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Development of Interactive E-Module Based on CLO3D for Kebaya Kutubaru Modifications as a Preparation for Garment Creation

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Abstract

The utilization of three-dimensional fashion design technology in vocational learning at vocational high schools is still suboptimal, particularly in providing structured digital learning materials that support independent practical learning. This condition affects the mastery of digital fashion design skills among students. This study aims to develop an interactive e-module based on digital fashion design applications for the topic of Preparation for Kebaya Kutubaru Modification and to assess its feasibility, practicality, and effectiveness as a learning medium. This research employs the Research and Development (R&D) method using the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation. The research subjects consist of 18 students from the 11th grade of Fashion Design Expertise Program at SMK Ibu Kartini Semarang. Data collection techniques include expert assessments, user response questionnaires, and pre- and post-performance tests. The results of the study indicate that the developed e-module is categorized as very feasible and highly practical for use in learning. Furthermore, the analysis shows an improvement in the skills of the students after using the e-module, with the N-Gain value categorized as moderate. Therefore, the developed interactive e-module is deemed effective as a learning medium to support the enhancement of digital fashion design skills among SMK students.

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INTRODUCTION

The Fourth Industrial Revolution is marked by the increasing integration of the physical, digital, and biological worlds through advanced technologies such as artificial intelligence, the Internet of Things (IoT), robotics, and virtual reality. This development not only transforms how people work and interact but also drives significant changes across various industry sectors, including the creative and fashion industries (Alsulaimani & Islam, 2022). Digital technology has opened up opportunities for creating more efficient, integrated, and consumer-oriented industrial ecosystems.

In the fashion industry, the use of digital technologies such as 3D garment design and printing has significantly altered the design-to-production process. These technologies allow for faster and more precise garment prototyping, while also reducing material waste typically generated by conventional methods. Beyond improving production efficiency, 3D design technology contributes to the development of more sustainable business models in fashion, adapting to consumer demands (Khajavi, 2021).

This rapid change necessitates that vocational education institutions, including Vocational High Schools (SMKs), adapt to technological advancements in the industry. As educational institutions focused on workforce preparation, SMKs must integrate cutting-edge technologies into their learning processes to ensure that graduates possess relevant skills that meet industry needs. One such adaptation is the use of 3D garment design software, such as CLO3D. The application of CLO3D in education enables students to visualize garment designs digitally, making the learning process more efficient, creative, and aligned with the demands of the Fourth Industrial Revolution (Prasetya et al., 2025).

The use of technology in education has proven to enhance the quality, accessibility, and effectiveness of learning. Digital learning media, including interactive e-modules, can improve concept understanding, increase student motivation, and foster independence in the learning process (Hidayatullah et al., 2023). In vocational education, integrating technology is crucial due to the hands-on nature of the learning, which directly relates to industry practice. To ensure that vocational graduates can compete in the labor market, education must keep pace with the technological advancements used in the industry (Suhaedin et al., 2023).

National policies also emphasize the importance of strengthening vocational education based on industry needs. Presidential Regulation No. 68 of 2022 states that vocational education and training aim to improve access, quality, and relevance to the labor market. Consequently, technological innovations in learning are vital for enhancing the quality of vocational education.

One relevant technology for integration into fashion design education is 3D Fashion Design, particularly through the use of CLO3D software. CLO3D is a three-dimensional fashion design application that enables virtual and realistic garment design, pattern making, and visualization. This software allows users to adjust body measurements, fabric types, and garment construction details digitally, accelerating the design process and saving on production costs and materials (Hartanto, 2020; Widy et al., 2023). Furthermore, CLO3D supports sustainable design approaches, such as zero-waste fashion design, which focuses on waste reduction from the design stage (McQuillan, 2020).

Numerous studies indicate that applying CLO3D in fashion design education enhances efficiency, creativity, and student readiness for the industry. The development of CLO3D-based virtual fashion design e-modules in higher education has been shown to be highly feasible as an interactive learning resource (Sholikhah et al., 2025). Additionally, using CLO3D for pattern making and virtual prototyping has proven to shorten time-to-market and reduce fabric waste in the production process (Renaningtyas et al., 2024).

Despite these benefits, the implementation of CLO3D in vocational education faces several challenges, such as limited software proficiency among teachers and the high hardware specifications required. CLO3D requires mid to high-end computers to function optimally, making infrastructure readiness a crucial factor for its successful implementation in vocational schools.

Based on observations at SMK Ibu Kartini Semarang, the school has significant potential for developing CLO3D-based learning, as it already has 25 computers equipped with CLO3D software and plotting machines. However, CLO3D-based learning has not been fully optimized due to a lack of instructors actively teaching the material and the absence of a specific, structured e-module for CLO3D that aligns with the characteristics of vocational learning. As a result, the learning process still relies on manual methods, even though students show high interest in digital technology-based learning.

Another challenge is the limited time for practical lessons in garment creation preparation, particularly for Kebaya Kutubaru Modifikasi. The manual process of creating designs, patterns, and prototypes is time-consuming, often preventing students from completing tasks within the allocated class time. By using CLO3D, this process can be completed digitally in a single platform, saving time and facilitating more equitable skill development among students.

The choice of Kebaya Kutubaru Modifikasi as the subject matter is based on its cultural value, aesthetic appeal, and technical complexity. The Kebaya is not only a traditional garment but also a symbol of Indonesian identity and cultural heritage, which continues to evolve with modern trends. The Kebaya Kutubaru Modifikasi is highly relevant to the national fashion industry and provides a contextual learning experience for students (Winuriska, 2024).

Based on the above discussion, the development of an interactive CLO3D-based e-module for the preparation of Kebaya Kutubaru Modifikasi garment creation is a strategic solution to support fashion design education at SMKs. This e-module is intended to support independent learning, enhance student digital design skills, and bridge the gap between vocational education and the technology-driven fashion industry.

METODHOLOGY

This study employs a Research and Development (R&D) approach with the ADDIE development model, which includes the stages of analysis, design, development, implementation, and evaluation. The ADDIE model was chosen due to its systematic development process and its ability to facilitate continuous evaluation to produce viable learning products (Alodwan, 2018). The developed product is an interactive e-module based on a digital fashion design application, focusing on the topic of Preparation for Kebaya Kutubaru Modification, targeted at students in the Fashion Design Expertise Program at Vocational High Schools (SMKs).

The analysis phase was conducted through observations and interviews with teachers and students at SMK Ibu Kartini Semarang to identify learning needs and the challenges they face. The design phase includes the creation of the e-module structure, learning objectives, material preparation, and the design of the interface and navigation, which are tailored to the characteristics of vocational learning.

The development phase involves turning the design into an interactive e-module, which is then validated by subject matter experts and media experts to assess the content quality, presentation, language, and visual design of the media. The research subjects consisted of material and media validation experts, who evaluated the feasibility of the e-module through validation sheets. The feasibility data were analyzed quantitatively using Aiken's V coefficient and percentage analysis to determine the e-module's feasibility category. The results of this analysis served as the basis for product revisions and the determination of the e-module's feasibility before it is used as a digital learning medium.

RESULTS AND DISCUSSIONS

Research Results

Before being used, all research instruments were validated by three validators using a 1-5 rating scale. The instruments validated included media feasibility, content feasibility, practicality, effectiveness, and performance tests. The validity analysis results using Aiken's V coefficient showed that all instruments fell within the range of 0.83-1.00, categorized as highly valid, thus deemed suitable for use.

Table 1. Results of Instrument Validation Using Aiken's V

Instrument	Aiken's V Value Range	Category	Description
Media Feasibility	0.8333 - 1	Very Valid	Suitable
Content Feasibility	0.8333 - 1	Very Valid	Suitable
Practicality	0.9166-1	Very Valid	Suitable
Effectiveness	0.9166-1	Very Valid	Suitable
Performance Test	0.8333 - 1	Very Valid	Suitable

The reliability test for the instruments of the subject matter experts and media experts was analyzed using the Intraclass Correlation Coefficient (ICC) with a two-way mixed effects model and absolute agreement. The ICC results showed that the Average Measures value was in the range of fair to good, and the F-test results showed a significance of $p < 0.05$. This indicates a significant agreement between the validators, ensuring that the research instruments have acceptable reliability.

Table 2. ICC Results for Media Expert Instrument

Intraclass Correlation Coefficient							
		95% Confidence Interval		F Test with True Value 0			
	Intraclass Correlation[b]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.308[a]	0.069	0.566	2.909	23	46	0.001
Average Measures	.572[c]	0.183	0.796	2.909	23	46	0.001

Table 3. ICC Results for Subject Matter Expert Instrument

Intraclass Correlation Coefficient							
		95% Confidence Interval		F Test with True Value 0			
	Intraclass Correlation[b]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.311[a]	0.039	0.621	2.743	15	30	0.009
Average Measures	.575[c]	0.108	0.831	2.743	15	30	0.009

Results of Media Feasibility Test

The media feasibility test was conducted by three media experts, with the assessment criteria including visual appearance, format suitability, navigation, interactivity, consistency and clarity, media support, technology relevance, and content suitability. The evaluation results showed that the e-module achieved feasibility percentages of 88%, 96%, and 95%, all of which were categorized as highly feasible.

Table 4. Results of Media Feasibility Test by Media Experts

No	Expert Name	Score Achieved	Max Score	Percentage	Category
1	Expert 1	70	80	88%	Very Feasible
2	Expert 2	77	80	96%	Very Feasible
3	Expert 3	76	80	95%	Very Feasible

The assessment of each aspect indicated that the visual appearance and technology relevance received the highest percentage (97%), suggesting that the e-module's design is attractive, and the use of CLO3D is highly relevant to fashion design learning in SMK. Other aspects such as navigation, consistency, media support, and content suitability also fell within the very feasible category, while the interactivity aspect showed potential for further development, although it still met the feasibility criteria.

Results of Content Feasibility Test

The content feasibility test was conducted by three subject matter experts, with assessment criteria including content feasibility, material presentation, language suitability, and contextual evaluation. The results indicated feasibility percentages of 97%, 96%, and 94%, all categorized as highly feasible.

Table 5. Results of Content Feasibility Test by Subject Matter Experts

No	Expert	Score Achieved	Max Score	Percentage	Category
1	Expert 1	116	120	97%	Very Feasible
2	Expert 2	115	120	96%	Very Feasible
3	Expert 3	113	120	94%	Very Feasible

The assessment of each aspect revealed that material presentation received the highest percentage (98%), followed by language suitability (96%), and content feasibility and contextual evaluation (94%). This shows that the material has been organized systematically, communicated effectively, and is contextual and relevant to the learning competencies for the preparation of Kebaya Kutubaru Modifikasi.

Based on the validation and feasibility tests, the experts provided minor suggestions for improvement, including aligning navigation buttons, adding a glossary, and including user instructions for the e-module. Revisions were made accordingly, and after the improvements, the e-module was deemed suitable for use without requiring further significant revisions.

Discussion

The discussion of the research results focuses on the feasibility of the CLO3D-based interactive e-module developed for the preparation of Kebaya Kutubaru Modifikasi creation at SMK Ibu Kartini Semarang. The results of the feasibility test by three media experts showed percentages of 88%, 96%, and 95%, all categorized as highly feasible. These findings indicate that the developed e-module meets the standards for high-quality digital learning media and is suitable for use in vocational education contexts. The aspects assessed included visual appearance, format suitability, navigation, interactivity, consistency and clarity, media support, technology relevance, and content suitability, all of which collectively demonstrate the media's high quality and its alignment with the needs of fashion practice learning at SMK.

Theoretically, Mayer (2009) emphasizes that effective learning media should be able to integrate text, visuals, and multimedia harmoniously to optimize student cognitive processes. This multimedia learning principle is reflected in the e-module through the use of CLO3D-based 3D visualizations, instructional videos, and interactive navigation that facilitate students in understanding the steps involved in preparing the Kebaya Kutubaru Modifikasi. The 3D visualization provides a more concrete representation of the form, structure, and details of the garment, helping students connect design concepts with practical garment creation in a more realistic and applicable way.

In terms of visual appearance and format presentation, the e-module shows excellent quality with high feasibility percentages. The clean, consistent layout and the use of soft colors support readability and student comfort during learning. This structured visual design aligns with the view of Rizqullah (2025), who states that good visual design in digital learning media plays a critical role in enhancing focus, comfort, and student engagement. Additionally, the systematic presentation format helps students understand the learning flow in a sequential manner, supporting

independent learning, which is an essential characteristic of e-module-based learning.

The aspects of navigation and interactivity also received the "highly feasible" category, indicating that the e-module was designed with student usability in mind. The clear and consistent navigation buttons, along with interactive features such as videos, links, and QR codes, enable students to directly interact with the learning material. This is in line with Rohmah's (2025) assertion that clear navigation and good interactivity in digital learning media can reduce user confusion and enhance learning effectiveness. The interactivity in this e-module also plays a role in increasing student engagement, especially in practical learning that requires detailed step-by-step visualizations.

The results of the content feasibility test showed percentages of 97%, 96%, and 95%, which are categorized as highly feasible, indicating that the content of the e-module aligns with the learning competencies for Fashion Design at SMK. The alignment of the content with the characteristics of SMK students is an important aspect in vocational education, as vocational training emphasizes the integration of both knowledge acquisition and practical skills (Sudira, 2016). The content is systematically and contextually organized, starting from the introduction of basic concepts to the application of practical steps in preparing the Kebaya Kutubaru Modifikasi using CLO3D, supporting meaningful and applicable learning.

Moreover, the language and contextual relevance of the content also showed a "highly feasible" category. The language used in the e-module is communicative, clear, and appropriate for the developmental level of SMK students, making it easier for students to understand the material and practical instructions. This aligns with Sugiantara's (2025) statement that the language in educational materials should be easy to understand, communicative, and adhere to language norms so that the information can be optimally received by students. The connection between the content and real-world contexts, along with fashion work practices, strengthens the e-module's relevance as a vocational learning medium.

Thus, the CLO3D-based interactive e-module developed not only meets the criteria for media and content feasibility but also has the potential to become a relevant, contextual, and innovative digital learning medium to support fashion practice learning at SMK.

CONCLUSION

Based on the research results and discussion, it can be concluded that the development of the CLO3D-based interactive e-module for the topic of Preparation for Kebaya Kutubaru Modifikasi, using the ADDIE model, has been successfully carried out and tested. The developed e-module meets the feasibility criteria based on the results of instrument validation, media expert validation, and content expert validation. The feasibility test results indicate that the e-module falls into the highly feasible category, considering aspects such as media appearance, presentation, language use, content suitability, and the relevance of technology to fashion design learning at SMK. Therefore, the CLO3D-based interactive e-module is deemed suitable for use as a digital learning medium for the topic of Preparation for Kebaya Kutubaru Modifikasi at SMK.

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