International Journal on Education Insight
Vol. 7, No. 2, April 2026, pp. 285-298
e-ISSN: 2722-2691 p-ISSN: 2722-2683 DOI: 10.12928/ijei.v7i2.15967
ORIGINAL RESEARCH PAPER

Developing manual transmission system video for vocational high school students using ADDIE model

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Abstract
The pedagogical challenge in vocational education is to bridge abstract mechanical concepts with practical technical skills. This study addresses the low learning outcomes in manual transmission materials by developing instructional video media for the Manual Transmission System topic in the Automotive Chassis subject for Grade XI Light Vehicle Engineering students at Tamansiswa Jetis Vocational High School, Yogyakarta. The learning video was developed using the ADDIE instructional design model to provide contextual and visual learning experiences that facilitate students' understanding of complex mechanical concepts and procedures. The feasibility evaluation showed that the developed media achieved a score of 91.5% from material experts and 78% from media experts, indicating that it is suitable for instructional use. Student responses reached 85%, demonstrating that the learning videos effectively enhanced students' understanding and engagement. These findings indicate that contextual digital learning media can significantly reduce the cognitive gap between theoretical concepts and practical applications, making it a valuable instructional resource for improving learning outcomes in vocational automotive education.

Keywords: ADDIE, automotive chassis, digital pedagogy, manual transmission, vocational education

How to cite: Saputro, Y., Setuju, & Handoyono, N. A. (2026). Developing manual transmission system video for vocational high school students using ADDIE model. *International Journal on Education Insight, 7*(2), 285-298. https://doi.org/10.12928/ijei.v7i2.15967

Article history: Received 10/03/2026, Accepted 12/08/2026, Published 21/08/2026

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INTRODUCTION

Education in the 2025 era faces a dynamic transition, especially in Indonesia where Vocational High Schools are expected to be able to produce competent human resources to respond to global challenges. In line with the mandate of Presidential Regulation No. 68 of 2022, strengthening vocational competence is a top priority to accelerate the creation of a competitive workforce (Presiden, 2022). In the context of Automotive Light Vehicle Engineering students are required to master hard skills and soft skills in an integrated manner. However, the main challenge today is how to transform theoretical knowledge into practical capabilities that are adaptive to modern industrial technologies (Ineme & Imbur, 2025; Mogaji, 2025; Rap & Blonder, 2025).

The gap between these ideal expectations and the reality on the ground is evident at the Tamansiswa Jetis Vocational High School in Yogyakarta. Student achievement in the Automotive Chassis subject, especially manual transmission material, is still below the Minimum Completeness Criteria (KKM). Preliminary data shows that the average score of grade XI students only reaches 58.6, far below the KKM of 75. This low achievement is rooted in students' difficulties in visualizing abstract concepts such as gear ratio calculations, power flow, and the working principles of complex transmission components, which are often unbridged by conventional teaching methods or the use of printed modules.

The rapid development of digital technology has prompted schools to allow the use of smartphones, but its use is still dominant in the entertainment aspect rather than academic purposes. Although video media has been introduced, the available materials are generally one-way procedural tutorials that only demonstrate the uninstall steps without touching on the high-level cognitive aspects (Handoyono et al., 2020; Salihin & Nursaid, 2025; Wati et al., 2024). In fact, the effectiveness of digital media in automotive vocational high schools is highly dependent on its ability to present interactive content that is relevant to the level of difficulty of technical materials (Anbiya et al., 2025). The weakness of the current media causes low diagnostic reasoning of students. As emphasized by Li et al., (2024), vocational students tend to be fluent in procedural skills but have difficulty in deductive analysis when faced with cases of real damage, such as the symptom of "teeth are difficult to move."

This study identified a specific research gap, namely the lack of interactive video-based learning media that can simulate the failure of manual transmission systems repeatedly to train diagnostic skills. In line with the findings from several studies, simulation based on damage cases or troubleshooting has been proven to be more effective in improving students' analytical thinking skills (Hidayatullah et al., 2024; Liao et al., 2023). The novelty of this research lies in the development of interactive learning videos that require students to go through structured cognitive processes: analysis of damage symptoms, hypothesis development, and testing using measuring tools in a safe digital environment. This approach is in line with the implementation of the Independent Curriculum which emphasizes contextual and meaningful learning experiences (Ferdaus & Novita, 2023).

The main objective of this study is to develop and validate interactive learning videos on manual transmission materials. The contribution of this article lies in the provision of a model of vocational learning media that focuses not only on "how to improve," but also on "how to analyze." By integrating industrial scenarios and technological potential, this research is expected to improve students' conceptual understanding and critical thinking skills to prepare competent graduates to face the demands of Industry 4.0 (Kamaruzaman et al., 2025; Triyono, 2019).

RESEARCH METHOD

This research uses a Research and Development (R&D) approach by implementing the ADDIE development model which consists of five systematic stages, namely Analysis, Design, Development, Implementation, and Evaluation. The selection of this model is based on its organized workflow and is empirically tested in producing quality instructional media. Historically, the ADDIE framework has its roots in the Interservice Procedures for Instructional Systems Development (IPISD) formalized by Branson et al., (1975) at Florida State University, which later evolved into a global standard in military instructional design as well as formal education. In the context of education in Indonesia, Sugiyono (2019) emphasized that the ADDIE model provides a structured design procedure to ensure the effectiveness of the educational products produced. Abuhassna et al., (2024) defines ADDIE not as a static linear model, but as an iterative methodology that guides developers in creating a learner-centered learning experience. This is emphasized by Kurt (2019) who stated that ADDIE's main strength lies in its flexibility in facilitating continuous evaluation at each stage of development to achieve optimal product quality. The development flow with the ADDIE model can be seen as follows Figure 1:

The research procedure begins with the needs analysis stage to map students' learning barriers, followed by the design of the video structure at the design stage. In the development stage, videos are produced using the CapCut application and go through a technical validation process. The implementation stage is carried out through field trials, which are then closed with a thorough evaluation to measure the feasibility of the product as a learning medium. The subjects of this study are 29 students of class XI of Automotive Light Vehicle Engineering at

Tamansiswa Jetis Vocational High School Yogyakarta. To guarantee the validity and reliability of the product, the media is tested by competent experts in the field.

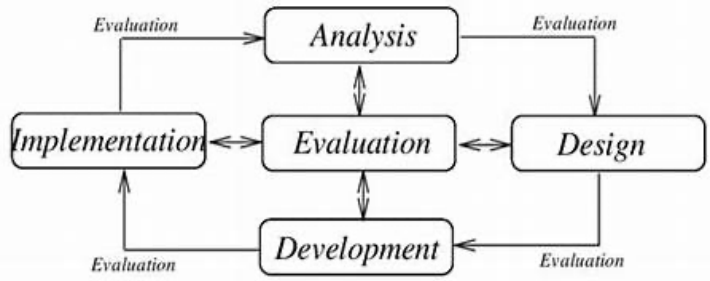


Figure 1. Media development flow with ADDIE model (adapted from Branch, 2009)

The validation process was carried out by two Material Experts consisting of mechanical engineering education academics and practitioners of automotive chassis subjects at the Jetis Tamansiswa Vocational High School. In addition, the audio-visual technical aspects are evaluated by a Media Expert who specializes in vocational education technology. The involvement of these experts ensures that the videos developed meet the standards of content accuracy as well as the aesthetic quality of digital media that vocational students deserve.

The research data were collected through a questionnaire using a four-point Likert scale. The questionnaire was developed based on several assessment constructs to evaluate the feasibility of the developed learning media, including visual clarity, content accuracy, instructional design, language clarity, ease of use, and user engagement. These aspects were assessed to obtain comprehensive information regarding the quality of the media from both content and technical perspectives.

The data analysis technique applied was quantitative descriptive analysis. The average score obtained from the questionnaire responses was calculated and converted into a percentage to determine the degree of media eligibility. The percentage results were then interpreted based on the eligibility criteria adapted from Arikunto (2021), as presented in Table 1, which categorizes the feasibility level into qualitative criteria. This approach allows the quantitative results obtained from the validation process to be systematically interpreted and used as a basis for determining the feasibility of the developed media (Arikunto, 2021). The assessment criteria are classified based on categories adapted from Arikunto (2021) as presented in Table 1.

Table 1. Percentage range and qualitative criteria

Score	Criteria	Presentase	Conversion Result
4	Strongly Agree	P ≥75%	Highly Worth It
3	Agree	50% ≤ P < 74.9%	Worthy
2	Disagree	25% ≤ P < 49.9%	Not Eligible
1	Strongly Disagree	P < 24.9%	Very Unworthy

The structured procedure allows the methodology of this research to be re-adapted by other researchers in the context of the development of learning media in similar educational settings.

RESULTS AND DISCUSSION

The result of this research is a learning video media product for the subject of Automotive Chassis Manual Transmission System material developed using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model.

Analysis

This stage aims to identify needs in the field. Based on the results of observations at the Tamansiswa Jetis Vocational High School Yogyakarta, several main problems were found, namely (1) low student learning achievement, (2) students' conceptual difficulties, and (3) the need for media as a supporter of learning activities. This stage aims to identify needs in the field. Based on the results of observations at the Tamansiswa Jetis Vocational High School Yogyakarta, several main problems were found, namely (1) low student learning achievement, (2) students' conceptual difficulties, and (3) the need for media as a supporter of learning activities.

Design

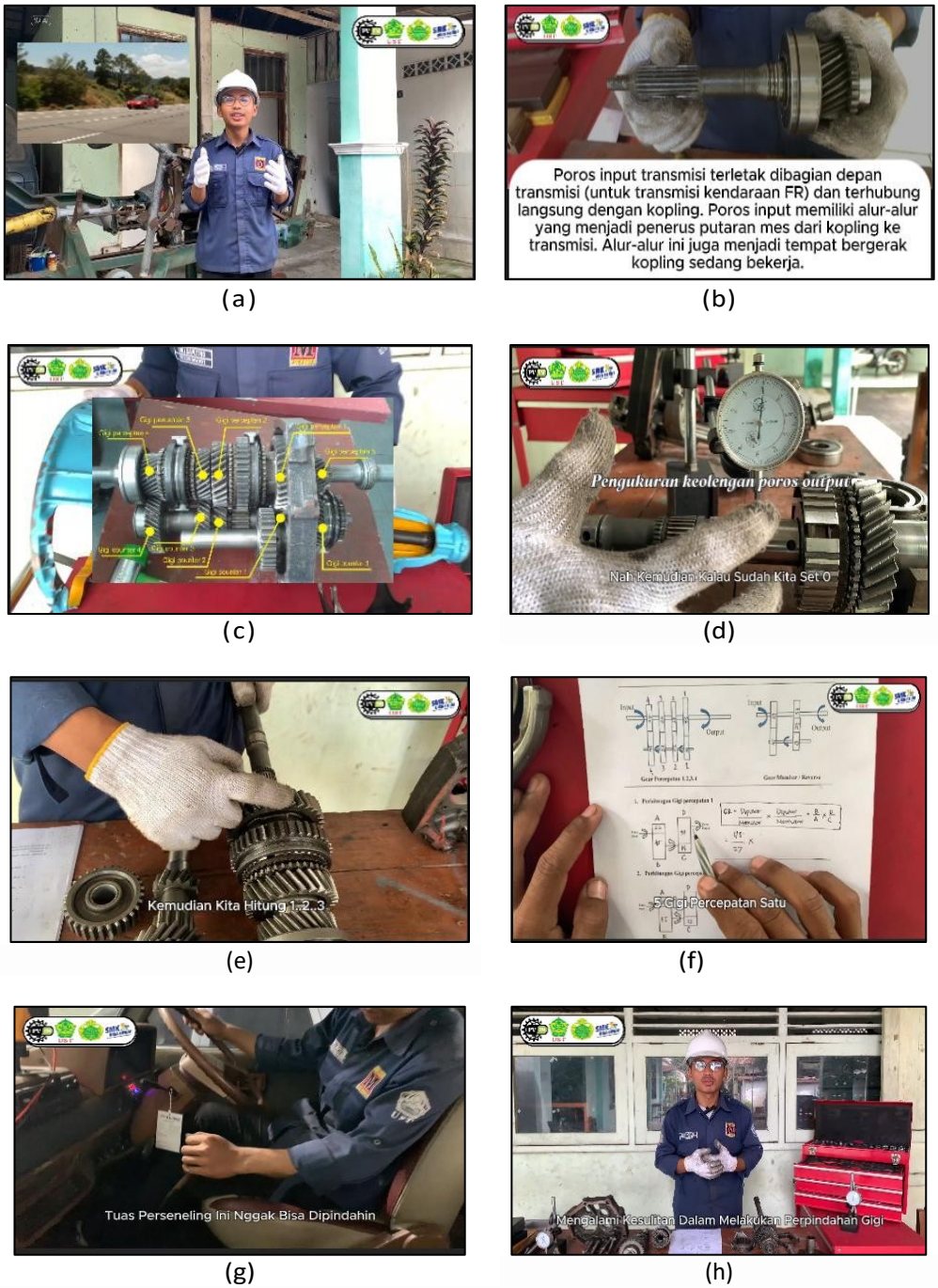
After the needs analysis stage is completed, the next step is to translate the needs into a concrete media design. The focus at this stage is the preparation of scripts and storyboards using the help of Microsoft Word software. The script is prepared to ensure that every information regarding the components and how the manual transmission works is conveyed logically and systematically. The storyboard serves as a visual representation that guides the course of the shooting to fit the learning objectives. Details of the activities, narrative flow, and estimated shooting time for each material session is documented in the script and storyboard on Table 2.

Table 2. Story board

Video		Activities			Time
	Script		*Script*	*Script*	
1. Definition and function of manual transmission	Opening	Content	Presentasion of material on the Definition and function of the Tranmsisi system	Closing	4 Minutes
2. Manual transmission components			Explain the names of components and their functions in the transmission	Thanks to the students who have watched the learning video.	10 Minutes
3. Principle of how manual transmission works	Delivery of Learning Objectives, Learning Outcomes and Occupational Safety & Health. Here I will explain the manual transmission system on a car vehicle.		Explain how the transmission works from gear shift from 1 to 4 and backward .	The appearance of the developer profile includes students, supervisors 1 and 2, validation of material and media experts, teaching teachers, cameramen, and reference sources	12 Minutes
4. Overhaul/gear calculation acceleration			Perform calculation of the number of acceleration gear points, study the acceleration comparison formula and perform ratio calculations.		15 Minutes
5. Manual Transmission Fault Diagnosis			Simulate damage that occurs in transmission, then perform repair analysis		8 Minutes

In addition to technical documents, the researcher also made physical preparations by collecting various tools and practicum materials in the Automotive Light Vehicle Engineering

workshop room. This is done so that the resulting video has a relevant background and displays a real object. Documentation of the readiness of the tools, materials, and the atmosphere of the initial video shoot can be seen in Figure 2.



(a) (b) (c) (d) (e) (f) (g) (h)

Figure 2. Documentation of the readiness of the tools, materials, and the atmosphere of the initial video shoot, including definitions and functions (a), transmission components (b), how transmission works (c), transmission component inspection (d), calculation of the number of transmission gear points (e), acceleration ratio calculation (f), ilustration of transmission malfunction (g), diagnosis of trouble in transmission components (h)

Based on the draft of the manuscript that has been made, the learning material is divided into several main parts. This division aims to keep the video duration efficient and easy for students to understand. The following is a summary of the material sharing that will be displayed in the learning video product. Through this design, the researcher has a clear operational guide before stepping into the stage of development or mass production of learning media. This is done to minimize technical errors and ensure that the media developed can answer students' learning difficulties in Automotive Chassis subjects.

Development

The development stage is a step in the realization of learning media products that have been designed beforehand. The first step at this stage is a validity test to ensure technical and material feasibility before the product is implemented in the field. Validity test data was obtained through a validation questionnaire filled out by experts who are competent in their fields. Media expert validation is carried out on the design of the learning video, which includes visual, audio, and navigational aspects for users. Based on the assessment by media experts, a percentage score of 78% was obtained which was included in the "Very Feasible" category. Meanwhile, the validation of material experts is carried out by lecturers and teachers at Vocational High Schools to evaluate the accuracy of the concept, the completeness of the manual transmission system material, and its suitability with the curriculum. The results of the data analysis of the validity of the learning video applied as a learning medium for the subject of Automotive Chassis of the Manual Transmission System material are found that the average result is 84.75% from two expert components with the Very Feasible category that shown on Figure 3.

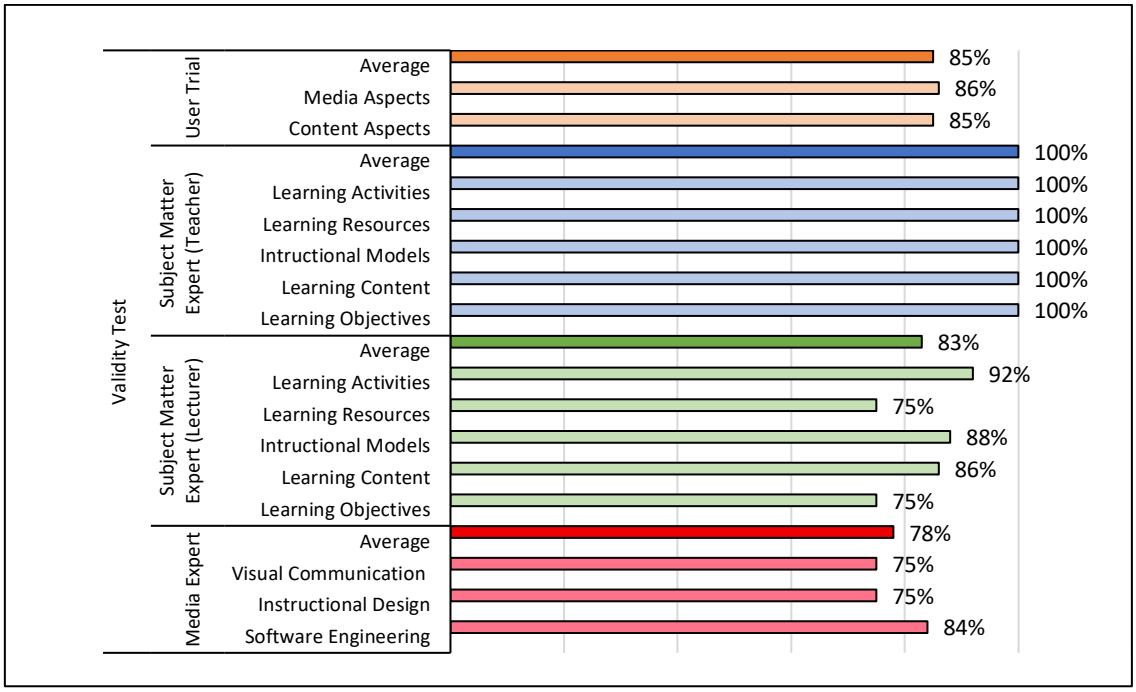
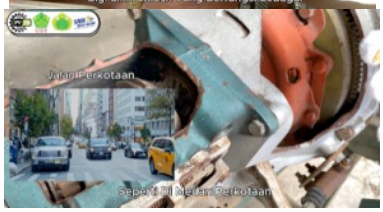


Figure 3. Feasibility test for media experts, subject matter experts, and trials to students

The input and suggestions provided by the experts during the validation process are then used as revision materials to improve the learning video product. The purpose of the validation by these experts is to see if the video media developed is appropriate, technically accurate, and in accordance with the needs of the learning process in Vocational Secondary Schools. The results of the validation can be seen in Table 3.

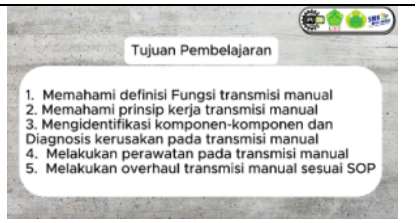
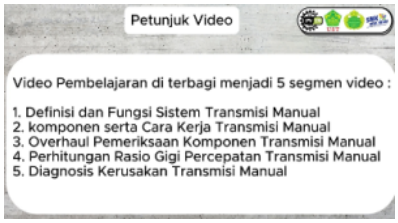
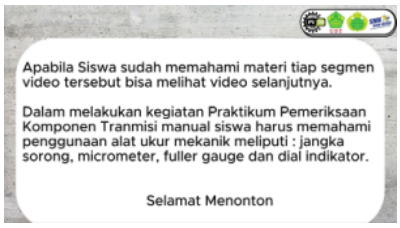
Table 3. Media expert revision

No.	Before	Correction	After
1.		The Source is placed at the end of the video.	
2.		Animated images/videos have been added to make it clearer.	
3.		Component instructions are accompanied by a name	
4.		Customized narrative writing	
5.		Fault diagnosis and solutions table	

Implementation

After the video product is declared valid or suitable for use for field trials by media experts and material experts, then the video media is implemented in learning activities The video learning is implemented to 29 students of grade XI of Automotive Light Vehicle Engineering at the Tamansiswa Jetis Vocational High School Yogyakarta. The results of the student response questionnaire showed a percentage of 85%, which shows that this media is "Very Feasible" and effective in the learning process. The revision process of the media can be seen in Table 4. In Table 4, we highlighted the before-after of the media with the explanation of the correction for each aspect.

Table 4. Material expert revision

No.	Before	Correction	After
1.		It is necessary to state at the beginning about the achievements to be achieved.	
2.		It is necessary to provide more detailed technical instructions related to the learning video which is divided into several sections or sections.	
3.		It is necessary to add the prerequisites for using video tutorials related to the needs and preparation before practice.	

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The results of the developed video is presented in Table 5.

Table 5. Content of each video

No	Video Title	Url YouTube
1.	Definitiun and function of manual transmission system	https://youtu.be/9jJtaPEbhTA?si=J55ES1Y2wbNuNfyU
2.	Manual transmission system component names and component functions	https://youtu.be/QTgPdeawVX0?si=PDwu5lxQ7t7_e5k3
3.	Overhaul manual transmission system component inspection	https://youtu.be/Z3u1oAhkRTI?si=WkjE3Op1cEmfHm4P
4.	Manual transmission acceleration gear ratio calculation	https://youtu.be/29Gsr6_o_LM?si=cvvYii-eTWY8N252
5.	Manual transmission system fault analysis diagnosis	https://youtu.be/JoWYe5dP9jE?si=Ggmf9v50ni8lYOOo

Evaluation

The final step is to make final improvements based on advice from experts and practitioners to ensure the quality of the media is in line with industry and curriculum standards. learning video media that has been developed by researchers. After the video media was tested in learning in class XI, students were asked to fill out a questionnaire containing responses to video media. The respondents in the product trial were 29 students. The following are the results of the students' responses to the video media that has been developed.

Based on the results of the analysis of product trial data by students, it shows a high level of practicality. The media aspect obtained a percentage of 86% which included visual quality and

ease of use, while the material aspect obtained 85% related to the clarity of content and understanding of concepts. Overall, the average score of 85% puts this Manual Transmission System learning video in the Very Decent category. This result proves that the media developed can facilitate students' learning needs and is effectively used in supporting instructional activities in the classroom.

The development of this manual transmission system learning video is carried out using the ADDIE model which is systematically organized to improve the quality of Automotive Chassis learning at Tamansiswa Jetis Vocational High School Yogyakarta. Based on the results of the research, the discussion focused on the theoretical validity of the product through expert assessment and its practical effectiveness in answering student learning problems. Overall, this media was declared "Very Feasible" with a validation score from material experts of 91.5%, media experts of 78%, and student responses of 85%. This high validity rate proves that the product can mitigate the low average score of previous students' private universities which only reached 58.6. This is in line with Handoyono's (2020) thought that media innovation must be able to bridge the needs of industry competence with the learning process in the classroom to increase the competitiveness of vocational graduates.

This video presents the manual transmission material comprehensively, from component functions such as synchromesh to overhaul procedures. This precise visualization is crucial to minimize the potential for human error in the workshop (Alvianto & Handoyono, 2024). These findings are supported by research by (Alvianto et al., 2022) who stated that video tutorials significantly improve cognitive learning outcomes and motivation because they can visualize components that are difficult to observe directly. In addition, Trenholm & Marmolejo-Ramos (2024) found that high-resolution videos help students understand mechanical details that are not seen in static textbooks. This is reinforced by the argument of Alimam et al., (2023) that the digital representation of mechanical systems serves as a cognitive bridge for students to mentally understand models of dynamically working machines.

The application of the principle of segmentation in the cognitive design of this video is in line with the Cognitive Theory of Multimedia Learning from Nurhatmi (2025), where dynamic visualization allows information to be absorbed without burdening the student's long-term memory (cognitive overload). This interactive instructional design has been proven to be able to accelerate information retention compared to conventional methods Skulmowski & Xu (2022). Such visualization capabilities are crucial for building in-depth diagnostic analysis (Skulmowski & Xu, 2022). YouTube's platform that provides control features such as pause and replay supports the creation of self-paced learning. Brame's research (2016) shows that students' active control over learning videos is the key to successful technology integration. This digitalization support is also strengthened by Roemintoyo & Budiarto (2025) regarding digital transformation in the vocational environment, where the use of smartphones is diverted to a productive means of digital literacy.

The implementation of this media provides practical solutions to learning difficulties in workshops (Nugraheni et al., 2022) and is in line with the strategy of aligning the vocational curriculum (Selamat et al., 2025). The use of video based on troubleshooting scenarios provides an authentic assessment experience for students to analyze the symptoms of system failure before making physical interventions on the vehicle (Ajjawi et al., 2020). Seamless accessibility through social media (YouTube) is very effective for the learning style of Generation Z that prioritizes the flexibility of space and time (Alruthaya et al., 2021; Ginanjar, 2025). Anwar & Sudira, (2022) also highlighted that in the industry 4.0 era, automotive technicians are required to have digital literacy to access video-based service literature. Thus, this interactive learning video is a relevant instructional solution to improve students' critical analysis skills in facing the challenges of professional technicians at the global level.

CONCLUSION

This research has succeeded in developing a manual transmission system learning video media through a structured ADDIE instructional design model, which consists of the Analysis, Design, Development, Implementation, and Evaluation phases. During the Analysis phase, the need for developing the instructional media was identified based on students' low average Mid-Semester Assessment (MSA) score of 58.6. The Design phase involved preparing the storyboard and instructional materials, while the Development phase focused on producing the learning video using CapCut and conducting validation by subject matter and media experts. The Implementation phase involved a field trial with 29 eleventh grade students of the Light Vehicle Engineering program at Tamansiswa Jetis Vocational High School, Yogyakarta, through the YouTube platform. Finally, the Evaluation phase was conducted to determine the overall feasibility of the developed learning media based on expert validation and students' responses.

The findings indicate that the developed learning video is highly feasible for use in the Automotive Chassis course. This conclusion is supported by the subject matter expert validation, which achieved an average score of 91,5%, categorized as very feasible. The score comprised an evaluation of 83% from a university lecturer in Vocational Mechanical Engineering Education, who emphasized the instructional organization of the content, and 100% from the vocational subject teacher, who confirmed the relevance of the material to practical workshop activities. Meanwhile, the media expert validation yielded a score of 78%, indicating that the learning video met the required feasibility criteria, particularly in terms of visual quality, accessibility, and instructional presentation. Recommendations provided by the media expert, including improving narration synchronization and adding labels to transmission components, were incorporated into the final version of the product.

The implementation results also demonstrated highly positive student responses, with an overall feasibility score of 85%, which falls within the very feasible category. Specifically, the media aspect received a score of 86%, while the content aspect obtained 85%. These findings indicate that the learning video effectively visualizes the operating principles of manual transmission components and damage diagnosis procedures in a concrete and dynamic manner, enabling students to understand concepts that were previously difficult to learn through conventional lectures or printed textbooks alone. Consequently, the developed learning media reduces the cognitive complexity of mechanical concepts and facilitates students in constructing a more accurate conceptual understanding before engaging in workshop practice.

From a theoretical perspective, the findings reinforce the application of the Cognitive Theory of Multimedia Learning, which posits that well-structured integration of visual and verbal information enhances learners' ability to process complex technical content effectively. From a practical perspective, the developed learning video provides an accessible digital learning resource that supports self-directed learning while promoting the productive use of smartphones as educational tools in response to the demands of the industry 4.0 era. Based on these findings, the developed learning video is considered suitable for implementation as a supplementary instructional medium in vocational education. Furthermore, this study may serve as a valuable reference for future research on the development of video-based learning media in vocational education and related fields, as well as for investigating its effectiveness in improving students' cognitive, affective, and psychomotor learning outcomes.

ACKNOWLEDGEMENT

We would like to express our gratitude to Tamansiswa Jetis Vocational High School Yogyakarta for their willingness to serve as research subjects and for assisting with the smooth collection of field data. We hope that the results of this research will make a tangible contribution to the development of digital learning media in vocational education settings.

DECLARATION

Author contribution
All authors contribute in the research and/or writing the paper, and approved the final manuscript.

Yuli Saputro	Conceptualizing the research idea, leading the investigation, and setting up the methodology.
Setuju	Assisting the investigation, reviewing the validity of the methodology, analyzing the data, and writing the original draft.
Nurcholish Arifin Handoyono	Assisting the investigation, reviewing the paper, enriching the data analysis, and translating the paper into English.

Funding
This research did not receive any funding.

Conflict of interest
All authors declare that they have no competing interests.

Ethics declaration
We as authors acknowledge that this work has been written based on ethical research that conforms with the regulations of our institutions and that we have obtained the permission from the relevant institutes when collecting data. We support the International Journal on Education Insight (IJEI) in maintaining the high standards of personal conduct, practicing honesty in all our professional practices and endeavors.

The use of artificial intelligence
We do not use any generative AI tools to write any part of this paper.

Additional information
Not available.

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