

Validity and practicality of educational videos on the use of oscilloscopes in FI motorcycles

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Abstract

This research developed a rigorously validated and highly practical instructional video that illustrated the operation of an Oscilloscope on fuel-injected (FI) motorcycles for incorporation into vehicle testing curricula. The production followed the Multimedia Development Life Cycle (MDLC) framework, advancing systematically through six stages: concept, design, material acquisition, production, trial, and distribution. The final video consisted of eight sequential modules that covered all essential procedures ignition, autaset, sensor measurement, data interpretation. Validation by three subject matter experts yielded a content validity index (CVI) of 0.93 and a media validity index (MVI) of 0.92, both indicating “highly valid.” Practicality assessments involving three lecturers and forty-seventh students produced scores of 91.56 % and 86.07 %, respectively, surpassing the 80 % adequacy threshold. These results confirmed that the video was accurate, well structured, and readily deployable in authentic instructional settings. Moreover, the findings corroborated existing literature that well-designed, interactive video-based media enhanced learner engagement, comprehension, and performance. By addressing a previously unmet need for a dedicated oscilloscope instructional resource in FI motorcycle contexts, this study contributed a novel, evidence-based multimedia tool poised to improve automotive education across both academic and vocational training environments.

Keywords

Validity, Practicality, Educational video, Oscilloscope, FI motorcycle

Introduction

The use of video as an instructional medium confers the benefit of concurrently delivering audio visual cues, thereby fostering a learning environment that is more vivid, immersive, and engaging. Empirical evidence demonstrates that the synergistic pairing of dynamic visual imagery with complementary sound enhances learners' attentional focus, motivational levels, and autonomous comprehension of conceptual material, owing to the capacity for repeated viewing and the adjustment of playback speed to

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suit individual learning tempos (Riyana, 2007; Brame, 2015). Within flipped classroom and blended learning frameworks, Buchner (2018) underscores the necessity of meticulously crafted educational videos that guide learners' focus, curtail extraneous distractions, and integrate coherent narration, aesthetically refined visuals, and interactive elements designed to provoke critical thinking, consequently reinforcing both conceptual understanding and skill acquisition.

Empirical investigations consistently affirm the efficacy of interactive video. Priyakanth et al. (2021) demonstrated that embedding H5P based videos within a learning management system heightened both engagement and analytical competence among 120 engineering undergraduates, as measured through quizzes and Bloom taxonomy aligned questions. Likewise, Aisyah S. et al. (2023) reported that for a cohort of 40 students enrolled in an online menswear design course, the mean score rose from 73.00 to 85.57 following the integration of tutorial videos, a difference that reached statistical significance ($p = 0.000$). Collectively, these findings substantiate that video, particularly when rendered interactive and seamlessly integrated into digital learning environments, constitutes a potent medium for augmenting learner motivation, participation, and academic performance in contemporary education.

In line with the above theory, the researcher conducted interviews related to video teaching materials with lecturers teaching the Vehicle Testing course in the Department of Automotive Engineering. From these interviews, it was found that there were no teaching materials in the form of special educational videos in the Department of Automotive Engineering on the use of gas analysers during practical sessions. To analyse the above findings, the researcher conducted a survey as a pre-research observation related to measuring students' knowledge of Oscilloscopes on FI Motorcycles. The results showed that 63.5% of students had never used oscilloscope. The survey results also showed that 98.4% of students were interested and felt that educational videos on the use of Oscilloscopes on FI Motorcycles would be helpful.

An oscilloscope is a fundamental measurement instrument employed to visualize electrical signals through graphical representation of voltage variations over time, with a display comprising eight vertical and ten horizontal divisions (div) subdivided into five strips of 0.2 units each (Alfanz, 2023). As an essential analytical instrument in electronics laboratories for determining critical signal parameters including frequency, amplitude, peak-to-peak voltage, and waveform morphology (Arianto & Suryantoro, 2024), oscilloscopes support the development and validation of energy efficiency optimization strategies and exhaust emission reduction methodologies through real-time monitoring of Electronic Fuel Injection (EFI) system parameters (Meetam et al., 2022; Ganesan et al., 2023). In advanced research involving low-pressure direct fuel injection systems for two-stroke engines, oscilloscopes enable real-time monitoring of electronic control signals to verify proper functionality of customized fuel injection control units and facilitate precise verification of fuel injection timing and duration through utilization of inductive sensor signals mounted on the crankshaft as temporal reference points (Gutiérrez et al., 2024). This capability ensures successful integration of fuel supply circuit modifications and enables comparative performance evaluation between newly developed and original fuel injection systems, making oscilloscopes indispensable diagnostic tools for automotive applications.

Fuel injection (FI) systems in motorcycles represent a technological advancement over traditional carburetors by employing electronically controlled fuel delivery, governed by an Electronic Control Unit (ECU). The ECU processes real-time data from sensors

monitoring engine temperature, intake manifold pressure, throttle position, and oxygen levels, then precisely calculates and delivers the optimal fuel amount into the intake manifold or combustion chamber via fuel injectors (Purwanto et al., 2024; Purwanto et al., 2025; Firmansyah et al., 2025). This precision-based approach significantly enhances combustion efficiency, reduces fuel consumption, and minimizes emissions through more complete and controlled combustion processes (Sharma & Agarwal, 2019; Hanifuddin et al., 2023). Research by Mokhtar et al. (2024) reported fuel savings of up to 15% compared to carbureted motorcycles, while increased injection pressure improves fuel atomization, resulting in higher engine power output and a more favorable air-fuel ratio (Sulistyo et al., 2023).

Method

This study falls within the category of research and development (R&D), a methodological approach specifically designed to generate an innovative product while simultaneously evaluating its effectiveness and practical utility (Sugiyono, 2018; Maksum, H., & Purwanto, W., 2022). The research employed the Multimedia Development Life Cycle (MDLC) model, originally proposed by Luther-Sutopo, which comprises six systematic stages (Figure 1): (1) Concept: defining learning objectives, identifying target users (students of automotive engineering), and specifying the scope of material (oscilloscope usage). (2) Design: preparing storyboards, flowcharts, and interface design of the video. (3) Material Collection: gathering theoretical references, technical manuals, images, and video recordings related to fuel-injected motorcycle systems. (4) Assembly: integrating text, narration, animation, and video into a complete multimedia product using video editing software. (5) Testing: conducting expert validation by automotive lecturers and small-scale trials with selected students to identify weaknesses. (6) Distribution: finalizing and presenting the video to the target users as a learning medium (S. L. Rahayu, 2019; H. Makaborang & A. C. Talakua, 2023; Qasadina, A. M., dkk., 2024).

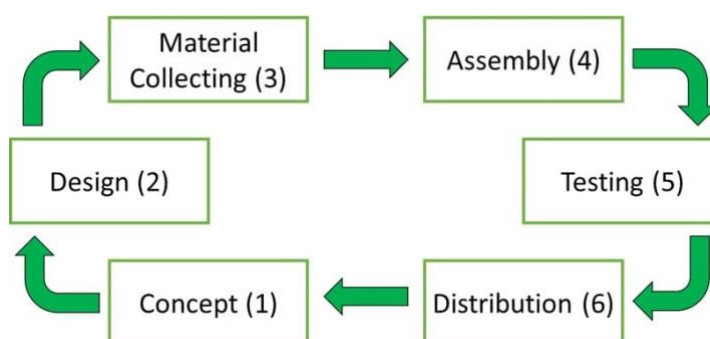


Figure 1. Multimedia development life cycle (MDLC) model

The primary output of this research is an educational video focused on the proper usage of oscilloscopes in fuel-injected motorcycle systems. The research was conducted from March to May 2024 at the Department of Automotive Engineering, Faculty of Engineering, Padang State University. The subjects involved two groups: (a) three expert lecturers specializing in automotive technology, who served as validators for the

content and media, and (b) 30 undergraduate students of automotive engineering, who acted as users for practicality testing.

The practicality questionnaire was developed to gauge the perceived usability and feasibility of the educational video as a learning tool from the perspectives of both subject matter experts and end users. Specifically, it was administered to expert lecturers in the field and undergraduate students specializing in automotive engineering. A detailed breakdown of the validity questionnaire framework is presented in Table 1, while the practicality questionnaire framework is shown in Table 2. Both the validity and practicality questionnaires utilized a Likert-scale rating system, with response options ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), ensuring quantitative data collection for robust statistical analysis.

Table 1. Validity questionnaire framework (content and media dimensions)

Content Validity		Media Validity	
Indicator	Items	Indicator	Items
Technical Accuracy	3	Visual Quality	4
Completeness of Content	3	Audio Quality	4
Relevance of Material	3	Presentation Structure	4
Learning Motivation	3	Video Duration	4
		Visual Appeal	4

Table 2. Practicality questionnaire framework (experts and students)

Indicator		Items
Lectures	Students	
Ease of Use	Accessibility	3
Content Suitability	Ease of Comprehension	3
Video Duration	Video Duration	3
Supporting Facilities	Technical Quality	3
Student Motivation	Learning Motivation	3

This study will employ Aiken’s formula to conduct the validity analysis of the developed multimedia material. The data collected from the content- and media-validation judges will be entered into the formula, allowing the researcher to quantify the validity level of the instructional video (Azwar, 2014). The specific computation employed is presented in Equation 1. According to the established criterion, a validity index exceeding 0.60 is regarded as acceptable for both content and media dimensions; the resulting classification is displayed in Table 3.

$$V = \frac{\sum s}{[n(c-1)]} \tag{1}$$

Where:

- V = Aiken’s validity coefficient,
- S = r – lo
- r = rating given by the validator
- lo = lowest possible rating
- c = highest possible rating
- n = Total Number of validators

$$\text{Percentage} = \frac{\sum \text{obtained score}}{\sum \text{maximum score}} \times 100\% \quad (2)$$

Table 3. Validity Categories

Validity Range	Classification
0.61-1.00	Valid
<0.60	Not valid

Tabel 4. Practicality Categories

Achievement Level (%)	Practicality Category
90 – 100	Highly practical
80 – 89	Practical
65 – 79	Moderately practical
55 – 64	Slightly practical
0 – 54	Not practical

Meanwhile, the practicality analysis uses percentage calculations based on the Likert scores from students and lecturers. The percentage results are then categorized according to Table 4, allowing interpretation of whether the product can be considered practical as a learning medium. Both analyses are carried out using Microsoft Excel to ensure accuracy and efficiency in data processing.

Results and discussion

The research produced an educational video as a pedagogical artifact. The development process followed the Multimedia Development Life Cycle (MDLC), which consists of six sequential stages: concept, design, material collection, production, pilot testing, and distribution. Based on a systematic needs analysis, the final video was structured into eight coherent sections: opening, introduction to the oscilloscope, ignition and auto set procedure, explanation of equipment and materials, instal probe and parameter settings, oxygen sensor measuring, diagnosis of the results, and closing. Detailed explanations of each section are provided in the figures and descriptions below.

The opening segment (Figure 2) introduces the presenter and states the video's topic, lasting 1 minutes 23 seconds. The subsequent portion (Figure 3) details the oscilloscope's display screen, buttons, knob, probe, and connector, with a duration of 1 minutes. Figure 4 explains the location of the power-switch and connector, demonstrates the ignition procedure, and describes the autosest process, occupying 2 minutes 48 seconds. Figure 5 provides an overview of the tools and materials employed, alongside the associated occupational-safety precautions, for 1 minute 39 seconds.



Figure 2. Video opening



Figure 3. Introduction to the components of the oscilloscope



Figure 4. Ignition and autoset process



Figure 5. Explanation of tools and materials



Figure 6. Instal probe on o2 sensor and parameter settings (oxygen sensor measuring)



Figure 7. Analysis of O2 sensors signals (oxygen sensor measuring)

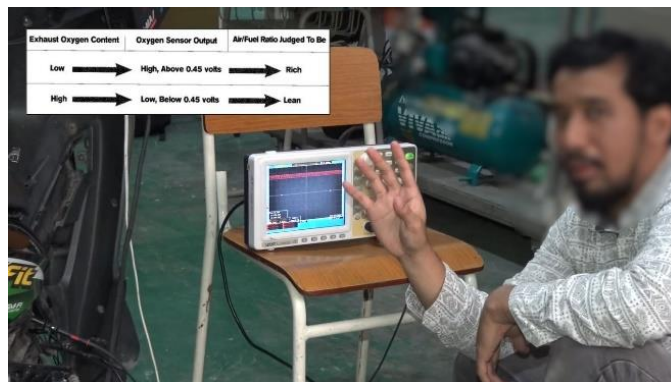


Figure 8. Diagnosis of test results

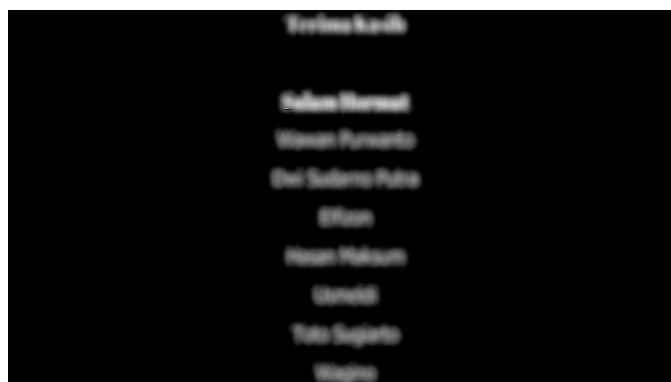


Figure 9. Video closing

Figure 6 outlines instal probe on oxygen sensors and setting parameter volt/div and second/div, spanning 2 minutes 30 seconds. Figure 7 discusses analysis the measure of oxygen sensor signal: voltage mean, voltage min, voltage max, and another parameter, lasting 2 minutes 30 seconds. Figure 8 describes the diagnosis of signal, compare with standard of oxygen sensor output, lasting 3 minutes. Finally, Figure 9 presents the video’s conclusion, summarizing the practical-session workflow, delivering closing remarks, and displaying the video credits, with a total runtime of 2 minutes 10 seconds.

Based on the data presented in Table 5, the assessment conducted by three validators of the educational video on the application of an oscilloscope for fuel-injected (FI) motorcycles resulted in a content-validity index of 0.93 and a media-validity index of 0.93. These scores fall within the accepted range for validity, indicating that the video is both valid and appropriate for use as a learning resource. The validity of the instructional material and the media are illustrated in Figures 10 and 11, respectively.

Table 5. Result of Validity

Validity of Educational Video						
Dimension	Validator			ΣS	V	Classification
	1	2	3			
Content Validity	5.00	4.33	4.83	11.17	0.93	Valid
Media Validity	4.45	4.85	4.75	11.05	0.92	Valid

Table 6. Result of Practicality

Responden	Practicality (%)	Classification
Lectures	91.56%	High Practical
Students	86.07%	High Practical

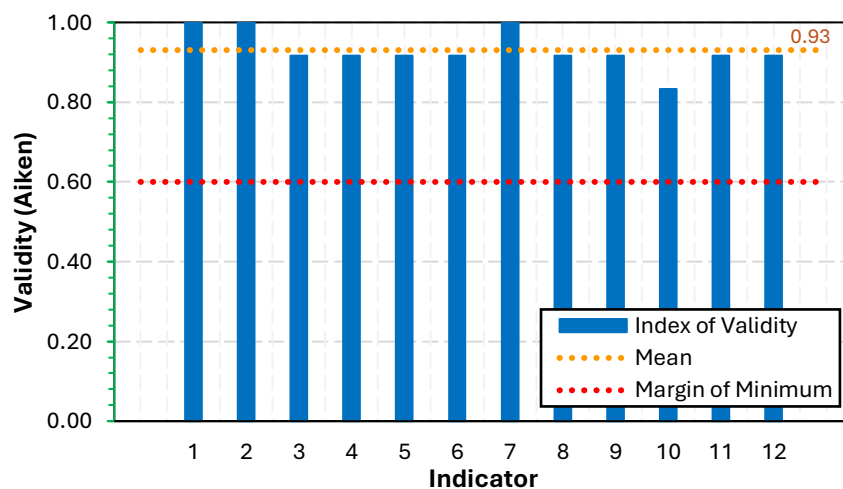


Figure 10. Content Validity

Based on Table 6, the practicality of the instructional video as perceived by faculty members registers a score of 91.56 %, whereas the perception of students yields a slightly higher score of 92.44 %. These figures collectively indicate that the video is highly practical and suitable for use as a learning resource. Moreover, the charts presented in

Figures 12 and 13 illustrate that all measured indicators received responses exceeding 80 %, further corroborating the video’s effectiveness and applicability.

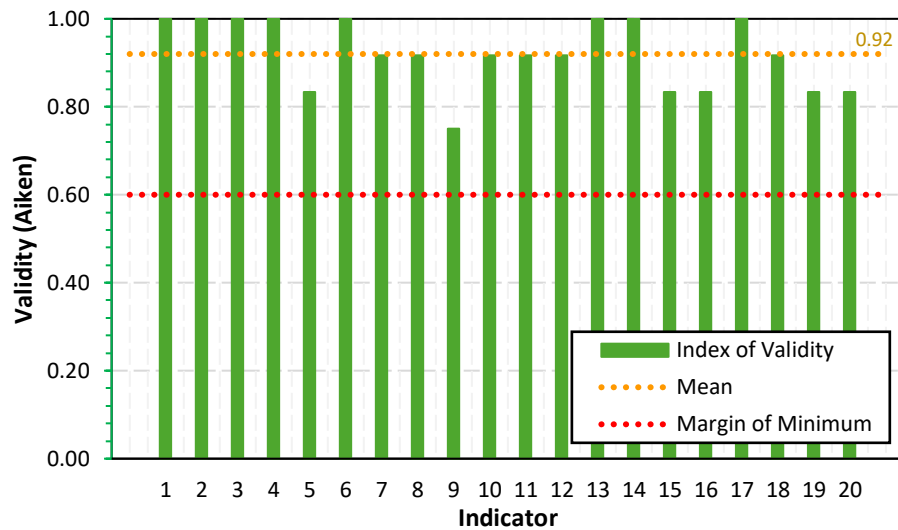


Figure 11. Media validity

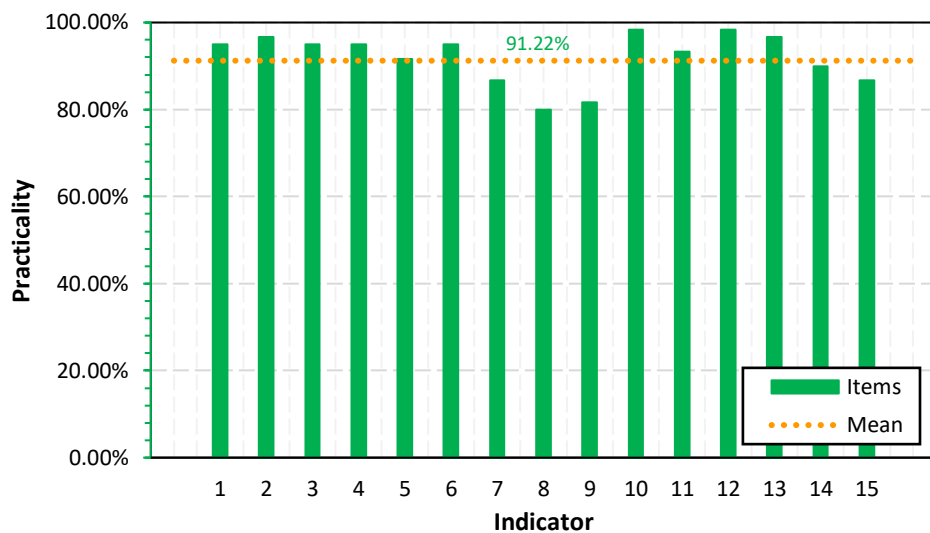


Figure 12. Lectures practicality

The aim of this study is to develop a validated and practical educational video that demonstrates the use of an oscilloscope on fuel-injected (FI) motorcycles for the vehicle-testing course. The video facilitates students’ learning of residential-installation practicum content because it can be accessed anytime and anywhere. The research adopts the Multimedia Development Life Cycle (MDLC) model, which comprises six phases: concept, design, material collection, production, trial, and distribution. Based on a needs-analysis, the instructional video was organized into eight sequential sections: (1) video opening, (2) introduction to the oscilloscope, (3) ignition and autotest procedures, (4) description of tools and materials, (5) parameter settings, (6) oxygen sensor measuring, (7) diagnosis of the results, and (8) video closing.

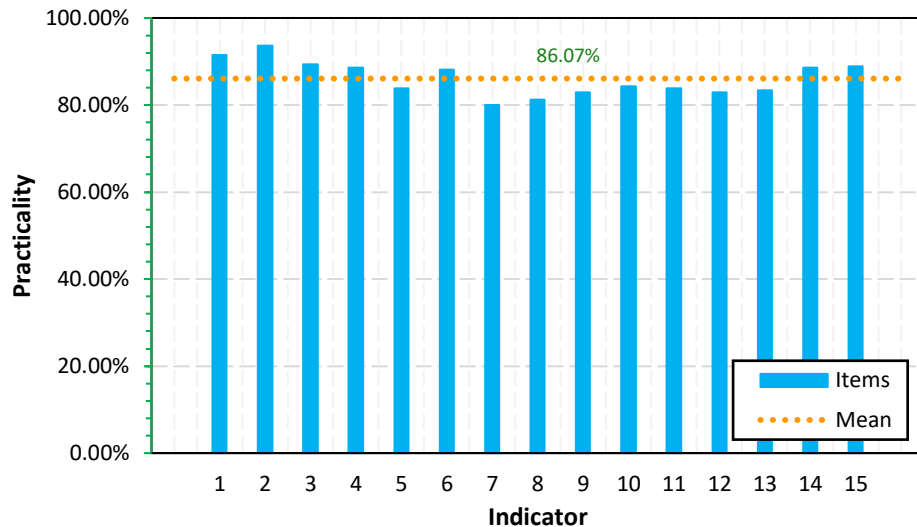


Figure 13. Students' practicality

The first evaluation concerned the video's validity, performed by experts in vehicle testing. Validity refers to measurement accuracy; a valid instrument must not only generate precise data but also provide an accurate representation of the underlying construct. Six faculty members assessed two aspects of validity content and media each with three expert raters. For content validity (12 indicators based on Table 1), the expert panel assigned a mean validity index of 0.93, categorised as highly valid. For media validity (20 indicators based on Table 2), the mean index was 0.92, also classified as highly valid. Consequently, the video can be declared highly valid for use in the vehicle-testing curriculum.

The second evaluation examined the video's practicality, involving both the course instructor(s) and the students who would employ the media during the residential-installation practicum. Practicability was measured with fifteen indicators. Lectures ($n = 3$) rated practicability at 91.56 %, indicating very high practicality, while automotive-engineering students ($n = 47$) provided a rating of 86.07 %, likewise denoting very high practicality. Thus, the video is regarded as exceptionally practical for instructional purposes.

These findings are consistent with previous studies demonstrating the effectiveness of validated video-based learning media for both students and educators. A pre-experimental study at Universitas Negeri Makassar reported a significant improvement in students' average scores from 73.00 to 85.57 ($p = 0.000$) after implementing online video tutorials (Aisyah et al., 2023). Likewise, Priyakanth et al. (2021) found that H5P based interactive videos integrated into a learning management system enhanced engineering students' engagement and analytical skills through Bloom taxonomy aligned assessments. Overall, these studies highlight the critical role of interactive elements in strengthening motivation and conceptual understanding.

Similarly, video tutorials implemented in the residential installation practicum of the Electrical Engineering program at Universitas Negeri Padang demonstrated strong

feasibility, achieving 90% content validity and practicality ratings of 95% from instructors and 84% from students (Qasadina A.M. et al., 2024). At the secondary level, Basyaev, Diens, and Kusumah Suwandi (2021) found that Video Based Learning with 432 eighth grade students significantly improved post test scores compared to traditional instruction. Comparable findings were reported in a primary school tennis tutorial study, which was considered valid, practical, and effective in improving student achievement (Riyanto A. and Yunani E., 2020).

Benkada and Moccozet (2017) further proved that adding teacher- or student-generated annotations to interactive videos boosts active engagement, material retention, and reduces the need for direct instructor intervention, especially in MOOCs, Khan Academy, and flipped-classroom settings. Buchner's (2018) design principles for educational videos attention control, distraction avoidance, compelling narration, engaging visuals, and cognitively stimulating interaction provide the theoretical foundation supporting these empirical outcomes. Altogether, the synthesized literature indicates that well-designed, interactive video learning media not only improve learning outcomes but also offer a versatile, scalable solution for diverse digital-learning contexts.

To date, no prior study has addressed the development of an educational video specifically for the operation of an oscilloscope on FI motorcycles an instructional artifact that combines procedural tutorials, interpretative guidance, and detailed annotations to facilitate student comprehension. The present video has been validated as highly valid in both content and media dimensions and has been judged very practical by both course instructors and students. Consequently, it represents a novel, evidence-based contribution to multimedia instructional resources for vehicle-testing education.

Conclusion

The educational video on the operation of an oscilloscope for fuel-injected motorcycles was developed using the Multimedia Development Life Cycle (MDLC) model and subjected to rigorous validation and practicality assessments. Content-validity (CVI = 0.93) and media-validity (MVI = 0.92) indices, derived from three expert validators, indicate that both the instructional material and its presentation meet the highest standards of scholarly validity. Practicality evaluations revealed high acceptance among both lecturers (91.56 %) and students (86.07 %), with all measured indicators exceeding the 80 % threshold, confirming that the video is readily usable in the residential-installation practicum. Consequently, the video can be regarded as a valid, highly practical multimedia resource, suitable for integration into the vehicle-testing curriculum to enhance learner outcomes and instructional efficiency.

Recommendation

The video should be integrated into the vehicle testing curriculum with brief follow-up quizzes, and its validity and practicality tested on larger samples of students (e.g., > 100 students) using pre-/post-tests to gauge learning gains. Expanding the content to other vehicle types and providing English subtitles will broaden its reach. Adding interactive elements (hotspots, simulations) and embedding the video in LMS platforms (Moodle, Canvas) can boost engagement and allow usage tracking. A small maintenance team should periodically update the material to reflect current standards, store revisions in a version-controlled repository, and publish the video on open platforms (e.g., YouTube Edu) under a Creative Commons license with low bandwidth options. Finally, conduct longitudinal studies to assess the video's impact on graduates' competence and employment outcomes, supporting further investment in automotive multimedia education.

Limitation

The study is constrained by several notable limitations. First, the validation and practicality assessments were performed with a modest convenience sample only three lecturers and twelve students thereby limiting the external validity and generalizability of the results. Second, the evaluation addressed solely content and media validity as well as perceived practicality, without measuring actual learning outcomes such as pre-test/post-test performance or skill acquisition. Third, the instructional video was designed exclusively for fuel-injected motorcycles, restricting its applicability to other vehicle categories or alternative instructional design models. Finally, no user-interaction analytics (e.g., viewing patterns, pause points) were collected, which hampers data-driven optimisation of the video's structure and pacing.

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