learning activities are essential for achieving good learning outcomes. The goal of assessing learning outcomes is to measure the success of the teaching and learning process.

The analysis revealed that the use of the developed e-module significantly improved students' understanding of the material, leading to better learning outcomes. According to Novianti, Zaiyar, Khaulah, Fitri, & Jannah (2023) a study titled "Development of a Problem-Based Learning E-Module on Students' Critical Thinking Skills" was conducted. The results, analyzed using the Independent Sample T-Test, showed a Sig. (2-tailed) value of 0.045. Since the Sig. (2-tailed) value of 0.045 is less than the significance level of 0.05, it can be concluded that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. This indicates that learning using the Problem-Based Learning e-module is more effective in enhancing students' critical thinking skills compared to conventional teaching methods. Based on the analysis and statistical description of the effectiveness indicators, including pre-test and post-test scores, it was observed that student activity during learning sessions using the "product-based e-module in the Database Practice subject" was normally distributed, with homogeneous variance and a significant impact on the pre-test and post-test variables, indicating a high level of effectiveness.

Although there are many advantages to using the product-based e-module, one challenge that requires attention is the time constraint, as the activities took longer than planned. Students needed more time and practice, while the allocated time per activity unit in the e-module was limited to 4x45 minutes.

Conclusions

Based on the research findings and discussions, it can be concluded that the development of a product-based e-module for database practice in the Software Engineering (RPL) concentration at SMK Negeri 1 Sintuk Toboh Gadang has resulted in an instructional tool that is valid, practical, and effective. The e-module, comprising seven interconnected topics, successfully guided students in producing database-related products, thereby enhancing their market-oriented practical skills and fostering an entrepreneurial mindset. Its validity was established through comprehensive curriculum and student analyses, supported by expert evaluations, with high validity and reliability scores across content, structure, and technical aspects. The practicality of the module was further supported by positive student feedback, demonstrated by high practicality coefficients (Kr = 0.98 and Ks = 0.95). Furthermore, significant improvements in pre-test and post-test scores indicate the module's effectiveness in increasing student engagement and achieving educational objectives.

However, the study also has limitations, including the relatively small sample size and the absence of a control group, which may limit the generalizability of the findings. These factors suggest that caution should be taken when applying the results to broader educational contexts. Future research should aim to involve larger and more diverse student populations to validate the effectiveness of the module across different settings. Additionally, follow-up studies could explore the integration of the e-module with other instructional methods or tools to enhance its adaptability and impact. By addressing these limitations and considering further development, the findings of this study could contribute significantly to vocational education and promote innovative, student-centered learning strategies for practical subjects like database practice.

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