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Development of Microlearning Video Media for Manufacturing Technical Drawing Learning Assisted by AI Adam CAD at SMK Negeri 52 Jakarta

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ABSTRACT

This study aims to develop and assess the feasibility of AI Adam CAD-assisted microlearning video media for Manufacturing Technical Drawing learning at SMK Negeri 52 Jakarta. The study employed a Research and Development (R&D) approach using the 4D development model (Define, Design, Develop, Disseminate), with the scope limited to the Develop stage. The developed product consists of microlearning videos covering 3D model creation using AI Adam CAD and technical drawing production using Autodesk Inventor, delivered through a web-based platform. Feasibility was evaluated by a content expert, a media expert, and Grade XI Machining Engineering students through questionnaires. Results indicate that the content expert rated the media at 97% (Very Feasible), the media expert at 96% (Very Feasible), and student responses reached 94% (Very Feasible). These findings confirm that the developed media meets feasibility criteria as an independent learning support tool for Manufacturing Technical Drawing at the vocational secondary level. Subsequent studies are encouraged to carry out the Disseminate phase in full and assess the media's effectiveness through an experimental design.

Keywords: *microlearning, AI Adam CAD, manufacturing technical drawing, vocational education*

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INTRODUCTION

The integration of CAD with virtual manufacturing, simulation software, and digital twins makes digital design data the foundation for production process optimization in the modern Industry 4.0 era (Soori et al., 2024, p. 2). Mastery of CAD and computer-based technologies remains a competency that needs to be strengthened among vocational high school graduates to meet the demands of the modern manufacturing industry (Zhahara et al., 2022, p. 561).

Despite its high relevance, CAD-based Manufacturing Technical Drawing learning in vocational high schools still faces fundamental problems. CAD material demands both conceptual understanding of technical drawing and procedural skill in operating the software, requiring sustained intensive practice (Pando Cerra et al., 2023, p. 27). Saputra et al. (2025, pp. 1–3) noted that students consider CAD software difficult to learn and time-consuming to master, which can potentially reduce motivation if not supported by adaptive learning media.

A similar condition was found at SMK Negeri 52 Jakarta. Based on observation data of 31 Grade XI students in the Machining Engineering program, most students consistently experienced delays in completing CAD assignments. In Assignments 1 and 3, 14 of 31 students (45.2%) failed to complete the task within the allotted time, while in Assignment 2, 12 students (38.7%) did so. This pattern indicates that students have not fully mastered the CAD workflow, compounded by the dominance of teacher-led demonstration methods without adequate independent learning media.

Previous studies show that microlearning video has the potential to improve procedural-visual learning outcomes. Fidhyallah et al. (2024, p. 814) demonstrated the feasibility of TPACK-based microlearning video in helping students understand content in a more focused manner. Wigati et al. (2024, p. 250) and Lubis (2025, p. 181) also reported improvements in students' understanding of technical work procedures as well as increased learning independence among vocational high school students through microlearning.

More specifically, these three studies each exhibit different limitations. Fidhyallah et al. (2024, p. 814) validated the feasibility of TPACK-based microlearning video but focused on pedagogical feasibility without directly measuring procedural competency mastery. Wigati et al. (2024, p. 250) reported improved understanding of technical work steps at the vocational level but did not address content requiring sequential operational precision such as CAD. (Lubis, 2025, p. 181) showed that microlearning can foster learning independence among vocational high school students, but within the domain of language learning rather than technical-procedural skills. Thus, none of these three studies has demonstrated how microlearning media can be used as a direct tool for mastering a sequential and interdependent CAD workflow. Meanwhile, Gligorea et al. (2023, pp. 1–2, 21) showed that the application of AI in adaptive learning contributes positively to engagement and learning outcomes, though its use for technical skills in vocational high schools has not been widely studied.

Jig J. Boncillo's (2025, pp. 436, 440–442, 444) systematic review confirms that AI studies in education are still dominated by conceptual learning, automated assessment, and recommendation systems, while its application to support technical skill learning such as CAD in vocational high schools remains very limited. Therefore, a specific research gap exists: no microlearning video media has yet integrated AI CAD as a direct tool in procedural learning of Manufacturing Technical Drawing in vocational high schools.

Unlike previous microlearning studies that focused on concept delivery or interactivity, this study integrates AI Adam CAD as a direct tool in the 3D model creation process at the early stage of the CAD workflow, allowing students to focus more on mastering the procedure of preparing technical working drawings, which is the core competency of the learning process. This novelty distinguishes the present study from the three microlearning studies above as well as from studies on AI application in adaptive learning in general (Gligorea et al.,

2023, pp. 1–2, 21; Jig J. Boncillo, 2025, pp. 436, 440–442, 444).

Based on the problems and research gap identified, this study aims to develop AI Adam CAD-assisted microlearning video media for Manufacturing Technical Drawing learning at SMK Negeri 52 Jakarta and to assess the media's feasibility based on validation by a content expert, a media expert, and student responses. The results of this study are expected to serve as an alternative learning medium that supports independent learning and improves the quality of Manufacturing Technical Drawing learning in vocational high schools.

RESEARCH METHODS

This study uses a Research and Development (R&D) approach, with the 4D model as its development framework. This model is divided into four stages: Define, Design, Develop, and Disseminate (Zamsiswaya et al., 2024, p. 11).

In the Define stage, identification of learning media needs was carried out through a combination of observation of the learning process, interviews with the teacher in charge of Manufacturing Technical Drawing, and interviews with students. The Design stage involved preparing the storyboard, video script, and designing the website structure as the media platform. The Develop stage covered the production of three microlearning videos featuring 3D model creation using AI Adam CAD through text prompting, file import into Autodesk Inventor, and the preparation of technical working drawings, all of which were packaged into a single learning media website.

This study involved two validators: Drs. Nur Pakih, a teacher in the Machining Engineering field at SMK Negeri 52 Jakarta, as the content expert, and Ahmad Lubi, M.Pd., M.T., a lecturer in the D4 Manufacturing Engineering study program at Universitas Negeri Jakarta, as the media expert. Both were responsible for validating the feasibility of the developed product. In addition, the media trial was conducted with 31 students of Grade XI-TP-A at SMK Negeri 52 Jakarta as users, to obtain student response data.

It should be noted that the product trial in this study was limited to one class in one school, with expert validation carried out by two validators (one content expert and one media expert). This scope is adequate for assessing the initial feasibility of the product at the Develop stage, in accordance with the defined scope of the study, but does not yet represent the variation in student characteristics or the broader context of vocational schools. Generalizing the media's feasibility results to a larger population requires further testing with a broader sample and validator coverage.

Three techniques were used to collect data in this study: observation, interviews, and questionnaires. In the Define stage, observation and interviews served to explore initial learning needs data. Subsequently, in the Develop stage, two types of questionnaires were distributed: a validation questionnaire completed by the content expert and media expert, and a response questionnaire completed by Grade XI-TP-A students. Both types of questionnaires were designed using a 1–5 Likert scale.

Data were analyzed using a descriptive percentage technique. Each item score was summed, and the feasibility percentage was calculated by dividing the obtained score by the maximum score and multiplying by 100%. The classification of percentage results followed Sugiyono's criteria (2023, p. 146), with the category Very Feasible for scores above 81%, Feasible for scores above 61%, Fairly Feasible for scores above 41%, and Not Feasible for scores of 41% and below.

RESULTS OF RESEARCH AND DISCUSSION

Needs Analysis

The needs analysis process was carried out by combining direct observation, teacher interviews, and student interviews within the environment of SMK Negeri 52 Jakarta. The observation findings revealed a recurring pattern of delays in the completion of CAD assignments among the majority of Grade XI-TP-A students, as presented in Table 1.

Table 1. CAD Assignment Submission Delay Data

Assignment	On Time	Not On Time	Percentage Not On Time
Assignment 1	17 students	14 students	45,2%
Assignment 2	19 students	12 students	38,7%
Assignment 3	17 students	14 students	45,2%

The subject teacher reported that the demonstration method remains the dominant approach in Manufacturing Technical Drawing learning, even though variation in students' learning pace means not all students can keep up with the stages simultaneously. A similar pattern emerged from interviews with three students, initialed MR, AP, and MRIW; they experienced difficulty as soon as they fell one step behind, since the 3D model creation stages are sequential and interdependent, while a re-accessible independent learning medium was not yet available. This finding, combined with the characteristics of the material and the students, points to the need for media that is concise, structured, and can be replayed at any time via digital devices.

The media development process proceeded through two stages: Design and Develop. During the Design stage, the research team prepared a storyboard and video script as production guides, while also designing the website structure that would serve as the media presentation platform. Entering the Develop stage, three microlearning video units were produced, each with a different focus: the first video shows 3D model creation through text prompting in AI Adam CAD, the second video covers the process of importing .STL files into Autodesk Inventor, and the third video explains the stages of preparing technical working drawings in the same application. The three videos were then integrated into a single learning media website that students could access independently.

Figure 1. Website Display for Learning Media Access

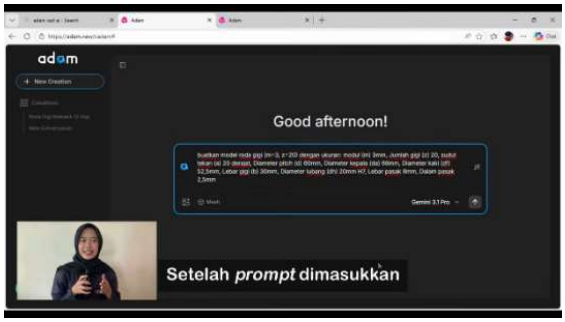

Figure 2. Microlearning Video Display

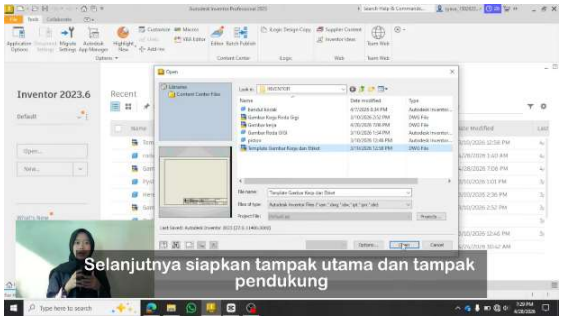

Figure 3. Microlearning Video Display

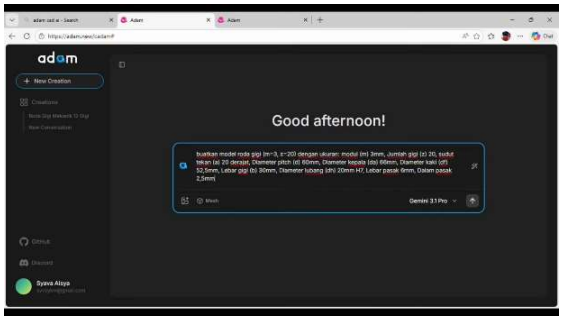

Figure 4. 3D Model Creation Process Using AI Adam CAD

Expert Validation Results

Feasibility assessment of the developed microlearning video media involved two validators: the content expert and the media expert. The detailed results of the content expert's validation are presented in Table 2.

Table 2. Content Expert Validation Results

Assessment Aspect	Score Obtained	Max. Score	Percentage (%)
Content Accuracy	20	20	100%
Concept Clarity	14	15	93%
Content Completeness	34	35	97%
Language Use	10	10	100%
Total	78	80	97%

The data in Table 2 show a total achievement of 97% for content expert validation, falling into the Very Feasible category. Perfect scores of 100% were achieved on two aspects, Content Accuracy and Language Use, indicating alignment between the content and the Phase F Learning Outcomes as well as appropriate language use. Meanwhile, the Concept Clarity aspect obtained 93%, reflecting that the procedural flow in the video had been conveyed reasonably well. Next, the media expert validation results are shown in Table 3.

Table 3. Media Expert Validation Results

Aspek Penilaian	Skor Perolehan	Skor Maks.	Persentase (%)
Tampilan Visual	25	25	100%
Kualitas Audio	15	15	100%
Karakteristik *Microlearning*	19	20	95%
Penyajian Pembelajaran	13	15	87%

Aspek Penilaian	Skor Perolehan	Skor Maks.	Persentase (%)
Kemudahan Penggunaan	10	10	100%
Total	82	85	96%

According to Table 3, media expert validation recorded a total percentage of 96%, classified as Very Feasible. Three aspects achieved perfect scores of 100%: Visual Display, Audio Quality, and Ease of Use. Meanwhile, the Microlearning Characteristics aspect reached 95% and Learning Presentation 87%, both still falling within the Very Feasible category. Overall, both experts agreed that the media is feasible for implementation in Manufacturing Technical Drawing learning.

Student Responses

A limited-scale trial involving 31 students of Grade XI-TP-A at SMK Negeri 52 Jakarta yielded the response results presented in Table 4.

Table 4. Student Response Results

Assessment Aspect	Score Obtained	Max. Score	Percentage (%)
Content	581	620	94%
Media Display	1029	1085	95%
Ease of Media Use	734	775	95%
Microlearning Characteristics	580	620	93%
Usefulness	728	775	94%
Total	3652	3875	94%

Table 4 shows that student responses reached a total percentage of 94%, falling into the Very Feasible category. The highest scores, 95%, appeared on two aspects simultaneously, Media Display and Ease of Media Use. Indicating that students found it easy to operate the website and video independently. Meanwhile, the Microlearning Characteristics aspect recorded 93%, indicating that the short duration and structure of the videos matched students' learning patterns.

Discussion

Overall, the AI Adam CAD-based microlearning video media designed in this study achieved the Very Feasible category from three assessment sources: content expert (97%), media expert (96%), and student responses (94%). The high score from the content expert indicates alignment between the content and the Phase F Learning Outcomes as well as structured preparation. This pattern is consistent with the findings of Fidhyallah et al. (2024, pp. 808–809, 814), which found that microlearning video designed with an appropriate pedagogical approach can help students understand material in a more focused way.

The microlearning format, which breaks material into short, focused units, proved suitable for procedural content such as CAD, as students can repeat specific sections as needed. This result reinforces the findings of Wigati et al. (2024, pp. 246–247, 250) regarding the effectiveness of microlearning video in improving understanding of technical procedures at the vocational level. In addition, the positive score on the Ease of Media Use aspect (95%) aligns with the study by Lubis (2025, pp. 1, 3–4), which stated that microlearning video can foster learning independence among vocational high school students, consistent with the needs already

identified since the Define stage, namely media that is flexible to access and replay.

The integration of AI Adam CAD as a tool for 3D model creation represents the novelty that distinguishes this media from previous research, as students can generate 3D models more efficiently and thus focus more on mastering the technical working drawing procedure that constitutes the core learning competency. Nevertheless, this study is limited to the Develop stage without implementation of the Disseminate stage and does not measure effectiveness on learning outcomes, so further research examining the media's effectiveness quantitatively is needed.

CONCLUSIONS AND SUGGESTIONS

Conclusion

This study developed AI Adam CAD-assisted microlearning video media for Manufacturing Technical Drawing learning at SMK Negeri 52 Jakarta using the 4D development model, implemented up to the Develop stage. The developed media consists of three microlearning video units covering 3D model creation using AI Adam CAD, model import into Autodesk Inventor, and preparation of technical working drawings, all packaged into a single learning media website.

Based on the validation process, the developed media obtained feasibility scores of 97% from the content perspective, 96% from the media perspective, and 94% based on student responses, all classified as Very Feasible. This achievement indicates that two research objectives were fulfilled simultaneously: the realization of the media product itself, and the attainment of feasibility standards enabling the media to function as independent learning support for Manufacturing Technical Drawing at the vocational secondary level.

It should be emphasized that these results were obtained from a limited trial scope, namely one class in one school with validation by two experts, and that the research was carried out only up to the Develop stage without implementation of the Disseminate stage and without quantitative measurement of effectiveness on student learning outcomes. Therefore, generalizing the media's feasibility to broader classes, schools, or student populations should be done with caution and requires further testing.

Suggestion

Future researchers are advised to carry out the Disseminate stage in full, with a broader sample and validator scope, and to examine the effectiveness of AI Adam CAD-assisted microlearning video media on improving procedural competency in Manufacturing Technical Drawing through an experimental research design.

The first author contributed to the conceptualization of the study, the design of the methodology, the development of instructional materials, data collection and analysis, the preparation of the initial draft of the manuscript, and the visualization of the research results. The second and third authors contributed to the supervision of the study, the validation of the methodology and research results, and the review and editing of the manuscript. All authors have read and approved the final version of the manuscript.

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