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Development and effectiveness of short tutorial videos in basic turning learning to enhance students' cognitive ability

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Abstract: This study aims to develop and evaluate the effectiveness of short tutorial videos in teaching the operation of lathes, a critical skill in mechanical engineering. Using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), the research was conducted at a Vocational High School in West Sumatra, involving 65 students from the mechanical engineering class. The short tutorial videos were designed to enhance students' understanding and cognitive skills in operating lathes, addressing challenges posed by conventional teaching methods. To assess them, the data were collected through questionnaires and practical tests. Validation by media and content experts indicated the media was valid, with average scores of 0.83 and 0.84, respectively. The practicality test from students showed a result of "very practical," with an average score of 0.92. Based on the descriptive statistical analysis, the post-test results showed a significant improvement, compared to the Minimum Completeness Criteria of 75, in understanding and cognitive ability, with an average score of 85.18 among the students. Although the normality test showed an abnormal distribution of data, the non-parametric proportions test confirmed a significant improvement in student performance on post-intervention, validating the effectiveness of video tutorials as a learning media in mechanical engineering. Future research is expected to explore other factors that influence cognitive skills, such as student motivation and instructor support, which may provide further insights to improve the effectiveness of learning media.

Keywords: Video tutorial; Supplementary course materials; Quality education; Mechanical engineering

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1. Introduction

Practicum sessions in Vocational High Schools (VHS) play a crucial role in preparing students for entry into the workforce (Fortuna, Prasetya, Luis, et al., 2024; Prasetya, Fajri, et al., 2023; Prasetya, Fortuna, Jalinus, et al., 2024; Prasetya, Fortuna, Samala, et al., 2024). Through practicums, students have the opportunity to directly apply the theoretical knowledge acquired in school within the context of real-world working environments, which, in turn, facilitates the development of the skills and competencies required for success in their respective fields (Bell & Bell, 2020; Perusso & Baaken, 2020; Rohm et al., 2021). These practicums are structured to deepen students' understanding of theory and practice, producing work-ready, skilled graduates who are highly competitive in industry or as entrepreneurs.

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In the initial phase of instruction, educators have explained the fundamentals of operating a lathe machine (Jalinus et al., 2019; Okafor, 2020; Ulia et al., 2024). However, not all students can grasp this information effectively, leading to errors during practice sessions (Carpenter et al., 2020; Donoghue & Hattie, 2021). Differences in comprehension levels and a lack of focus are vital challenges that must be addressed (Niu et al., 2021). A proposed solution is using more effective instructional media, such as short tutorial videos, to enhance students' understanding of the material and minimize errors during practical sessions.

In the current era of technology, educators must be adept at implementing innovative teaching methods, including audiovisual media like educational videos (Abdulrahaman et al., 2020; Nicolaou, 2021). Such media capture students' attention and simplify the understanding of complex material. With the increasing adoption of digital media and technological advancements, the opportunities for learning new concepts have become more expansive and accessible (Burbules et al., 2020; Pinto & Leite, 2020). Appropriate technology integration in education can yield significant positive impacts.

The tutorial video developed as part of this study aims to serve as a working guide for students during practicums, helping them understand the operational steps of the lathe machine, reduce errors, and enhance skills through repetitive practice. This video is an information resource and an efficient educational media, facilitating teacher content delivery and improving student comprehension (Menggo et al., 2023). Consequently, this study contributes to enhancing the quality of learning, producing more competent and creative students, and fostering a deeper understanding of the work instructions provided in the job sheet.

2. Material and methods

2.1 Research design

This study adopts a Research and Development (R&D) approach aimed at observing, examining, analyzing, and describing data in depth (Prasetya, Syahri, et al., 2023; Rahim et al., 2024; Waskito et al., 2024). In developing instructional videos, the ADDIE model proposed by (Branch, 2009) serves as the foundational framework, encompassing five stages: Analysis, Design, Development, Implementation, and Evaluation. Each stage is systematically executed to ensure the quality and effectiveness of the resulting instructional videos.

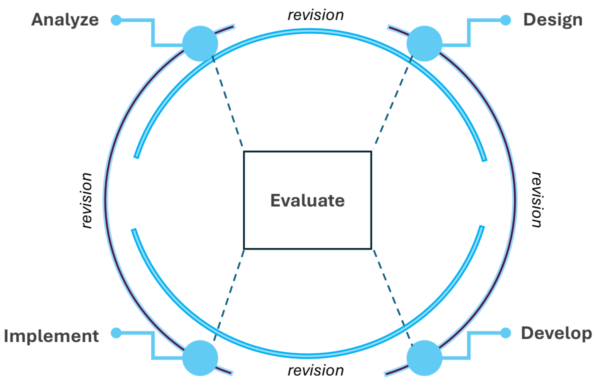

Figure 1. The ADDIE Model (Branch, 2009)

Based on the ADDIE development model, instructional media for lathe machines begins with the Analysis stage, which involves a comprehensive evaluation to identify critical issues and determine specific learning needs (Hardiansyah & Mulyadi, 2022). At this stage, critical aspects analyzed include the target users—vocational high school students, learning objectives, and content focused on lathe machine practice. Initial interview results are also utilized to identify student performance gaps by collecting data on the causes of performance disparities (Mufit et al., 2024).

Subsequently, the design stage involves the creation of instructional media that aligns with the identified needs, including selecting tutorial video formats to support lathe machine practice (Prasetya, Syahri, et al., 2023). The Development stage then covers creating and testing the tutorial video prototype based on the established design, emphasizing the creation of interactive and easily comprehensible content for students. During the Implementation stage, the developed tutorial videos are piloted in an authentic learning environment, where students use the media to delve into learning materials (Fitria, 2023; Tri et al., 2023; Yanto et al., 2023). Evaluation constitutes the final stage, involving assessing the short tutorial videos' effectiveness in enhancing students' understanding and skills in operating lathe machines. This evaluation is conducted through performance measurements and analysis of students' cognitive ability after using the developed instructional media to ensure optimal achievement of educational objectives.

2.2 Research procedure

This study involved 65 students in self-directed learning through the ADDIE model approach, utilizing short tutorial videos in lathe machine operations. The participants were drawn from SMK Negeri 1 Sumatra Barat, comprising 35 students from class XI TP1 and 30 others. Both groups were given equal access to the developed short tutorial videos to facilitate their understanding of fundamental lathe machine techniques. The short tutorial videos were structured to demonstrate the operational steps of the lathe machine in detail, aiming to enhance students' conceptual understanding and cognitive ability in applying accurate turning techniques.

The learning process began with students thoroughly watching the videos to comprehend the fundamental techniques presented. After viewing the short tutorial videos, students were asked to analyze the content, followed by comprehensive data collection to assess their understanding of the learning materials. Students were expected to apply the acquired knowledge in practical activities, enabling them to develop lathe machine operational skills more effectively. This method also allowed students to revisit the material as needed, reinforcing their understanding and enhancing cognitive ability.

Data collection was conducted using a questionnaire consisting of 25 questions aimed at evaluating students' comprehension of the learning materials. Additionally, data on cognitive ability were gathered by administering 30 questions to students to assess how much they could apply the concepts learned through the short tutorial videos. Finally, the effectiveness of the developed instructional media was measured by evaluating how well students mastered the material presented and how the media supported the overall learning process. This analysis aimed to ensure that the short

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tutorial videos facilitated theoretical understanding and enhanced students' cognitive abilities in real-world contexts.

2.3 Video tutorials

The stages of material delivery and demonstration in the short video tutorial are shown in Figure 2. These stages consist of:

Step 1 Opening	:	Explain the video's purpose, the material's scope, and the demonstration of machine operation and equipment use.
Step 2 First Lesson	:	Deliver the first material on the fundamental principles theory of machine work processes and equipment use.
Step 3 Feedback	:	Giving feedback to students by displaying a question related to the basic principles of machine work processes and equipment use. The students were given 20 seconds to answer the question. After the time was over, the correct answer was explained.
Step 4 Second Lesson	:	Showing the second material demonstrates how to operate the machine and use the tools.
Step 5 Feedback	:	Giving feedback by displaying a question related to machine operation and tool usage. Students were given 20 seconds to answer the question. After the time was over, the correct answer was explained.
Step 6 Closing	:	The closing was done by summarising the materials delivered in the video.

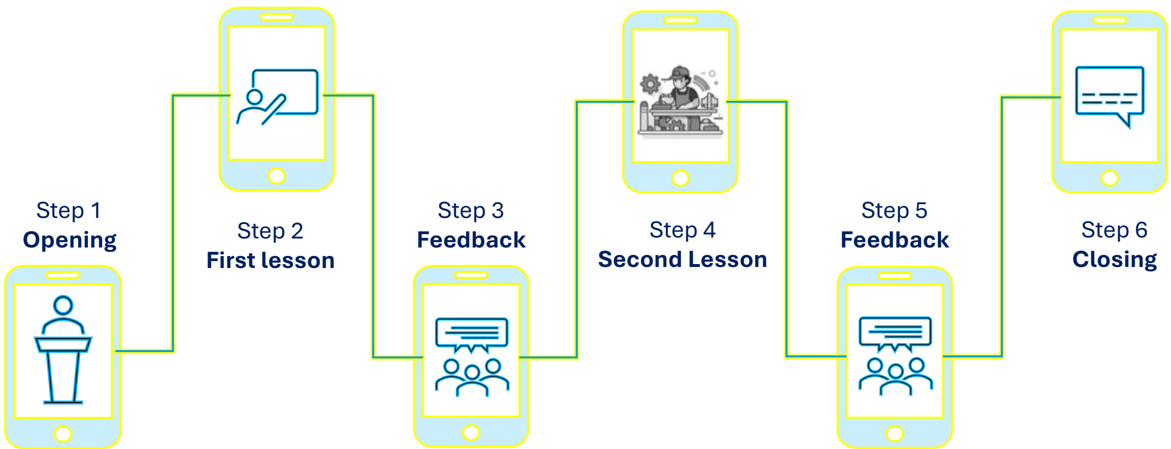

Figure 2. The short video tutorial stages

Eight video tutorials were made. The topic coverage of the videos created is presented in Table 1.

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Table 1. Learning video of turning basics

No	Videos title	Description
1	Making videos of personal protective equipment and readiness before turning	This video describes personal protective equipment commonly used by lathe operators and their readiness. The tools described include wearpack, apron, gloves, glasses, and work helmet. The video also explains operator readiness, including ensuring good physical health, avoiding operating the lathe after taking drugs with side effects, and wearing personal protective equipment
2	Making a video introducing and explaining lathe machining parts	This video explains the parts of the lathe and their functions. The parts listed in the video include machine support, fixed head, machine bed, and carrier sledge
3	Making a video on how to calculate RPM, feed, and depth of cut	This video explains how to calculate the feeding speed, RPM speed, depth of cut, and machining time
4	Making a video on how to install workpieces and lathe tools	This video explains how to attach the workpiece to the fixed head and the cutting tool to the shaft
5	Making a video on how to turn the face and turn the flat	This video explains how to turn faces by tilting the toolpost 8-15 degrees and feeding 1 mm thick, and turning by straightening the toolpost and turning to a depth of 1 mm
6	Making a video on how to turn a 30-degree taper	This video explains the steps of taper turning by tilting the cross sledge 30 degrees with each feed at a depth of 1.5 mm
7	Making a video on how to drill a 6 mm diameter lathe	This video explains the drilling step with several passes, using gradual diameters until reaching a final diameter of 6 mm
8	Understanding steady rest tools in lathe machining	This video explains the meaning and function of the steady rest tool in lathe machining

2.4 Research instruments

The research instrument was developed based on previous studies that have been proven effective, as indicated in the literature (Fortuna et al., 2023; Prasetya, Fortuna, et al., 2023; Waskito et al., 2024). The development process of this instrument involved three main testing stages: validity, practicality, and effectiveness. The initial phase, the validity test, was designed to confirm that the instrument assessed the intended variables precisely. The subsequent phase, the practicality test, assessed the instrument's effectiveness and efficiency when utilized in a natural educational setting. The effectiveness test's final phase evaluated how well the instrument improved students' comprehension and skills. The results from these three testing phases were essential in determining the overall success and effectiveness of the ADDIE model implementation.

2.4.1 Media and material experts of the validity test instrument

The validation of the short tutorial videos received excellent feedback from six validators, consisting of two media experts and four content experts. The media experts were lecturers in the Visual Communication Design program with over ten years of teaching experience (Syahril et al., 2021). Meanwhile, the content experts included two lecturers who teach Basic Mechanical Engineering courses with over ten years of teaching experience and two Machining Technique teachers at vocational schools with more than 30 years of experience. This validation process was conducted using a pre-designed evaluation questionnaire. The details of the questionnaire grid are presented in Table 1, which outlines the aspects assessed in the short tutorial videos, ensuring that every element of the instructional media has been comprehensively evaluated and aligned with academic standards. This assessment aimed to ensure the quality and appropriateness of the tutorial video content to meet students' learning needs and to identify areas that require further refinement.

Table 2. Media and material experts of assessment questionnaire grids

No	Assessment Aspect	Indicator of Assessment
Media		
1	Media quality	The quality of the video tutorial is excellent
		The duration of the tutorial video is on the material presented
		The flow of the learning video is clear
		Learning media is easy to operate
		The video tutorial display is clear
		The lighting in the shooting is proper
		The audio in the learning video sounds clear
		The backsound used is appropriate
		The text size is clear and easy to read
		The font type is appropriate for the learning media
2	Media Layout	Colour alloy quality
		Video display quality
		Harmony of writing layout
		Clarity of title display
		Appropriateness of image and writing proportions
Material		
1	Suitability of material with the semester learning plan	Suitability of material with the semester learning plan
		Content suitability with learning outcomes
		Suitability of material with competency standards
2	Correctness of concept	Systematic arrangement of materials
		Alignment of video concepts with learning materials
		Accuracy of term use
3	Appropriateness of the examples used in the material	Image suitability with learning materials
		Accuracy of image selection
		Suitability of measurement process description
4	The material is easy to understand	Ease of understanding of the material
		Simple and concrete presentation of material
		Clarity of material description

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2.4.2 Practicality test for students

The practicality test involved 65 students from two classes, utilizing an evaluation questionnaire focused on three primary aspects: appearance, operation, and usefulness. The assessment of appearance aspect evaluated the visual quality and design of the media; the operation aspect assessed the ease of use and interactivity of the media; while the usefulness aspect measured the extent to which the media supports the learning process and achieves the desired educational objectives. The practicality test analysis grid used is presented in Table 3.

Table 3. Practicality test analysis grid for students

No	Aspect	Indicator
1	Video Display	Attractiveness of display
		Clarity of video, images, text, and sound
2	Operation	Ease of choosing which tutorial to follow
		Ease of operation
3	Usability	Facilitate student self-learning
		Clarity of competencies is to be achieved
		Increases student attention

2.4.3 Effectiveness test on short tutorial videos for students

The effectiveness test was conducted using 30 objective questions designed to measure students' understanding of the material presented in the short tutorial videos. This test was administered to 65 students to evaluate how well they could apply the acquired knowledge. The results from this test were then compared to the Minimum Completeness Criteria (KKM) of 75, thus providing in-depth insights into the impact of short tutorial videos on enhancing students' understanding and cognitive ability, as well as the effectiveness of the video tutorial media in lathe machine learning at vocational high schools. The effectiveness assessment grid for the video tutorial is provided in Table 4.

Table 4. Grids for assessing the effectiveness of video tutorials on students

No	Assessment Aspect	Indicator of Assessment
1	The main functions of lathe	Cutting and shaping the workpiece
2	Lathe parts	Chuck: for holding the workpiece
		Tailstock: supports the workpiece when turning long
		Transverse crank: the place where the tool post is installed
3	Types of turning processes	Boring: to make a hole in the workpiece
		Taper Turning: to form a conical surface
		Facing: to flatten the end of the workpiece
		Threading: to create threads on the surface of a workpiece
		Parting: to cut or divide the workpiece
4	Cutting tools and measurements	Lathe tool: a cutting tool in a lathe
		Micrometer and vernier: These are used to measure the outer diameter of the workpiece

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5	Turning parameters	Cutting speed: the speed of the tool when cutting the workpiece Coolant: reduces friction and heat

2.5 Data collection and data analysis techniques

This study utilized evaluation questionnaires from media and content experts, analyzed using the V coefficient (Aiken, 1985). This analysis method was employed to determine the validity level of the assessments provided by the experts. The data analysis was conducted by considering the following:

$$V = \frac{\sum s}{n\,(c-1)}$$

Based on research from (Benavides et al., 2022), the assessment model of V coefficients was used to measure the validity of the assessment scores from the questionnaires provided by media experts. Here, the V value for the first 15 rows represents the maximum valid scores, while the following 15 rows show the minimum scores that are still considered valid in the validation process. These results enable researchers to assess the extent to which the evaluation instruments used meet the established validity standards and ensure that the developed instructional media meets the expected criteria. Thus, the analysis of the V coefficient is a crucial step in testing the reliability and validity of the learning media being developed. The media expert validation of assessment score thresholds is presented in Table 5.

Table 5. Media expert validation assessment score

No. of items (m) or raters (n)	V coefficients
15	.78
15	.69

In order to assess the validity of the scores from the content expert questionnaire, refer to Table 6. This table outlines that the highest value in the first 12 rows is the V coefficient representing the maximum valid value, while the next 12 rows indicate the V as the minimum validation value.

Table 6. Material expert validation of assessment score

No. of items (m) or raters (n)	V coefficients
12	.87
12	.80

The practicality test for students who had used the short tutorial videos was measured through a questionnaire consisting of 25 statements, completed by students after they had watched all the short tutorial videos. The questionnaire was distributed via Google Forms to obtain systematic data on the extent to which students considered the short tutorial videos practical and beneficial. The results of this measurement can be found in Table 7, which presents data related to the practicality evaluation of the instructional media (Bernal-Garcíaa et al., 2020).

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Table 7. Practicality test assessment (Landis & Koch, 1977)

Values	Interpretation
0.01 to 0.20	Impractical
0.21 to 0.40	Less practical
0.41 to 0.60	Moderately low
0.61 to 0.80	Practical
0.81 to 1.00	Very practical

Before evaluating the effectiveness of short video tutorials in teaching basic lathe operations in terms of students' cognitive abilities, it is essential to first conduct a descriptive analysis, a normality test, and a non-parametric proportion test. These tests help assess the data distribution and the proportion of students who meet the minimum proficiency criteria. The descriptive analysis provides an overview of the data, including the mean score, standard deviation, and the distribution of students' scores. The normality test determines whether the data follows a normal distribution, which influences the selection of the subsequent statistical analysis methods. In this case, a non-parametric proportion test is applied since the data is not normally distributed ($p > 0.05$). The hypotheses for this study are as follows:

- H_o = The average student score is ≥ 75, with a significance value (Sig.) greater than 0.05
- H_a = The average student score is ≤ 75, with a significance value (Sig.) less than 0.05

The proportion test aims to evaluate whether there is a significant improvement in students' understanding and cognitive abilities after using the video tutorials in the basic lathe operation lessons. The findings are expected to provide evidence of whether the developed instructional media has successfully achieved the research objective, which is to enhance students' conceptual understanding and practical skills in the learning process.

3. Results

The preliminary interviews revealed key issues in instructional media development, including gaps in students' understanding, ineffective delivery methods, and a need for better teaching aids. These findings highlight students' difficulties understanding basic turning learning concepts and the importance of more exciting and effective media. Consequently, developing interactive and adaptive media is essential to improve cognitive ability. Details are provided in Table 8.

Table 8. Results of initial interviews with students

No	Questions	Respondents' answers
1	How do you feel about using video tutorials to learn mechanical engineering?	I find the video tutorial very helpful as it gives me a clear picture of the cognitive steps I must take. I feel more confident when practicing in the workshop
2	Do you think these video tutorials help you understand the material	Yes, I find it easier to understand the material because the video tutorials

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	better than traditional teaching methods?	provide detailed explanations, and I can repeat them whenever I feel confused
3	How did the video tutorials help you in completing the assignment or exam?	The video tutorials helped me remember the steps to do so I could complete the assignments and exams better
4	Do you prefer learning through video tutorials compared to reading books or listening to lectures?	I prefer learning through video tutorials because they are more cognitive, and I can directly see how to do it, unlike reading a book, which is sometimes confusing
5	How do video tutorials affect your motivation to learn?	This video tutorial makes me more enthusiastic about learning because the material presented is attractive and easy to follow

Table 8 indicates that, according to student responses, video tutorials in mechanical engineering education are highly effective. Students found the visual clarity of the tutorials helpful for understanding practical steps, allowing them to learn at their own pace. Video tutorials were perceived as more engaging than traditional methods, such as reading books or listening to lectures, enhancing students' motivation and comprehension. Overall, the interviews affirm that video tutorials are highly effective technical education learning tools, supporting theoretical understanding and practical application.

At the design stage, researchers developed eight videos focused on the fundamentals of lathe practice. These videos provide more cognitive and structured guidance on understanding basic lathe techniques, making it easier for students to follow the learning steps more effectively. The creation of these videos was based on a careful needs analysis, aiming to support a comprehensive and interactive learning process. Figure 3 illustrates a series of video tutorials designed to enhance students' skills in basic lathe operations, progressing from safety fundamentals to advanced techniques. The tutorials begin with a video on safety protocols essential for safe lathe operation, followed by a quiz to assess knowledge of lathe components. Subsequent videos cover calculating revolutions per minute (RPM) for various operations, understanding the lathe tool post, and reducing workpiece diameter. Advanced techniques are introduced, including taper turning and a lathe drilling process. The final video focuses on using a steady rest to support long workpieces during machining. Together, these tutorials provide a structured learning pathway to build foundational knowledge and cognitive ability in lathe machining.

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(a) https://youtu.be/bmoC36csWgE

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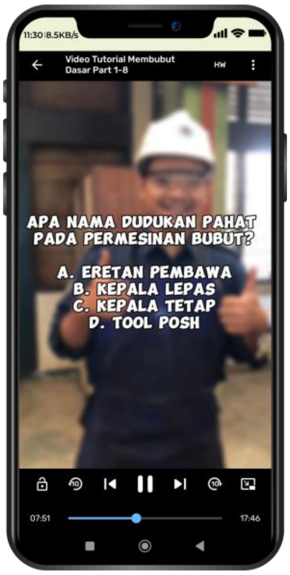
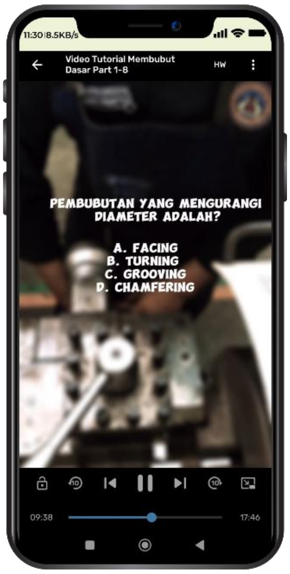


(d) https://youtu.be/YpQHvfgDWq0



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(f) https://youtu.be/8DpOX5Bu42s

(g) https://youtu.be/AQ1qd4jahpA

(h) https://youtu.be/GNHSl0czbTg

Figure 3. (a) Video on safety introduction before using a lathe machine; (b) Quiz on the introduction to lathe components; (c) Video on how to calculate revolutions per minute (RPM) in turning operations; (d) Video on the introduction to lathe tool post; (e) Video on the process of reducing the workpiece diameter; (f) Video on taper turning; (g) Video on the drilling process using a lathe machine; (h) Video on the use of steady rest in lathe machining

3.1 Validity

This study evaluates the results of the tutorial video development by referring to validation conducted by media and subject matter experts. This validation aims to

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assess the quality of the content, visual clarity, and relevance of the material presented in the short tutorial videos. Media experts evaluate aspects such as media quality, layout, and interactive design to ensure the media used is compelling and engaging for students. The assessment results from the media expert are summarized in Table 9.

Table 9. Assessment results from media expert validation

No	Assessment Aspect	Indicator of Assessment	Validity Score	Description
1	**Media quality**	The quality of the video tutorial is excellent.	1.00	Valid
		The duration of the tutorial video is on the material presented.	0.75	Not valid
		The flow of the learning video is clear.	0.88	Valid
		Learning media is easy to operate.	0.88	Valid
		The video tutorial display is clear.	1.00	Valid
		The lighting in the shooting is proper.	0.88	Valid
		The audio in the learning video sounds clear.	1.00	Valid
		The backsound used is appropriate.	1.00	Valid
		The text size is clear and easy to read.	0.75	Not valid
		The font type is appropriate for the learning media.	0.75	Not valid
		Average	0.89	Valid
2	**Media Layout**	Color alloy quality	0.75	Not valid
		Video display quality	0.63	Not valid
		Harmony of writing layout	0.63	Not valid
		Clarity of title display	0.75	Not valid
		Appropriateness of image and writing proportions	0.75	Not valid
		Average	0.70	Not valid
		Overall Average	0.83	Valid

Meanwhile, subject matter experts focus on the accuracy and appropriateness of the instructional content, ensuring that the content supports the achievement of established learning objectives. The validation results are then used to refine and optimize the short tutorial videos to enhance their effectiveness as educational tools and to ensure that the developed media significantly improves student understanding and skills. The assessment results from the subject matter expert are presented in Table 10.

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Table 10. Assessment results from material expert validation

No	Assessment Aspect	Indicator of Assessment	Validity Score	Description
1	Suitability of material with the semester learning plan	Suitability of material with the semester learning plan	0.69	Valid
		Content suitability with learning outcomes	0.75	Valid
		Suitability of material with competency standards	0.75	Valid
Average			**0.73**	**Valid**
2	Correctness of concept	Systematic arrangement of materials	0.75	Valid
		Alignment of video concepts with learning materials	0.75	Valid
		Accuracy of term use	0.75	Valid
Average			**0.75**	**Valid**
3	Appropriateness of the examples used in the material	Image suitability with learning materials	0.75	Valid
		Accuracy of image selection	0.94	Valid
		Suitability of measurement process description	0.94	Valid
Average			**0.88**	**Valid**
4	The material is easy to understand	Ease of understanding the material	1.00	Valid
		Simple and concrete presentation of material	1.00	Valid
		Clarity of material description	1.00	Valid
Average			**1.00**	**Valid**
Overall Average			**0.84**	**Valid**

3.2 Practicality

The practicality test in this research aims to assess how the developed lathe machine tutorial video can be effectively implemented in real-world learning contexts. Additionally, the practicality test seeks to gather feedback from end-users, including students and instructors, regarding further improvements or refinements needed to enhance the media's usability and effectiveness in various mechanical engineering learning situations.

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Table 11. Practicality test results for students

Aspect Assessment	Student Response	
	Average	Description
Video Display	0.93	Very practical
Correctness of Concept	0.91	Very practical
Expediency	0.92	Very practical
Overall Average	**0.92**	**Very practical**

The practicality test results for the lathe machine tutorial videos indicate that students consider educational media highly practical. According to Table 11, the video display aspect received an average score of 0.93, categorized as "very practical," indicating that the video tutorials have an excellent visual presentation and are easily comprehensible for students. Furthermore, the "Correctness of Concept" aspect received an average score of 0.91, also falling into the "very practical" category, showing that the content delivered in the videos is accurate and aligns with lathe machine learning concepts. The "Expediency" aspect achieved an average score of 0.92, again categorized as "very practical," reflecting that the video is highly beneficial and relevant for students in understanding and applying lathe machine concepts.

Overall, the average practicality score for the tutorial video is 0.92, which is categorized as "very practical." This suggests that the lathe machine tutorial video is an effective learning tool in facilitating the learning process in content delivery and concept comprehension. These findings support the research objective of developing engaging and effective educational media to enhance students' cognitive abilities in lathe machining.

3.3 Effectivity

After implementing the tutorial video-based learning media, the researcher conducted a descriptive statistical analysis to assess the cognitive abilities of students from two classes that received the media treatment based on post-test results, aiming to measure the effectiveness of the media. The post-test data were analysed to evaluate the distribution of students' scores, calculate the mean, and observe the data spread relative to the mean (standard deviation). The results of the descriptive statistical analysis are presented in Table 12.

Table 12. Descriptive analysis

Group Class	N	Minimum	Maximum	Mean	SD
Mechanical Engineering	65	76.26	96.57	85.18	4.83

Based on the descriptive statistical results in Table 12, the student's cognitive abilities following the implementation of the video tutorial-based learning media showed a mean score of 85.18 in the Mechanical Engineering class, with a total of 65 students. The minimum score achieved was 76.26, while the maximum score was 96.57. The standard deviation (SD) of 4.83 indicates a relatively wide range of scores.

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Next, a normality test was conducted to determine whether the data distribution was normal using the Shapiro-Wilk statistical test. This test enabled the researcher to statistically evaluate the normality of the data, using SPSS software to compute the average distribution values. If the test results show a significance value (p-value > 5% or 0.05), the data can be considered normally distributed. The normality test results are shown in Table 13.

Table 13. Normality test

Group Class	Normality Test			Description
	Shapiro-Wilk	df.	Sig.	
Mechanical Engineering	0.957	65	0.024	Abnormal

Based on the normality test results presented in Table 13, the analysis indicated that the student's cognitive ability data [S-W = 0.961; Sig.> 0.05 = 0.024] showed a significance value lower than 0.05, indicating that the data are not normally distributed, as per the Shapiro-Wilk test. Thus, it can be concluded that the data do not meet the assumption of normality, and for subsequent tests, a non-parametric proportion test was employed as an alternative method. The non-parametric proportion test was used to assess whether there was a significant difference after the students received the short tutorial video treatment. The results of the proportion test are shown in Table 14.

Table 14. Proportion Test

Group Class	95% confidence interval		Proportion Test	
	Lower	Upper	Test Prop.	Exact Sig. (2-tailed)
Mechanical Engineering	76.26	96.57	0.50	0.000

According to the proportion test results shown in Table 14, the analysis revealed a significant difference in the cognitive abilities of the Mechanical Engineering class after the implementation of the short tutorial video. The non-parametric proportion test indicated a significance value (Sig.) of 0.000, which is smaller than the 0.05 significance level. This suggests that the null hypothesis (Ho), which stated that the average student score was 85.18, can be rejected. This means the data indicated not only that students achieved this score but also showed an even more significant improvement. Since the null hypothesis was rejected, the alternative hypothesis, which posited that the average student score was ≤ 75, was accepted. This demonstrates that the student's average score was significantly higher than the predetermined threshold.

Therefore, the use of a non-parametric proportion test in this study was appropriate, given that the data did not follow a normal distribution (p > 0.05). This shows that the implementation of the short tutorial video effectively enhanced students' cognitive understanding, resulting in average scores well above the minimum proficiency threshold. These findings support the idea that innovative learning media, such as tutorial videos, can positively contribute to the learning process and help students understand basic machining concepts.

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After conducting the normality test and non-parametric proportion test, the researcher interpreted the students' post-test results through a histogram that illustrates the frequency of scores after both classes received the tutorial video-based learning on basic machining. This histogram visualizes the distribution of students' scores, allowing for a more detailed analysis of changes in cognitive abilities. The interpretation aims to identify significant trends and provide a comprehensive picture of the effectiveness of the learning media, as illustrated in Figure 4.

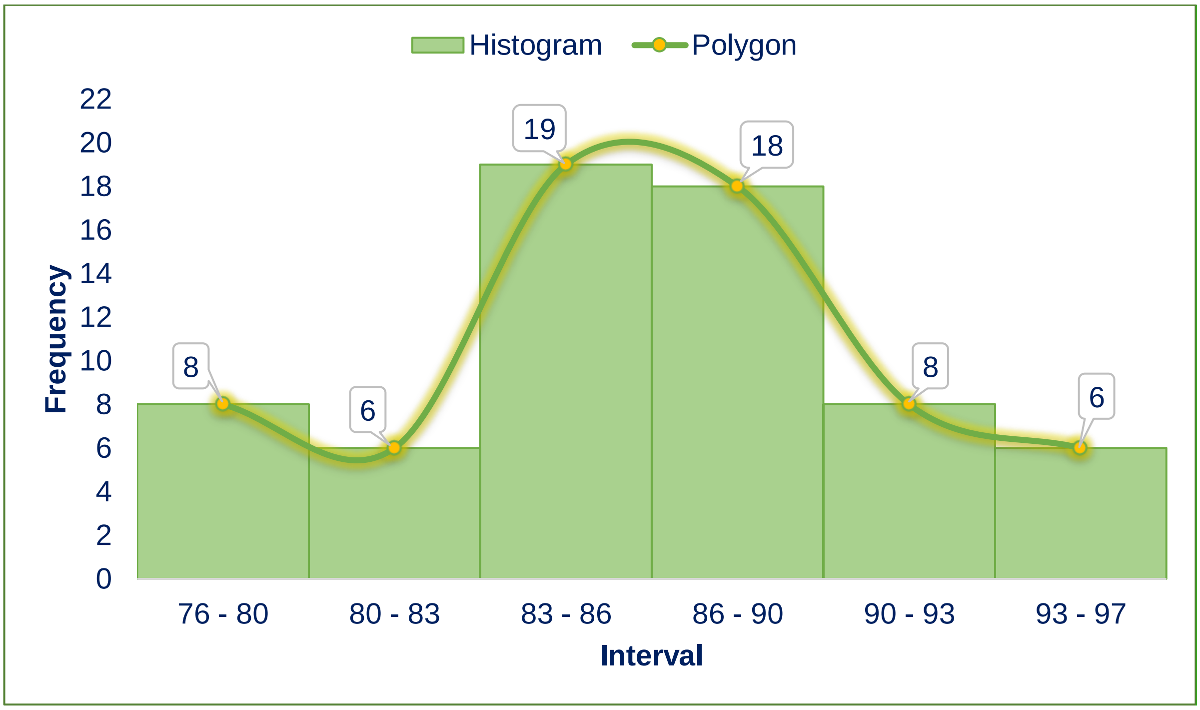

Figure 4. Frequency Histogram of 65 students

The histogram in Figure 4 illustrates the distribution of post-test scores for 65 students after the short tutorial video on basic machining techniques was implemented. The x-axis represents the score intervals, ranging from 76-97, while the y-axis shows the frequency of students in each interval. The data reveal that most students scored in the ranges of 86-90 and 83-86, with 19 and 18 students, respectively, indicating that a large proportion of the class achieved high scores. Conversely, the lowest and highest intervals, 76-80 and 93-97, recorded lower frequencies of 8 and 6 students, respectively. This suggests that while most students performed well, a small number either struggled or excelled beyond the expected range.

Overall, the histogram demonstrates a relatively normal distribution of scores, with the highest concentration of students achieving scores around the middle interval, reflecting the effectiveness of the tutorial video in improving cognitive abilities. This is aligned with the research objective of developing and measuring the effectiveness of the tutorial video in teaching basic machining techniques.

4. Discussion

Previous research has focused on developing instructional media in tutorial videos for Vocational Competency subjects, particularly within the competency standards for

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operating lathe machines (Kusuma et al., 2021). This research aimed to produce instructional media in short tutorial videos and evaluate the feasibility of the resulting product. The development process included several stages: concept creation, production, trial testing, and distribution. The study's findings indicate that the tutorial video was feasible based on expert evaluations and student feedback (Daryanes et al., 2023).

The tutorial video is centred explicitly on fundamental turning techniques and is designed as a supplementary medium to enhance students' comprehension. The video reinforces and complements existing learning materials by presenting basic turning concepts in a visual and interactive format (Madhankumar et al., 2021). The primary focus is on delivering foundational content that is easily comprehensible and repeatable by students to deepen their understanding. As an additional media resource, the video emphasizes a practical approach, featuring step-by-step demonstrations and simplified visual explanations. The results of this study demonstrate that the developed tutorial video effectively improves students' comprehension and skills in lathe machine operations. Statistical analysis showed that the data was normally distributed, allowing a one-sample t-test to be conducted to evaluate whether there was a significant difference between the post-test results of the two classes after using the video tutorial.

In order to enhance student engagement during the learning process, tutorial videos serve not only as learning media (Chandra et al., 2023). After receiving the material, students are presented with questions that test their understanding, enabling them to participate in the learning process rather than merely watching actively. Research indicates that tutorial videos in mechanical engineering education are highly effective; students report that these videos clearly depict the cognitive steps they must take. This clarity boosts their confidence during practical sessions in the machining workshop (Fortuna, Prasetya, Samala, et al., 2024).

The impact of educational videos on turning processes, for instance, allows students to visually observe technical processes that may be challenging to comprehend through text or verbal explanations alone (Cica et al., 2020). Consequently, these videos allow students to closely examine each step of the turning process in detail, thereby deepening their understanding of the correct techniques and procedures. The average student response score indicates that short tutorial videos are rated as highly practical (0.92), reflecting the quality of visual presentation and the ease of understanding the material.

It is hoped that students would not only passively watch the videos as learning materials but also internalize the presented information and apply it in their coursework, particularly in introductory turning courses. Through short tutorial videos, students are encouraged to think critically and apply the concepts they have learned through the exercises provided (Wiyaka et al., 2020). This process enables them to practice the skills learned in the classroom and the laboratory, thus reinforcing their understanding of the material and enhancing the technical competencies required in mechanical engineering.

This research contributes to mechanical engineering education, particularly in lathe machine training. Firstly, the study successfully developed a compelling tutorial video as an engaging instructional medium that enhances students' cognitive abilities in lathe machining. The tutorial video serves as a guide that helps students understand the operational steps of lathe machines, reduces errors, and improves skills through material repetition. Furthermore, the study demonstrates that the tutorial video can facilitate content delivery by instructors and enhance student comprehension, contributing to improved teaching quality and producing more competent and creative students. The research also emphasizes the need for more interactive and adaptive instructional media to meet diverse learning needs.

Nevertheless, there are some limitations to this study. Firstly, the research was conducted at a single educational institution, namely SMK Negeri 1 Sumatera Barat, which may limit the generalizability of the findings to other educational contexts. Secondly, while the tutorial video shows effectiveness in improving student comprehension, the variation in understanding levels suggests that the media may not fully meet the needs of all students, necessitating further adjustments. The study did not explore other factors that might influence cognitive ability, such as student motivation or instructor support, which could be areas for further investigation.

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5. Conclusion

This study concludes that the developed tutorial video has enhanced students' comprehension and cognitive ability in lathe machine operations. The video functions not only as a guide to assist students in understanding lathe machine operational steps but also facilitates content delivery by instructors, thereby improving overall teaching quality. Despite this, there is variation in student understanding levels, indicating that the media may not completely fulfil the needs of all students. Therefore, it is essential to continue developing more interactive and adaptive instructional media to support more effective cognitive ability. Future research could focus on developing more interactive and adaptive educational media to meet diverse learning needs. Additionally, exploring other factors influencing cognitive ability, such as student motivation and instructor support, could provide further insights into enhancing instructional media effectiveness. Research across various educational institutions is also needed to test the generalizability of these findings.

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Declarations

Author contribution

Muhamad Julianes Prasetyo: Conceptualization, formal analysis, funding acquisition, research, validation, visualization, project management, resources, supervision, writing - original draft, writing - review & editing. Rifelino: Conceptualization, data curation, formal analysis, investigation, methodology, writing - original draft, writing - review & editing. Anna Niska Fauza: Investigation, validation, visualization.

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Competing interest

There are no conflicts of interest in this research.

Ethical Clearance

Research involving human subjects must include a statement that permission has been obtained from the institution where the research is being conducted and that the person involved has consented to be a subject in research conducted in accordance with the Declaration of Helsinki (MWA). The implementation of video testing research and data collection of teachers and students has received permission from the Education Office of Provinsi Sumatera Barat with permit letter number 420.02/967/PSMK-2024.

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