Instructional Video Media as a Solution for Teaching Wheel Alignment (Spooring) Practices in Vocational High Schools

Aziz Cahya Pradana [1], Martubi [2]

Email : aziz0530pasca.2021@student.uny.ac.id

Abstract: *Vocational education prepares students with industry-relevant technical competencies through practice-based learning. In automotive vocational programs, wheel alignment is a critical skill involving the adjustment of camber, caster, and toe angles to ensure vehicle stability and safety. However, the implementation of wheel alignment practice in vocational high schools often faces constraints such as limited workshop facilities, restricted practice time, and an imbalance between the number of students and available equipment. These limitations frequently result in teacher-centered demonstrations with limited opportunities for students to observe and practice procedures, which may hinder the development of procedural understanding. This study aims to examine the effectiveness of instructional video media in improving students' learning outcomes in wheel alignment competency. A quasi-experimental method with a one-group pretest–posttest design was employed involving 36 twelfth-grade students at SMKN 1 Jetis. Data were collected through observation, questionnaires, and practical performance tests. The paired sample t-test results showed a significant improvement in student learning outcomes, with the mean score increasing from 63.08 in the pretest to 84.62 in the posttest ($p < 0.05$). These findings indicate that instructional video media effectively enhance students' procedural understanding and support their readiness for workshop practice in vocational education.*

Keywords: *Instructional Video Media, Learning Outcomes, Wheel Spooring, Vocational High School*

Abstrak: *Pendidikan kejuruan berperan penting dalam mempersiapkan siswa dengan kompetensi teknis yang relevan dengan kebutuhan industri melalui pembelajaran berbasis praktik. Dalam program keahlian otomotif, wheel alignment merupakan salah satu kompetensi penting yang melibatkan penyetelan sudut camber, caster, dan toe untuk memastikan stabilitas dan keselamatan kendaraan. Namun, pelaksanaan praktik wheel alignment di Sekolah Menengah Kejuruan sering menghadapi berbagai keterbatasan, seperti terbatasnya fasilitas bengkel, waktu praktik yang terbatas, serta ketidakseimbangan antara jumlah siswa dan peralatan yang tersedia. Kondisi tersebut sering menyebabkan pembelajaran lebih berpusat pada demonstrasi guru dengan kesempatan praktik yang terbatas bagi siswa, sehingga pemahaman prosedural siswa belum berkembang secara optimal. Penelitian ini bertujuan untuk menganalisis efektivitas penggunaan media video pembelajaran dalam meningkatkan hasil belajar siswa pada kompetensi wheel alignment. Penelitian ini menggunakan metode kuasi-eksperimen dengan desain one-group pretest–posttest yang melibatkan 36 siswa kelas XII di SMKN 1 Jetis. Data dikumpulkan melalui observasi, kuesioner, dan tes kinerja praktik. Hasil uji paired sample t-test menunjukkan adanya peningkatan hasil belajar yang signifikan, dengan*

[1]*Pendidikan Teknologi dan Kejuruan, Sekolah Pascasarjana, Universitas Negeri Yogyakarta*
[2]*Pendidikan Teknologi dan Kejuruan, Sekolah Pascasarjana, Universitas Negeri Yogyakarta*

rata-rata nilai meningkat dari 63,08 pada pretest menjadi 84,62 pada posttest (p < 0,05). Temuan ini menunjukkan bahwa media video pembelajaran efektif dalam meningkatkan pemahaman prosedural siswa serta mendukung kesiapan mereka dalam melaksanakan praktik di bengkel.

Kata Kunci: Media Video Pembelajaran, Hasil Belajar, Spooring Roda, Sekolah Menengah Kejuruan

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INTRODUCTION

Vocational education functions as a bridge between academic knowledge and the practical skills required by the labor market by preparing graduates with direct experience and industry-specific competencies (Iliescu et al., 2025; Wismansyah et al., 2024; Yusop et al., 2023). Consequently, practice-based learning constitutes the core of automotive competency development in vocational high schools (SMK), as it enables students to acquire technical knowledge, psychomotor skills, and professional work attitudes through hands-on workshop activities (Inderanata & Sukardi, 2023). Structured practical training and demonstrations of machinery and equipment have been shown to enhance students' job readiness, particularly in mechanical and automotive engineering programs (Wismansyah et al., 2024). However, rapid developments in the automotive industry in the era of Industry 4.0 including automation, electric vehicles, and AI-based production systems require a workforce that possesses not only technical expertise but also problem-solving abilities, digital literacy, and adaptability to technological change (Crețu et al., 2024; Yu et al., 2025). Therefore, aligning practical competencies developed in vocational education with evolving industry demands has become increasingly critical, particularly in mastering technical skills related to the maintenance and adjustment of vehicle wheel systems (Stareček et al., 2023).

Wheel alignment refers to the process of adjusting wheel angles so that they are perpendicular to the road surface and parallel to each other through parameters such as camber, caster, and particularly toe, allowing the vehicle to move straight and remain stable without pulling to one side (Das et al., 2024). Proper alignment is essential for maintaining directional stability, driving comfort, and overall vehicle performance by ensuring optimal tire–road contact (Xu et al., 2024). Misalignment, especially toe-in deviation, can increase rolling resistance by up to approximately 129%, leading to higher energy consumption and emissions, as well as significantly accelerated tire wear. In addition, misalignment causes uneven tire wear, reduces traction and vehicle stability, and increases the risk of accidents due to compromised vehicle control (Prasshanth & Vaithiyanathan, 2024). Therefore, wheel alignment competence constitutes a critical component of the automotive curriculum in vocational education, as the ability to diagnose and adjust wheel angles according to manufacturer specifications is essential to ensure vehicle performance, efficiency, and safety (Dahalan et al., 2023; McGrath & Yamada, 2023). However, the practical teaching of this competency in vocational schools still faces several implementation challenges.

Practical instruction in wheel alignment (spooring) at vocational high schools (SMK) faces several challenges that may affect the effectiveness of the learning process. Limited workshop facilities and the availability of alignment equipment often restrict students' opportunities to engage directly in practical activities. In addition, limited practice time and the imbalance between the number of students and available equipment tend to make the learning process more teacher-centered, relying primarily on demonstrations with limited student participation. The technical complexity of wheel alignment procedures encompassing measurement, wheel angle analysis, and precise suspension adjustments

also poses difficulties when the material is delivered solely through verbal explanations or brief demonstrations. As a result, students' procedural understanding of the spooring practice may not develop optimally, which can affect their readiness to perform the procedure independently. Therefore, a learning approach that enables students to visualize technical procedures more clearly and systematically before and during workshop practice is required.

Instructional videos possess multimodal characteristics that integrate audio, visual, textual, and instructional design elements, making them effective for conveying technical and procedural skills in vocational and professional education (Lin & Yu, 2023; Navarrete et al., 2023). Through instructional video, learners can directly observe work sequences, hand movements, and the use of tools, facilitating observational learning that supports the development of cognitive representations necessary for skill execution (AlKahtani et al., 2025). The visual and step-by-step presentation of procedures also simplifies the understanding of complex motor skills compared to explanations delivered solely through text or verbal instruction (Vallecillo et al., 2025). Moreover, the flexibility of video allowing learners to pause, replay, and review specific segments enables self-paced learning and has been shown to improve practical skill mastery and long-term retention (Arqub et al., 2024; Dantas et al., 2025; Dervisbegovic et al., 2025). Consequently, instructional video has increasingly been adopted as a learning medium to support the development of technical skills across various fields of vocational and professional education.

Recent studies indicate that the use of instructional videos in technical and vocational education can significantly enhance learners' knowledge, practical skills, and learning motivation compared with conventional instructional methods and even some forms of simulation-based learning (AlKahtani et al., 2025; Lin & Yu, 2023; Navarrete et al., 2023). The integration of visual and auditory channels in multimedia learning environments has been shown to deepen procedural understanding and improve skill performance, as evidenced in training contexts such as pharmaceutical counseling, nursing practice, and other clinical procedures (Ba et al., 2025; Kimura et al., 2023; Morgado et al., 2024). In automotive education, modeling-based videos and tutorial videos have likewise been reported to be more effective than conventional self-directed practice in enhancing learners' diagnostic abilities and problem-solving skills (Reyna et al., 2017; Widjanarko et al., 2024). Furthermore, procedural videos are widely utilized in technical and transportation training such as vehicle system operation and advanced driver assistance systems (ADAS) because they provide standardized demonstrations that can be repeatedly reviewed to support mastery of practical work procedures (Murtaza et al., 2024; Widjanarko et al., 2024). These findings highlight the substantial potential of instructional video as a learning medium for supporting the development of technical and procedural competencies in professional education.

Although the use of instructional videos has been extensively investigated across various educational contexts, most studies have predominantly focused on conceptual learning or the delivery of theoretical content and general practices in technical education. Research specifically examining the application of instructional videos for practical learning of wheel alignment (spooring) in vocational high schools (SMK) remains relatively limited. Furthermore, empirical studies assessing how video media can support students' procedural understanding, enhance their preparedness prior to workshop practice, and help mitigate the constraints of limited school facilities are still scarce. This gap underscores the need for further research on the utilization of instructional videos in practical spooring education. Therefore, this study aims to analyze the effectiveness of video media in improving procedural comprehension and students' readiness for practical activities in SMK spooring instruction.

METHODS

This study employed a quasi-experimental approach with a one-group pretest–posttest design to examine the effect of instructional video media on students' learning outcomes in performing wheel alignment practices. The same group of participants was assessed before and after the learning

intervention to identify changes in their procedural competence. A pretest measured students' initial understanding and performance, while a posttest was conducted after the implementation of instructional video–based learning. The comparison of these two measurements was used to determine whether the instructional video significantly improved students' procedural learning outcomes in wheel alignment practice.

The participants in this study comprised 36 vocational high school (SMK) students enrolled in an automotive engineering program who were engaged in practical learning of wheel alignment. They were purposively selected from a class scheduled to study the wheel alignment procedure as part of the automotive maintenance curriculum. All participants received an instructional intervention using video-based learning media, designed to investigate the effectiveness of instructional videos in enhancing students' procedural understanding and practical readiness. The intervention employed a carefully structured instructional video that systematically presented the wheel alignment procedure, integrating explanations of essential concepts, demonstrations of equipment usage, and step-by-step procedural guidance. By providing a visual and sequential representation of the practice, the video allowed students to observe proper techniques and workflow prior to engaging in hands-on workshop activities, while also serving as a reference during the practical sessions to reinforce procedural comprehension and ensure accurate execution of the tasks.

The study employed several instruments to collect data on students' procedural performance in conducting wheel alignment practices. Data collection began with field observation to identify learning conditions and practical constraints in the workshop environment as part of the needs analysis. The main instrument was a performance assessment questionnaire designed to evaluate students' ability to perform the wheel alignment procedure according to standard operational practices. This instrument was used to measure students' procedural competence before and after the implementation of instructional video–based learning, providing measurable data on changes in their practical learning outcomes.

The performance assessment indicators were developed based on the main stages of wheel alignment practice, including vehicle preparation, wheel inspection, and alignment adjustment. These stages reflect the essential procedures required to ensure accurate measurement and proper adjustment of alignment parameters such as camber, caster, and toe, which are critical for vehicle stability, tire performance, and driving safety (Das et al., 2024; Xu et al., 2024). Each stage was further divided into several operational sub-indicators describing specific tasks performed during the practical activity, enabling a systematic evaluation of students' procedural performance.

Table 1. Wheel Alignment Practice Assessment Indicator

Stage of Procedure	Indicator	Sub-Indicator
Preparing the vehicle on a four-post lift	Vehicle preparation	Positioning the vehicle on the four-post lift correctly
	Safety inspection	Ensuring the vehicle is stable and properly secured on the lift
	Initial inspection	Conducting a preliminary inspection before the alignment test
Removing and inspecting the wheels using a wheel balancer	Wheel removal	Removing the wheels using proper tools and procedures
	Wheel inspection	Checking tire condition and wheel components

Reinstalling and aligning the wheels using a 3D alignment machine	Wheel balancing	Inspecting wheel balance using a wheel balancer
	Wheel installation	Reinstalling the wheels correctly after inspection
	Alignment measurement	Measuring wheel alignment parameters using a 3D alignment machine
	Alignment adjustment	Adjusting camber, caster, and toe according to manufacturer specifications (Das et al., 2024; Xu et al., 2024)

The data collection procedure was conducted through several stages to measure students' procedural learning outcomes in wheel alignment practice. First, a needs analysis was carried out through field observation to identify learning conditions and practical constraints in the school workshop. Next, a pretest was administered to assess students' initial competence in understanding the wheel alignment procedure. The learning intervention was then implemented using instructional video media demonstrating the procedural steps of wheel alignment. After observing the video, students performed the procedure during a practical workshop session. Finally, a posttest and performance assessment were conducted to evaluate students' procedural performance after the intervention.

The data from the pretest and posttest were analyzed using a paired sample t-test to determine whether there was a statistically significant difference in students' learning outcomes before and after the implementation of instructional video based learning. Prior to hypothesis testing, descriptive statistics (mean and standard deviation) were calculated to describe the distribution of students' performance scores. The paired sample t-test was then applied to compare the pre- and post-intervention results, in order to determine the effectiveness of instructional video media in improving students' procedural competence in wheel alignment practice.

RESULT AND DISCUSSION

The study involved 36 vocational high school (SMK) students enrolled in the Automotive Engineering program (Teknik Kendaraan Ringan Otomotif/TKRO). All participants belonged to the same class cohort and were scheduled to study the wheel alignment (spooring) procedure as part of the Automotive Maintenance curriculum. Participants were purposively selected based on their enrollment in the relevant practical course. No participant was excluded from the analysis, resulting in a complete dataset comprising 36 students.

Descriptive Statistics of Pretest and Posttest Scores

Prior to the instructional video intervention, students demonstrated a moderate level of procedural competence in wheel alignment practice, with a pretest mean score of M = 58.64 (SD = 8.32) and scores ranging from 40 to 75 out of 100. This distribution indicates variability in students' baseline understanding of the wheel alignment procedure, particularly in aspects related to vehicle preparation and the adjustment of alignment parameters. Following the implementation of instructional video–based learning, students' procedural performance improved substantially, as reflected in a posttest mean score of M = 82.17 (SD = 6.45) with scores ranging from 68 to 97. In addition to the increase in average performance, the reduction in standard deviation from 8.32 to 6.45 suggests a more homogeneous distribution of students' competence after the intervention. Overall, the mean difference between pretest and posttest

scores was 23.53 points, indicating a considerable improvement in students' procedural learning outcomes after exposure to the instructional video.:

Table 2. Descriptive Statistics of Procedural Learning Outcomes in Wheel Alignment Practice

Variable	Mean	SD	Min	Max
Pretest Score	58.64	8.32	40	75
Posttest Score	82.17	6.45	68	97
Mean Difference	+23.53	—	—	—

As presented in Table 2, the descriptive statistics indicate a consistent and substantial improvement in students' procedural scores across all measured indicators. The pretest and posttest scores represent the aggregate performance obtained from the wheel alignment practice assessment instrument, which evaluated three main procedural stages: vehicle preparation on a four-post lift, wheel removal and inspection using a wheel balancer, and wheel reinstallation and alignment using a 3D alignment machine. The observed increase in the overall mean score, accompanied by a reduction in score dispersion in the posttest results, suggests that the instructional video contributed not only to higher performance but also to a more uniform level of procedural competence among students during the wheel alignment practice.

Prior to hypothesis testing, the normality of the pretest and posttest score distributions was assessed using the Shapiro–Wilk test, which is recommended for sample sizes of *n* ≤ 50 due to its higher statistical power in detecting deviations from normality in small to moderate samples (Field, 2018; Razali & Wah, 2011). In this test, the null hypothesis assumes that the data are normally distributed; therefore, a non-significant result ($p > .05$) indicates that the assumption of normality is not violated and that the data are suitable for subsequent parametric analysis.

Table 3. Mean Score Results

Variable	Statistic	df	p-value	Interpretation
Pretest Score	0.962	36	.234	Normal
Posttest Score	0.971	36	.418	Normal

As shown in Table 3, the results of the Shapiro–Wilk test indicated that both the pretest scores ($W = 0.962$, $p = .234$) and the posttest scores ($W = 0.971$, $p = .418$) were normally distributed, as both p-values exceeded the significance threshold of $\alpha = .05$. These findings confirm that the assumption of normality was satisfied for both measurement points, thereby supporting the use of parametric statistical analysis. Accordingly, a paired sample t-test was conducted to compare the pretest and posttest mean scores and to determine the significance of the instructional video intervention on students' procedural performance.

Paired Sample t-Test Analysis

To determine whether the observed difference in students' procedural learning outcomes was statistically significant, a paired sample t-test was conducted to compare the pretest and posttest scores of the same group of 36 participants. The null hypothesis (H_0) stated that there was no significant difference in students' procedural competence before and after the instructional video intervention, whereas the alternative hypothesis (H_1) posited that students' posttest scores would be significantly higher than their pretest scores following the intervention.

Table 4. Mean Score Results

Comparison	Mean Diff.	t-value	df	p-value	Sig.
Pretest – Posttest	−23.53	−17.84	35	< .001	Yes

The paired sample t-test results (Table 3) showed a statistically significant difference between the pretest and posttest procedural scores, t (35) = −17.84, p < .001, indicating that students' posttest scores were significantly higher than their pretest scores. Because the significance value was below the threshold of α = .05, the null hypothesis was rejected, confirming that the instructional video intervention significantly improved students' procedural competence in wheel alignment practice. The mean difference of −23.53 points between the pretest (M= 58.64) and posttest (M = 82.17) further indicates a substantial improvement in students' procedural performance, particularly in alignment measurement and adjustment tasks involving the use of the 3D alignment machine and the interpretation of camber, caster, and toe parameters.

N-Gain Score Calculation and Category Distribution

The N-Gain scores were calculated for each of the 36 participants based on their individual pretest and posttest scores to determine the level of improvement in procedural learning outcomes. The distribution of N-Gain categories derived from these calculations is presented in Table 5.

Table 2. Mean Score Results

N-Gain Category	Range	n (students)	Percentage (%)
High	g > 0.70	14	38.89
Medium	0.30 ≤ g ≤ 0.70	19	52.78
Low	g < 0.30	3	8.33
Total	—	36	100.00

As shown in Table 4, most students (52.78%, n = 19) achieved a medium N-Gain category, indicating a moderate improvement in procedural competence after the instructional video intervention. Additionally, 38.89% of students (n = 14) reached the high gain category, reflecting substantial improvement in procedural skills, while only 8.33% (n = 3) were classified in the low gain category, suggesting that a small number of students may require additional instructional support.

Table 2. Mean Score Results

Variable	Mean	SD	Min	Max
N-Gain Score	0.57	0.14	0.21	0.88

The mean N-Gain score of g = 0.57 (SD = 0.14) indicates that the overall learning gain of the cohort falls within the medium category, suggesting a meaningful improvement in students' procedural competence following the instructional video intervention. The relatively low standard deviation (SD = 0.14) also indicates that the improvement was fairly consistent across participants. The N-Gain values ranged from 0.21 to 0.88, reflecting variation in individual responsiveness to the video-based learning. Overall, these findings demonstrate that instructional video media was effective in facilitating procedural learning gains, with more than 91% of students achieving at least a medium level of normalized gain, while only a small proportion remained in the low gain category.

The findings of this study indicate a substantial improvement in students' procedural learning outcomes in wheel alignment practice following the implementation of instructional video media. The increase in the mean score from the pretest (M = 58.64) to the posttest (M = 82.17), with a mean difference of 23.53 points, suggests that the instructional video effectively supported the development of students' procedural competence in performing the alignment process. This improvement can be interpreted as the result of the video's ability to present technical procedures in a clear and structured manner, enabling students to observe each stage of the workflow before engaging in hands-on practice. Through the integration of visual demonstrations, step-by-step explanations, and the presentation of equipment usage, the video facilitated a more concrete understanding of the wheel alignment procedure, including vehicle preparation, wheel inspection, and alignment adjustment using specialized tools. Consequently, the visual representation of operational steps and the systematic sequencing of tasks likely helped students construct a clearer mental model of the procedure, thereby improving their ability to execute the practical tasks accurately during the workshop session.

The results also indicate a consistent improvement in procedural competence among students following the implementation of instructional video–based learning. This pattern is reflected in the reduction of the standard deviation from the pretest (SD = 8.32) to the posttest (SD = 6.45), suggesting that students' procedural performance became more evenly distributed after the intervention. The decrease in score dispersion implies that the instructional video not only improved overall performance but also helped minimize disparities in competence among students by providing a uniform reference for understanding the wheel alignment procedure. This trend is further supported by the distribution of N-Gain scores, in which the majority of students achieved either medium (52.78%) or high (38.89%) gain categories, while only a small proportion (8.33%) fell into the low gain category. Such a distribution indicates that most participants experienced a meaningful improvement in procedural learning outcomes, demonstrating that the instructional video intervention was broadly effective in supporting students' acquisition of wheel alignment skills across the cohort.

Video plays an important role in vocational practice learning because it allows students to clearly learn the sequence of technical work steps before entering the workshop, so that they already understand the stages of the procedure and the use of tools when they begin direct practice (Alkattan & Alreshaid, 2025; Navarrete et al., 2023; Schriek et al., 2025). Through a combination of visual and auditory channels, videos help students build procedural mental models that include sequences of actions, cause-and-effect relationships between steps, and correct performance standards, which are known to contribute to increased procedural knowledge and practical skills in technical and clinical skills training (Hamzah et al., 2025; Morgado et al., 2024). Thus, videos are an effective preparation medium for improving practice

readiness, because they can be studied before laboratory sessions, repeated as needed, and provide observational experiences of procedures that resemble real-life work situations so that students are more cognitively and psychomotorically prepared when practicing in the workshop or laboratory (Morgado et al., 2024; Rosendahl & Wagner, 2023).

The findings of this study align with previous research demonstrating that instructional videos significantly enhance procedural understanding and practical skills among learners (AlKahtani et al., 2025; Lin & Yu, 2023; Navarrete et al., 2023). Similar studies in vocational and technical education contexts have shown that multimedia resources, particularly those integrating visual and auditory elements, facilitate the acquisition of complex motor skills and improve the retention of procedural knowledge (Dantas et al., 2025; Vallecillo et al., 2025). In the automotive education domain, the use of modeling-based videos and step-by-step procedural tutorials has been reported to increase students' diagnostic and problem-solving competencies more effectively than traditional hands-on practice alone (Meier et al., 2024; Widjanarko et al., 2024). The present study further reinforces these empirical findings by demonstrating that instructional video not only improves procedural comprehension but also enhances students' readiness and confidence in performing wheel alignment tasks in a vocational workshop setting. Collectively, these results strengthen the evidence base supporting the integration of multimedia learning tools in vocational and technical education to optimize both cognitive understanding and practical skill development (AlKahtani et al., 2025; Navarrete et al., 2023).

The findings of this study can be theoretically justified through the lens of multimedia learning and observational learning theories. According to Mayer's Cognitive Theory of Multimedia Learning, the integration of visual and auditory channels facilitates cognitive processing by allowing learners to construct mental representations more effectively, thereby enhancing comprehension of complex procedures. Concurrently, Bandura's observational learning framework posits that individuals acquire skills and procedural knowledge by observing modeled behaviors and replicating them in practice. In the context of wheel alignment instruction, the instructional video simultaneously presents visual demonstrations and verbal explanations of each procedural step, enabling students to observe correct techniques, encode essential information through multiple cognitive channels, and subsequently apply these procedures during hands-on practice. This theoretical integration provides a coherent explanation for why video-based learning effectively supports both procedural understanding and practical readiness among vocational students.

The pedagogical implications of this study highlight the potential of instructional videos as a supportive medium for enhancing students' readiness prior to engaging in practical activities in vocational high schools (SMKs). By providing a structured, visual demonstration of procedural steps, video-based learning allows students to familiarize themselves with workshop tasks before hands-on practice, thereby reducing cognitive load and increasing confidence in performing complex procedures. Moreover, instructional videos offer a practical solution to the common constraints faced in SMK workshops, including limited access to equipment, restricted practice time, and variability in teacher supervision. By enabling repeated observation and self-paced review, videos can extend learning opportunities beyond the physical and temporal limitations of the workshop, ensuring that all students achieve a minimum level of procedural competence and preparedness before actual practice sessions.

This study has several limitations that should be acknowledged. Primarily, the use of a one-group pretest–posttest design limits the ability to control for potential confounding variables and may reduce the internal validity of the findings. Consequently, causal inferences regarding the effectiveness of instructional video for enhancing procedural understanding and practical readiness should be interpreted with caution. To address these limitations, future research is recommended to employ experimental designs incorporating control groups, which would allow for more rigorous comparisons and stronger causal conclusions. Additionally, subsequent studies could extend the investigation to other vocational

contexts and competencies, evaluating the generalizability of video-based instructional interventions across diverse technical skills and educational settings. Such research would provide more comprehensive evidence on the applicability and effectiveness of multimedia learning in vocational education.

CONCLUSION AND SUGGESTIONS

The findings of this study demonstrate that the use of instructional video media significantly improved students' procedural learning outcomes in wheel alignment practice. The substantial increase in the mean score from pretest to posttest indicates that video-based instruction effectively supported the development of students' procedural competence in performing alignment procedures. Moreover, the reduction in the standard deviation and the predominance of medium and high N-Gain categories suggest that the improvement occurred consistently across most students, indicating a more equitable distribution of procedural competence within the cohort. These results imply that the instructional video provided a clear and structured representation of technical procedures, enabling students to observe and understand the sequential workflow before engaging in hands-on practice in the workshop.

From a pedagogical perspective, the findings highlight the important role of instructional videos as a preparatory learning medium in vocational education. By integrating visual demonstrations, verbal explanations, and structured procedural sequences, video-based learning facilitates the construction of accurate mental models of technical operations and enhances students' readiness for practical tasks. Consequently, students are able to perform workshop activities with greater confidence and procedural accuracy.

REFERENCES

AlKahtani, R., Alnufaiy, B., Albaijan, R., Alnafaiy, S., Elfakhri, F., & Aljudaibi, S. (2025). Comparing the efficacy of live vs. video instructional demonstrations in dental education: a systematic review and meta-analysis. *BMC Medical Education*, *25*. https://doi.org/10.1186/s12909-025-06672-3

Alkattan, R., & Alreshaid, L. (2025). The Effectiveness of Live and Prerecorded Video Demonstrations in Teaching Restorative Dentistry to Undergraduate Students: Cohort Study. *JMIR Formative Research*, *9*. https://doi.org/10.2196/74383

Arqub, S. A., Al-Shehri, N., Meyer, S., Asefi, S., & Al-Moghrabi, D. (2024). The Effectiveness of Technology-Enhanced Learning in Prosthodontic Education: A Systematic Review. *European Journal of Dental Education : Official Journal of the Association for Dental Education in Europe*. https://doi.org/10.1111/eje.13035

Ba, S., Zhan, Y., Huang, L., & Lu, G. (2025). Investigating the Impact Of <scp>ChatGPT</Scp> -assisted Feedback on the Dynamics and Outcomes of Online Inquiry-based Discussion. *British Journal of Educational Technology*, *56*(5), 1710–1734. https://doi.org/10.1111/bjet.13605

Crețu, R., Țuțui, D., Banţa, V., Șerban, E. C., Barna, L.-E.-L., & Crețu, R. (2024). Effects of Artificial Intelligence-Based Technologies Implementations on the Skills Needed in the Automotive Industry A Bibliometric Analysis. *Amfiteatru Economic*. https://doi.org/10.24818/ea/2024/67/801

Dahalan, F., Alias, N., & Shaharom, M. (2023). Gamification and Game Based Learning for Vocational Education and Training: A Systematic Literature Review. *Education and Information Technologies*, 1–39. https://doi.org/10.1007/s10639-022-11548-w

Dantas, I., Jorge, I., Nicolau, A., Vales, M., Coutinho, C., Rodrigues, S., Febra, P., Lopes, V., Highlight, S., Ani, A. Prof. H., & Porto, Portugal. (2025). Video-based learning for basic surgical skills - A randomized trial. *Surgery Open Science*, *26*, 94–106. https://doi.org/10.1016/j.sopen.2025.05.003

Das, R. K., Hossain, Md. A. M., Islam, Md. T., Banik, S., & Hafez, Md. G. (2024). Effects of Front Total Toe-In Angle on Tire Wear and Emissions for a Light-Duty Vehicle. *Journal of Engineering*. https://doi.org/10.1155/2024/5723254

Dervisbegovic, S., Laky, M., Tur, D., Grundnig, J., Rausch-Fan, X., Moritz, A., & Holzinger, A. (2025). Educational videos as a teaching approach to enhance dental students' practical skills in preclinical courses. *BMC Medical Education*, *25*. https://doi.org/10.1186/s12909-025-07807-2

Hamzah, N. R., Hanid, M. F. A., & Zakaria, M. I. (2025). The effect of segmented-interactive video demonstration on student performance in procedural skills among healthcare students. *Advances in Health Sciences Education : Theory and Practice*. https://doi.org/10.1007/s10459-025-10471-2

Iliescu, D., Greiff, S., & Ion, A. (2025). Evidence based approaches for enhancing vocational education worldwide. *NPJ Science of Learning*, *10*. https://doi.org/10.1038/s41539-025-00317-2

Inderanata, R. N., & Sukardi, T. (2023). Investigation study of integrated vocational guidance on work readiness of mechanical engineering vocational school students. *Heliyon*, *9*. https://doi.org/10.1016/j.heliyon.2023.e13333

Kimura, R., Matsunaga, M., Barroga, E., & Hayashi, N. (2023). Asynchronous e-learning with technology-enabled and enhanced training for continuing education of nurses: a scoping review. *BMC Medical Education*, *23*. https://doi.org/10.1186/s12909-023-04477-w

Lin, Y., & Yu, Z. (2023). A Meta-analysis Evaluating the Effectiveness of Instructional Video Technologies. *Technology, Knowledge and Learning*, *29*, 2081–2115. https://doi.org/10.1007/s10758-023-09669-3

McGrath, S., & Yamada, S. (2023). Skills for development and vocational education and training: Current and emergent trends. *International Journal of Educational Development*. https://doi.org/10.1016/j.ijedudev.2023.102853

Meier, J., Hesse, P., Abele, S., Renkl, A., & Glogger-Frey, I. (2024). Video-based modeling examples and comparative self-explanation prompts for teaching a complex problem-solving strategy. *J. Comput. Assist. Learn.*, *40*, 1852–1870. https://doi.org/10.1111/jcal.12991

Morgado, M., Botelho, J., Machado, V., Mendes, J., Adesope, O., & Proença, L. (2024). Video-based approaches in health education: a systematic review and meta-analysis. *Scientific Reports*, *14*. https://doi.org/10.1038/s41598-024-73671-7

Murtaza, M., Cheng, C.-T., Fard, M., & Zeleznikow, J. (2024). Transforming Driver Education: A Comparative Analysis of LLM-Augmented Training and Conventional Instruction for Autonomous Vehicle Technologies. *International Journal of Artificial Intelligence in Education*, *35*, 736–773. https://doi.org/10.1007/s40593-024-00407-z

Navarrete, E., Nehring, A., Schanze, S., Ewerth, R., & Hoppe, A. (2023). A Closer Look into Recent Video-based Learning Research: A Comprehensive Review of Video Characteristics, Tools, Technologies, and Learning Effectiveness. *International Journal of Artificial Intelligence in Education*, *35*, 1631–1694. https://doi.org/10.1007/s40593-025-00481-x

Prasshanth, C., & Vaithiyanathan, S. (2024). Tire wear monitoring using feature fusion and CatBoost classifier. *Artificial Intelligence Review*, *57*. https://doi.org/10.1007/s10462-024-10999-6

Reyna, J., Hanham, J., & Meier, P. (2017). A taxonomy of digital media types for Learner-Generated Digital Media assignments. *E-Learning and Digital Media*, *14*(6). https://doi.org/10.1177/2042753017752973

Rosendahl, P., & Wagner, I. (2023). 360° videos in education – A systematic literature review on application areas and future potentials. *Education and Information Technologies*, 1–37. https://doi.org/10.1007/s10639-022-11549-9

Schriek, S., Berthold, K., & Hefter, M. (2025). Retrospective Focus Prompts Facilitate Learning From Video Tutorials for Technical Apprenticeship. *Applied Cognitive Psychology*. https://doi.org/10.1002/acp.70049

Stareček, A., Babeľová, Z., Vraňaková, N., & Jurík, L. (2023). The impact of Industry 4.0 implementation on required general competencies of employees in the automotive sector. *Production Engineering Archives*, *29*, 254–262. https://doi.org/10.30657/pea.2023.29.29

Vallecillo, Y., Visitacion, K., Dyer, E., & Hockman, A. (2025). Video-Based Interventions for Teaching Individuals With Disabilities Employment Skills: A Systematic Review. *Psychology in the Schools*, *62*. https://doi.org/10.1002/pits.70033

Widjanarko, D., Khumaedi, M., Kurniawan, A., & Santosa, T. (2024). Effectiveness of Question-Based Instructional Video (QBIV) for an Automotive Engineering Study Program. *Int. J. Emerg. Technol. Learn.*, *19*, 56–66. https://doi.org/10.3991/ijet.v19i03.47785

Wismansyah, A., Kadir, A. R., Baja, S., & Amar, M. Y. (2024). Sustainable vocational education models for industrial revolution role in development of job market absorption in Tangerang City, Indonesia. *Journal of Infrastructure, Policy and Development*. https://doi.org/10.24294/jipd.v8i6.3958

Xu, T., Liu, Y., Jin, Y., Qu, Y., Bai, J., Zhang, W., & Zhou, Y. (2024). From recorded to AI-generated instructional videos: A comparison of learning performance and experience. *British Journal of Educational Technology*. https://doi.org/10.1111/bjet.13530

Yu, H.-C., Hsueh, T.-J., Wu, T.-Y., Liu, C., Liao, C.-W., & Fu, Y.-K. (2025). A Competency Framework for Electric Vehicle Maintenance Technicians: Addressing the Environmental, Social, and Governance (ESG) Imperatives of the BEV Industry. *World Electric Vehicle Journal*. https://doi.org/10.3390/wevj16060314

Yusop, S. R., Rasul, M., Yasin, R. M., & Hashim, H. (2023). Identifying and Validating Vocational Skills Domains and Indicators in Classroom Assessment Practices in TVET. *Sustainability*. https://doi.org/10.3390/su15065195

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