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Development of occupational health and safety multimedia to enhance learning interest in vocational automotive education

M. Syamsul Arifin^{*}, Ranu Iskandar, Samsudi Samsudi

Universitas Negeri Semarang, Semarang, Indonesia

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ABSTRACT

This study aimed to develop automotive occupational health and safety learning multimedia and examine changes in students' learning interest after its use. The study employed a research and development approach using the ADDIE model and a one-group pretest–posttest design involving 31 Grade 10 automotive engineering students. Data were collected using a 20-item learning interest questionnaire. Expert validation results indicated that the multimedia was highly feasible, with scores exceeding 87%. All questionnaire items were valid, with Cronbach's alpha values of 0.890 for the pretest and 0.843 for the posttest. The mean learning interest score increased from 70.03 to 86.61, with a normalized gain of 55.52%, categorized as moderate. A one-sample t-test showed that the posttest mean was significantly higher than the reference value of 70 ($p < 0.001$). These findings suggest that the multimedia has potential to support students' learning interest. However, the absence of a control group limits causal conclusions.



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Corresponding Author:

M. Syamsul Arifin,
Universitas Negeri Semarang,
Email: syamsularifin01@students.unnes.ac.id

Introduction

Learning interest is one of the important aspects in the learning process because it relates to the attention, interest, and involvement of students in understanding the material being studied (Linassari & Arif, 2022; Mohammad & Nur, 2025; Aisah et al., 2024). Students who have a learning interest tend to show attention to the material, participate in learning activities, and have a desire to deepen their understanding (Aprijal et al., 2020; Rahmasari, 2023; Lubis et al., 2024). Conversely, a lack of learning interest can be related to low attention and involvement of students during learning (Yakin, 2021; Tsabitah, 2025; Amalia, 2024). In the context of vocational education, attention to learning interest becomes important because learning is not only oriented toward knowledge mastery but also toward students' readiness to understand and apply work procedures in accordance with industry demands (Risqi et al., 2020). This is relevant in the learning of Occupational Health and Safety (OHS) in automotive, which requires students to understand potential hazards, safety procedures, and the use of personal protective equipment as part of the preparation for practical activities in automotive workshops (Wicaksono et al., 2026).

Automotive learning not only emphasizes the mastery of skills and technology but also the understanding of work procedures and the application of SOPs and K3 to form safe work attitudes and behaviors, as well as to prevent the risk of injuries and accidents in the workshop (Wahrini & Hasbi, 2021; Dayanti et al., 2021). K3 material covers various aspects, such as the introduction of potential hazards, causes of work accidents, the use

of Personal Protective Equipment (PPE), Work Safety Standard Operating Procedures (SOP), housekeeping and the 5R culture, emergency handling, and responsibilities in implementing the K3 culture. The application of work safety guidelines needs to be habituated by students during practical sessions in the workshop, considering that practical activities in the workshop have the potential risk of accidents that can occur due to negligence, non-compliance with SOPs, and the improper use of Personal Protective Equipment (PPE) (Afosma et al., 2023; Saputra & Guntur, 2022). These conditions indicate the need to enhance students' understanding of the K3 culture as a foundation for applying it in the workplace (Solikin, 2020). Therefore, the K3 learning process needs to be supported by students' interest in learning so that the material can be understood and applied optimally. Learning interest in this study is examined through several indicators, namely feelings of enjoyment, interest, attention, and student involvement in learning activities.

Learning media is highly needed in the learning process as an intermediary in conveying information or messages (Saputra & Guntur, 2022; Aisah et al., 2024). The use of multimedia in learning becomes one of the efforts to create a more engaging learning process. Multimedia allows the presentation of material through a combination of text, images, audio, video, animations, and interactive elements, making information delivery more concrete and engaging (Dwqi et al., 2020; Kamila et al., 2024; Mubaidilla, 2025). The use of multimedia is closely related to automotive K3 learning because it can clarify the delivery of material, increase student engagement, and visualize working conditions and safety procedures that are difficult to understand through verbal delivery (Khatimah, 2021). For example, the potential hazards in the workshop, the use of Personal Protective Equipment (PPE), the procedures for using Fire Extinguishers (APAR), actions during emergencies, and the implementation of a safety culture will be easier to understand when accompanied by images, videos, animations, and interactive activities. Thus, learning multimedia has the potential to create a more engaging learning experience and encourage student involvement during the learning process (Purbatua, 2020).

Based on the observations made during the Lantip 7 activities at SMK Negeri 5 Semarang, issues were found in the learning process related to students' interest in the automotive K3 material. In the learning activities, some students have not yet shown optimal attention and engagement with the material provided by the teacher. Learning that is still dominated by conventional material delivery limits students' opportunities to gain more varied learning experiences. This condition is evident from some students who pay less attention to the teacher's explanation, are less active in asking questions or discussing, and feel bored during the lesson. In addition, the characteristics of K3 material, which are partly conceptual and require real-life situational examples, necessitate media that can provide more concrete visualizations. This condition indicates the need for the development of learning media that can help create a more engaging K3 learning process and actively involve students.

Previous research shows that the use of multimedia in learning can contribute positively to students' interest in studying. According to Waruwu (2022), the use of interactive multimedia is effective in increasing students' interest and attention during learning after using interactive multimedia. This is in line with (Rahmasari et al., 2023; Muftizar et al., 2020; Gusmania & Agustyaningrum, 2022; Alparizi & Septari, 2026) which show that students' interest in learning increases after the implementation of multimedia-based learning. Before the use of multimedia, students' interest in learning was still relatively low, whereas after the implementation of multimedia, students' interest in participating in learning increased. Rachmawati's research (2024); Anita et al., (2026) shows that students' interest in learning through interactive multimedia-based learning is higher compared to before the use of multimedia. Nevertheless, research on the development of multimedia specifically focusing on automotive K3 introduction materials and aimed at increasing the learning interest of vocational high school students still needs further development.

Based on the description, this research aims to develop multimedia learning for the introduction of automotive K3 for 10th-grade Automotive Engineering students at SMK Negeri 5 Semarang and to determine the increase in students' interest in learning after using the developed multimedia. The developed learning multimedia is expected to serve as an alternative learning media that is engaging, interactive, and aligned with the characteristics of automotive learning in vocational schools. Additionally, this research is expected to contribute to the utilization of learning technology to support more contextual K3 learning, enhance student engagement, and foster interest in understanding and applying workplace safety principles in the automotive workshop environment.

Method

This research is a Research and Development (R&D) study aimed at producing multimedia learning for the introduction of automotive Occupational Safety and Health (OSH) and to determine changes in students' learning interest after using the developed multimedia (Grustan et al., 2026). The development model used is ADDIE, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation

(Risdianto et al., 2026; Fitriyah et al., 2021). This study uses a quantitative approach with a pre-experimental design in the form of a One-Group Pretest-Posttest Design. This design involves one group of subjects who are measured before and after the treatment without a control group (Wati et al., 2024). Therefore, score changes are used to illustrate changes in students' learning interest after the use of multimedia, while still considering the design limitations in controlling other factors that may affect the research results.

The research was conducted from July to August 2026 at SMK Negeri 5 Semarang with 31 subjects from the X 2 Automotive Engineering class. The research data consists of primary and secondary data. Primary data were obtained from expert validation sheets for content, media expert validation sheets, student learning interest questionnaires, and observations. Secondary data were obtained from books, journal articles, and other scientific sources relevant to the development of learning multimedia and automotive K3.

Multimedia Development Procedure

The development of learning multimedia is carried out using the ADDIE model, which includes five stages. In the Analysis stage, the identification of automotive K3 learning problems, the need for learning media, and student characteristics are conducted as the basis for product development (Johan et al., 2026). In the Design stage, the planning of learning objectives, the preparation of materials, the design of multimedia appearance, and the determination of text, image, animation, and video components to be used are carried out (Yani & Sapriati, 2026). In the Development stage, the design is realized into learning multimedia, which is then assessed through validation by subject matter experts and media experts to determine the feasibility of the material and the quality of the media (Fitriyah et al., 2021). The assessment results are used as a basis for product improvement if necessary.

At the Implementation stage, multimedia learning for automotive safety and health introduction was applied in learning activities involving 31 students from class X 2 Automotive Engineering. The implementation of the treatment took place over one week with a total of three meetings, each lasting 6 lesson hours (JP), making the total treatment encompass 18 JP. Before the use of multimedia, students were given a pretest in the form of a learning interest questionnaire to determine the initial condition of their learning interest. Subsequently, students participated in learning using the developed multimedia. After the entire treatment series was completed, students were given a posttest using a questionnaire with the same indicators to determine the condition of their learning interest after the use of multimedia (Ali et al., 2026).

In the Evaluation stage, a review of the product validation results and the data on learning interest before and after the use of multimedia is conducted. The data is analyzed to evaluate the feasibility of the product and to illustrate the changes in students' learning interest after the treatment (Yulianto, 2026).

Instruments and Data Collection Techniques

The data collection techniques used include questionnaires and observations. The research instruments consist of expert validation sheets for content, media, and student learning interest questionnaires. Product validation involves one content expert and one media expert. The content expert validation sheet is used to assess the relevance and quality of automotive K3 materials, while the media expert validation sheet is used to evaluate aspects of appearance, navigation, interactivity, and multimedia technical aspects.

The learning interest questionnaire consists of 20 statements covering five aspects, namely enjoyment (Play full), interest, attention, involvement, and desire to learn. The questionnaire uses a five-point Likert scale, namely strongly agree with a score of 5, agree with a score of 4, neutral with a score of 3, disagree with a score of 2, and strongly disagree with a score of 1. The questionnaire was administered before and after the treatment to obtain data on students' learning interest (Zainuddin, 2024).

Data analysis includes multimedia feasibility analysis by experts, instrument validity test, instrument reliability test, normality test, One-Sample t-test, and N-Gain test. Multimedia feasibility analysis is conducted based on the assessment of one content expert and one media expert. The feasibility percentage is calculated by comparing the obtained score with the maximum score, then multiplying by 100%. The feasibility percentage calculation uses the following formula:

$$P = \frac{\text{Score Obtained}}{\text{Maximum Score}} \times 100\%$$

The percentage results are interpreted based on the criteria (Mahesti & Koeswanti, 2021), namely very good (81%–100%), good (61%–80%), moderate (41%–60%), and poor (21%–40%). These criteria are used to determine the feasibility level of the developed learning multimedia. The validity of the questionnaire items was tested using the Product Moment correlation with the help of IBM SPSS Statistics version 25. The testing was conducted on 31 respondents with a table r value of 0.3550 at a significance level of 5% ($\alpha = 0.05$). An item

statement is considered valid if the calculated r value is greater than the table r value and the significance value is less than 0.05 (Liska et al., 2024).

The reliability test is conducted to determine the internal consistency of the research instrument. The instrument in the form of a questionnaire with a rating scale can be tested using the Cronbach's Alpha technique. Reliability testing is conducted on pretest and posttest data using IBM SPSS Statistics version 25. The instrument is considered to have good internal consistency if the Cronbach's Alpha value reaches at least 0.70. The test results are used to determine the internal consistency of the student learning interest questionnaire (Putra et al., 2022). The normality test is conducted to determine the data distribution that will be analyzed using parametric statistics. The testing is performed using the Shapiro–Wilk method with the assistance of IBM SPSS Statistics version 25 because the number of respondents is less than 50. Data is considered normally distributed if the significance value is greater than 0.05, while a significance value less than or equal to 0.05 indicates that the data does not meet the normality criteria. The normality test is adjusted according to the data used in each statistical analysis (Rosya, 2023).

One-Sample t-test is used to test whether the average posttest scores of students' learning interest significantly differ from the predetermined reference value (Armaijn et al., 2024). This test compares the average of a single sample with a reference value, rather than directly comparing the pretest and posttest averages. Therefore, its interpretation is limited to the difference in the posttest average against the reference value used. The N-Gain test is used to measure the extent of the increase in learning interest scores between the pretest and posttest after the use of learning multimedia, referring to (Rachmawati and Kusmiyati 2024). The N-Gain calculation is performed using the formula:

$$g = \frac{\text{Score Posttest} - \text{Score Pretest}}{\text{Score Maximal} - \text{Score Pretest}}$$

The N-Gain results are interpreted based on the category of high if $g > 0.70$, medium if $0.30 < g < 0.70$, and low if $g < 0.30$. The calculation results are used to describe the level of improvement in students' learning interest scores after the treatment. The one-group pre-experimental design used in this study does not involve a control group. Thus, changes in learning interest scores may be related to the use of multimedia, but the influence of other factors, such as student maturation, experience during the study, and the effects of repeated measurements, cannot yet be fully ruled out. These limitations are taken into account in the interpretation of the research results.

Results and Discussions

The results of the research on the development of multimedia learning for automotive K3 introduction are presented based on the stages of the ADDIE model, which consists of five stages, as follows:

Analyze

The analysis stage is conducted to identify learning problems, learning objectives, student characteristics, the availability of facilities and infrastructure, as well as multimedia display preferences. The results of the observation indicate that automotive K3 learning still tends to be conventional and the use of learning media is not yet optimal. Some students also experience boredom, resulting in suboptimal attention and engagement in learning. The analysis of learning objectives establishes the scope of the material, which includes K3 concepts, hazard identification, accident causes, the use of personal protective equipment (PPE), the application of SOP and 5S, emergency handling and first aid, as well as K3 culture. From the aspect of facilities and infrastructure, computers or laptops and projectors are available to support multimedia use, but the K3 materials used are still limited. Meanwhile, the results of the display preference questionnaire show that students prefer a gray theme, Times New Roman font, and black font color. These findings serve as the basis for developing multimedia that integrates text, images, animations, and videos to support students' understanding of K3 concepts and procedures in automotive workshops.

Design

The design stage includes the collection of materials and the design of multimedia learning. The collection of materials includes relevant content, images, and videos related to the eight automotive K3 topics, namely the definition of K3, potential hazards in automotive workshops, causes of workplace accidents, personal protective equipment (PPE), workshop safety SOPs, housekeeping and the 5R culture, emergency response, as well as the K3 culture and student responsibilities. The materials and images were obtained from the official website of the Ministry of Manpower of the Republic of Indonesia, specifically e-training.kemnaker.go.id, jdih.kemnaker.go.id, and kclc.kemnaker.go.id. Demonstration videos on the use of fire extinguishers (APAR) were obtained from the GuardALL Fire Protection YouTube channel and used as supporting media for emergency response material. The materials that have been collected are then organized into a learning

multimedia using the Microsoft PowerPoint application. The design began with the preparation of a product content diagram and a storyboard to illustrate the flow of the material, navigation, and multimedia display. The results of the storyboard design are shown in Figure 1.

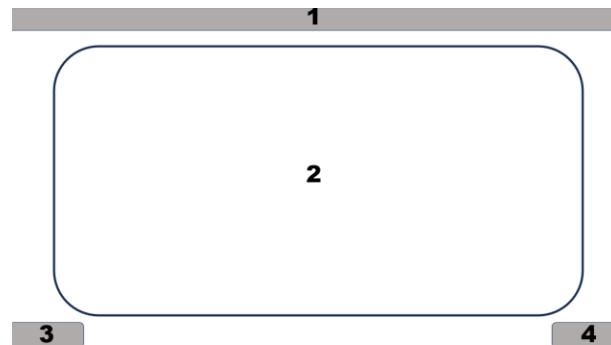


Figure 1. Storyboard for multimedia learning on automotive K3

Development

The development stage produced multimedia learning for automotive K3 introduction that integrates text, images, animations, and videos into eight topics, namely the definition of K3, potential hazards in automotive workshops, causes of work accidents, personal protective equipment (PPE), workshop safety SOP, housekeeping and 5S culture, emergency handling, and K3 culture and student responsibilities. The product developed using Microsoft PowerPoint was subsequently validated by one media expert and one content expert to evaluate its feasibility before being implemented to students (Sodsai et al., 2026).

The validation results show that the multimedia received a very good category from both validators. The media expert's assessment yielded a percentage of 87–100% across all evaluated aspects, while the content expert's assessment yielded a percentage of 95–100%. These results indicate that the aspects of appearance, navigation, multimedia presentation, as well as the completeness and comprehensibility of the material have met the feasibility criteria used in this study.

Although it received a very good category, the product was still revised based on the validators' feedback. The revisions include enhancements to the content and multimedia appearance to improve the product's alignment with the learning objectives. The changes made are shown through a comparison of the appearance before and after the revision in Table 5.

Table 1. Improvement results from material experts and media experts

Recommendations	Before	After
The addition of questions to the material presented.		
Change the font to Calibri.		
Add the word "exercise" to each question.		

Recommendations	Before	After
Add a congratulations page and click the check icon to continue.		

Implementation

The implementation stage is carried out to determine the change in students' learning interest after using multimedia learning for automotive K3 introduction, which has been validated by media and subject matter experts. The implementation involved 31 students from the X Automotive Engineering class at SMK Negeri 5 Semarang. The measurement of learning interest was conducted using a questionnaire before (pretest) and after (posttest) learning with multimedia.

Table 2. Results of Multimedia Learning Implementation

Statistik	Pretest	Posttest
Jumlah siswa	31	31
Rata-rata	70,03	86,61
Standar deviasi	7,55	6,04
Skor minimum	53	74
Skor maksimum	83	99

The results of the descriptive analysis show that the average student interest score increased from 70.03 on the pretest to 86.61 on the posttest. The standard deviation decreased from 7.55 to 6.04, indicating that the spread of posttest scores was smaller compared to pretest scores. In addition, the minimum score increased from 53 to 74, while the maximum score increased from 83 to 99. These results indicate an increase in students' learning interest scores after the use of automotive K3 multimedia learning. The level of improvement was further analyzed using N-Gain during the evaluation stage.

Evaluation

The validity test of the instrument was conducted using the Pearson Product Moment correlation with a total of 31 respondents and an r-table value of 0.3550 at a 5% significance level. The test results showed that all 20 items in the pretest and posttest instruments had calculated r-values greater than the r-table, with pretest r-values ranging from 0.4177 to 0.7555 and posttest r-values ranging from 0.3832 to 0.7303. Thus, all statement items are declared valid and can be used to measure students' learning interest.

Next, the reliability test was conducted using the Cronbach's Alpha method to determine the consistency of the research instrument. The test results showed a Cronbach's Alpha value of 0.8897 for the pretest instrument and 0.8429 for the posttest instrument. Both values are greater than 0.700, indicating that the instrument is reliable and has good internal consistency.

The normality test was conducted using the Shapiro-Wilk method to determine the distribution of the research data. The test results show a pretest significance value of 0.4264, a posttest value of 0.8144, and an N-Gain value of 0.6922. All significance values are greater than 0.05, so the data are declared to be normally distributed.

Hypothesis testing was conducted using a One-Sample t-test with a comparison value of 70. The analysis results showed a posttest average score of 86.61, with a t-value of 15.3217 and a significance $p < 0.001$. The t-value was greater than the t-table value of 2.0423, indicating that the average posttest score was significantly higher than the established comparison value. These results indicate that the average student interest scores after using multimedia exceeded the benchmark value.

Next, the N-Gain test was conducted to determine the extent of the increase in students' learning interest after using multimedia learning. Based on the N-Gain category criteria according to Rachmawati and Kusmiyati (2024), an average N-Gain of 0.5552 or 55.52% was obtained, rounded to 56%. This value falls into the moderate category with a fairly effective level of effectiveness. These results indicate that the increase in students' interest in learning after using automotive K3 multimedia learning falls into the moderate category.

These findings are in line with previous research that shows the use of multimedia in learning can positively contribute to students' interest in studying. Waruwu (2022) reported that the use of interactive multimedia can

increase students' interest and attention. These findings are also in line with the research of (Rahmasari et al. 2023; Muftizar et al. 2020; Gusmania and Agustyaningrum 2022), as well as Alparizi and Septari (2026), which show an increase in student learning interest after the implementation of multimedia-based learning. Additionally, the research by Rachmawati (2024) and Anita et al. (2026) shows that interactive multimedia-based learning is associated with higher student interest compared to before the use of multimedia.

The increase in learning interest in this study is suspected to be related to the characteristics of the developed multimedia, which integrates text, images, animations, and videos to present automotive K3 material. The combination of various formats helps to visualize the conceptual and procedural material more concretely, thereby potentially increasing students' interest and attention during the learning process. In addition, the multimedia display tailored to students' preferences at the Analyze stage also supports comfort during the learning process. Unlike general multimedia research, this study specifically develops learning multimedia for automotive K3 introduction material for vocational high school students. Thus, this research contributes by developing learning media that can be used to support occupational safety and health education in the automotive vocational field.

However, this research has several limitations. First, the One Group Pretest-Posttest design used does not involve a control group, so the increase in learning interest cannot be fully attributed to the use of multimedia due to the possibility of other influencing factors. Second, the research subjects were limited to 31 students in one class, so the results cannot be widely generalized. Third, the measurement of learning interest used a self-report questionnaire, which is potentially influenced by student response bias. Therefore, subsequent research is recommended to use an experimental design with a control group, involve students from several schools with diverse characteristics, and add measurement instruments such as direct observation of student engagement. Future research can also examine the relationship between the use of automotive K3 learning multimedia and students' ability to apply safety procedures.

Conclusions

This research aims to develop multimedia learning for automotive K3 introduction using the ADDIE model and to determine the increase in learning interest of class X Automotive Engineering students at SMK Negeri 5 Semarang after its use. The research results show that the developed multimedia meets the very feasible criteria based on the assessments of media and material experts, with an evaluation percentage above 87%. The learning interest questionnaire instrument is also declared valid and reliable, making it suitable for measuring students' learning interest. The implementation results show an increase in the average learning interest score from 70.03 in the pretest to 86.61 in the posttest. Additionally, the One-Sample t-test results indicate that the average posttest score is significantly higher than the reference value of 70 ($t = 15.3217$; $p < 0.001$). The N-Gain calculation resulted in a value of 0.56, which falls into the moderate category with a fairly effective level of effectiveness. These findings indicate that multimedia integrating text, images, animations, and videos has the potential to enhance students' interest in learning automotive K3 material. Practically, this multimedia can serve as an alternative learning medium for teachers to present occupational health and safety material in a more engaging and contextual manner, in line with the characteristics of vocational education. However, this study is limited to 31 students in one class and uses a One Group Pretest-Posttest design without a control group, so the increase in learning interest cannot be fully attributed to the use of multimedia. Therefore, further research is recommended to involve a control group and samples from several schools, as well as to combine questionnaires with observations of student engagement to strengthen the evaluation of the effectiveness of automotive K3 multimedia learning.

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