



Feasibility Evaluation of a 110 cc-Class Automatic Motorcycle Engine Cutaway for Supporting Practical Curriculum Implementation in Automotive Vocational Education

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Abstract

Automatic motorcycle engines are closed mechanical assemblies that limit students' observation of internal components during vocational practice. This study developed and evaluated the feasibility of a 110 cc-class automatic motorcycle engine cutaway for supporting practical curriculum implementation in automotive vocational education. A Research and Development design with the ADDIE model was used. The product exposed key components, including the piston, cylinder, combustion chamber, crankshaft, valve mechanism, lubrication passages, and automatic transmission section, as a real-object medium for observing automatic engine mechanisms. Feasibility data were obtained from two media experts, two material experts, and responses from 25 Automotive Engineering students after limited implementation. Five-point Likert-scale data were analyzed descriptively. Media expert validation reached 86%, and material expert validation reached 90%, both categorized as highly feasible. Student responses reached 90%, categorized as very good. The cutaway was feasible and accepted, although learning effectiveness was not measured.

Keywords

automatic motorcycle engine cutaway; 110 cc-class engine trainer; ADDIE development model; practical curriculum implementation; automotive vocational education

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Submitted : June 18, 2026. Accepted : June 30, 2026. Published : June 30, 2026

INTRODUCTION

Automotive vocational education requires practice-oriented learning that connects conceptual knowledge with the operation, inspection, and maintenance of real technical systems. In engineering and automotive education, trainer-based learning media are often developed to address laboratory limitations and to make technical systems easier to demonstrate in controlled learning contexts. Previous studies on automotive and mechanical trainers, including car air-conditioning simulators, throttle-position sensor trainers, and electro-pneumatic trainers, show that real or semi-real instructional media can support practicum activities by presenting technical components in an observable and operable form [1]-[3].



In competency-based automotive vocational education, curriculum implementation depends not only on written learning outcomes but also on the availability of appropriate practical learning resources, workshop facilities, and instructional media. For motorcycle engine practice, the alignment between curriculum competencies, learning activities, and observable technical objects is essential because students are required to connect theoretical concepts with actual engine structures and mechanisms. Therefore, the development of practical learning media can also be positioned as part of supporting curriculum implementation, particularly when the media is designed to address specific competency needs in workshop-based learning.

In motorcycle engine practical learning, students are expected to identify engine components, explain operating principles, and relate engine mechanisms to basic maintenance procedures. These tasks become difficult when the engine is studied only as a closed mechanical assembly. Components such as the piston, cylinder, crankshaft, valve mechanism, lubrication passages, fuel-system parts, and transmission elements cannot be fully observed during ordinary practice. Similar challenges have encouraged the development of visual and interactive automotive learning media, including augmented-reality media for automotive components, instructional videos for vehicle body electrical systems, and smart trainers integrated with QR codes [4]–[6].

For motorcycle-specific learning, trainer media have also been developed to help students observe technical systems that are usually difficult to trace directly. A fuel-flow trainer for a Honda Beat FI injection system was designed to demonstrate the path and function of injection-system components, while a four-stroke motorcycle injection-system study provides relevant technical context for explaining fuel delivery and combustion-system operation [7], [8]. These studies indicate that automotive practicum media need to represent the actual structure and functional relationships of vehicle components rather than merely display isolated parts.

Among practice-oriented learning media, engine cutaway media are particularly relevant for motorcycle engine instruction because they use actual engine components that have been opened or sectioned to make internal mechanisms visible. Previous development of manual motorcycle transmission cutting-engine media showed that sectioned engine components can help visualize mechanical structures, component arrangement, and transmission-related working mechanisms [9]. Similarly, the use of motorcycle engine cutting media in valve-mechanism learning was associated with improved posttest scores and active student participation in a one-group learning setting [10]. Android-based valve-mechanism media have also been developed to support motorcycle engine maintenance learning, indicating that valve-system understanding remains a recurring focus in automotive learning-media development [11].

Real engine-based training further supports the pedagogical value of observable mechanical media in vocational contexts. Training using a cutting engine allowed students to observe four-stroke engine components and demonstrate the working principles of internal combustion engines [12]. Collectively, these prior studies show that physical and visual learning media are valuable for connecting theoretical explanation with workshop observation. However, the existing engine cutaway literature is still dominated by manual or non-automatic motorcycle engines and by competencies related mainly to combustion, lubrication, cooling, and valve mechanisms.

This leaves a specific gap in the development of cutaway media for automatic motorcycle engines. Automatic motorcycles have construction characteristics that differ from manual motorcycles, particularly in the automatic transmission system and power-transfer mechanism. Therefore, a cutaway medium for this type of engine should not only expose combustion and valve mechanisms but also help students observe the relationship between the

engine and the automatic transmission section. Based on this gap, the present study develops and evaluates the feasibility of a 110 cc-class automatic motorcycle engine cutaway as a practical learning medium to support the implementation of motorcycle engine practical competencies in automotive vocational education. The contribution of this study lies in providing feasibility evidence for a real-object learning medium that visualizes hidden internal components of an automatic motorcycle engine, including its automatic transmission and power-transfer section, without making claims about learning effectiveness beyond the validation and student-response data collected in this study.

METHOD

This study used a Research and Development (R&D) approach because its purpose was to produce a learning media product and evaluate its feasibility before broader use in motorcycle engine practical learning. The development process followed the ADDIE model, which consists of analysis, design, development, implementation, and evaluation. This model was selected because it provides a systematic instructional design sequence for identifying learning needs, designing and developing media, implementing the product in a limited learning context, and evaluating its feasibility through user and expert feedback [13], [14]. In this study, the ADDIE model was applied to develop a 110 cc-class automatic motorcycle engine cutaway as a practical learning medium.

The overall methodological sequence is presented in [Figure 1](#). The flowchart shows that the study began with the identification of learning problems and workshop needs, followed by product design, cutaway development, limited implementation with students, and feasibility evaluation. The figure also indicates a qualitative revision loop from the evaluation stage to the development stage, meaning that expert comments and field observations were used to refine the product before determining the final feasible cutaway medium.

The analysis phase was conducted to identify learning problems, student needs, available workshop facilities, and motorcycle engine practical competencies. The main problem identified in this phase was the limited visibility of internal components in automatic motorcycle engines during practical learning. Therefore, the analysis focused on the need for a concrete learning medium that could display the internal structure of an automatic motorcycle engine, especially the combustion mechanism, valve mechanism, lubrication passages, and automatic transmission section. This phase also considered the alignment between the developed media and motorcycle engine practical competencies so that the product could support workshop-based curriculum implementation.

The design phase included determining the engine parts to be cut, designing the support brackets and stand, selecting component labels, preparing validation instruments, and planning the limited implementation scenario. The cutaway areas were selected based on their relevance to motorcycle engine practical competencies and their ability to expose important internal components without reducing product safety. The validation instruments were prepared to assess both the technical quality of the media and the accuracy of the motorcycle engine material. The use of expert review in questionnaire preparation was intended to ensure that the instrument indicators were relevant to the product characteristics and the intended learning objectives [15].

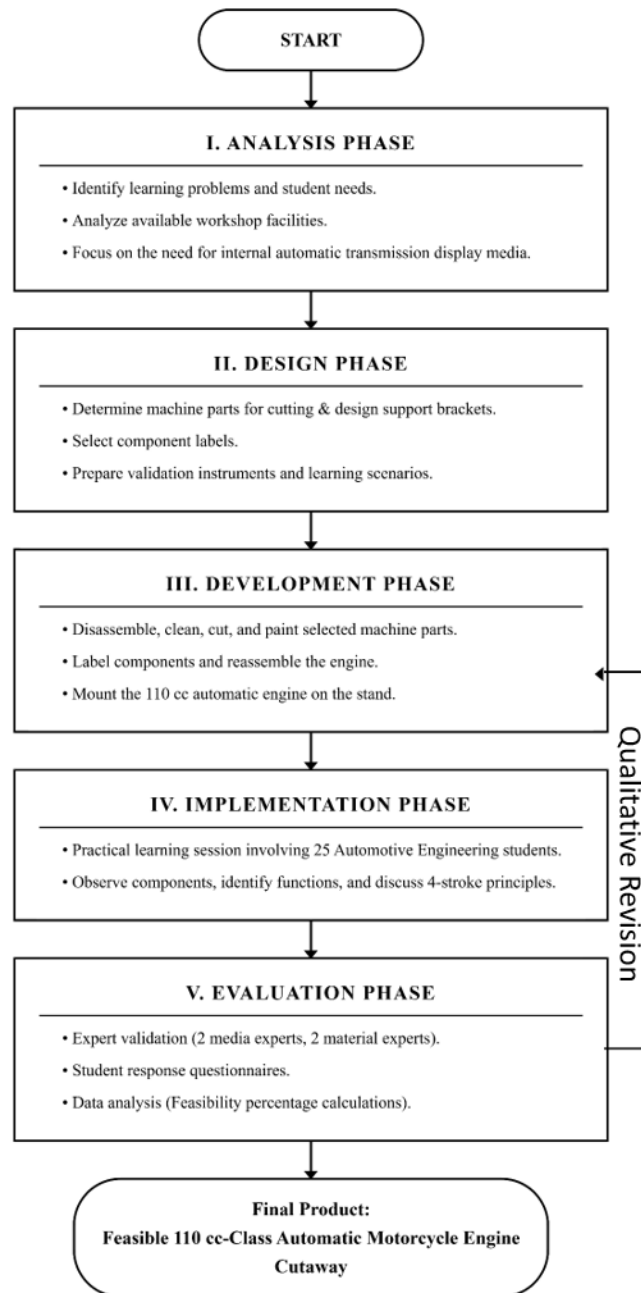


Figure 1. Research and development flowchart for the 110 cc-class automatic motorcycle engine cutaway based on the ADDIE model.

The development phase involved producing the 110 cc-class automatic motorcycle engine cutaway. The procedure consisted of disassembling the engine, cleaning the components, cutting selected engine parts, painting the cut sections, labeling visible components, reassembling the engine, and mounting it on a stand. These procedures followed the general practice used in previous engine cutaway and engine-based trainer development, where the physical engine is modified to expose internal components for instructional purposes [9], [12]. Product revision was carried out based on validator comments and implementation observations, including improving the visibility of selected cutaway areas, strengthening the stand construction, refining component labels, improving the neatness of painted cut sections, and ensuring that the exposed components remained safe for use during practical learning.

The implementation phase was conducted in a limited motorcycle engine practical learning session involving 25 Automotive Engineering students. The students were enrolled in a motorcycle engine practice course and had previously received basic theoretical instruction on gasoline engines and motorcycle engine systems. The participants were selected purposively because they were directly involved in the practical learning activities relevant to the developed media. Purposive sampling is appropriate when participants are selected based on specific characteristics related to the research purpose [16]. The inclusion criteria were students who were actively registered in the Automotive Engineering program, attended the practical learning session, and completed the student response questionnaire after using the 110 cc-class automatic motorcycle engine cutaway. Students who did not participate in the implementation session or did not complete the questionnaire were excluded from the response analysis.

During the implementation session, students observed the exposed engine components, identified component names and functions, discussed the four-stroke operating principle, traced the lubrication flow, and explained the relationship between the combustion system and the automatic transmission power-transfer mechanism. Observation during implementation focused on students' attention to the media, ability to identify visible components, participation in discussion, ability to explain component functions, and safe interaction with the cutaway engine. Documentation was also collected to record the development and implementation process.

The evaluation phase was conducted through expert validation and student response questionnaires to determine the feasibility and acceptance of the developed learning medium. The validation involved two media experts and two material experts. The media experts were lecturers or instructors with experience in automotive learning media, workshop practice, and instructional media development. The material experts were lecturers or instructors with expertise in motorcycle engine systems and automotive engineering education. The media validation instrument consisted of five indicators: media design and appearance, component visibility, construction and stand strength, occupational safety, and ease of use and mobility. The material validation instrument consisted of five indicators: conformity with learning objectives, accuracy of component names, accuracy of component functions, relevance to motorcycle engine practical materials, and clarity of four-stroke engine operating principles.

The student response questionnaire was used after limited implementation to measure students' acceptance of the developed media. The questionnaire consisted of five indicators: media attractiveness, ease of understanding engine components, ease of understanding four-stroke engine operating principles, relevance to motorcycle engine practice, and motivation and interest in learning. Each item in the expert validation sheets and student response questionnaire was assessed using a five-point Likert scale, ranging from 1 = very poor to 5 = very good. A five-point Likert scale is commonly used in educational and social science research because it allows respondents to express graded perceptions while maintaining a manageable response format [17].

Data were collected using media expert validation sheets, material expert validation sheets, student response questionnaires, observation sheets, and documentation. Quantitative data from expert validation and student responses were analyzed using descriptive quantitative analysis by converting the obtained scores into percentages. Descriptive analysis is suitable for summarizing Likert-type educational technology data when the objective is to describe response patterns rather than test causal effects [18]. Qualitative comments from validators, student feedback, observation notes, and documentation were analyzed descriptively to support product revision and interpret the feasibility results.

The feasibility percentage of the developed media was calculated using Equation (1).

$$P = \frac{S_o}{S_m} \times 100\% \quad (1)$$

where P represents the feasibility percentage, S_o is the obtained score from validators or respondents, and S_m is the maximum possible score. The formula was applied to media expert validation, material expert validation, and student response data. The percentage results were interpreted using the following criteria: 81–100% = highly feasible, 61–80% = feasible, 41–60% = fairly feasible, 21–40% = less feasible, and 0–20% = not feasible.

RESULTS AND DISCUSSION

Results

The product developed in this study was a 110 cc-class single-cylinder four-stroke automatic motorcycle engine cutaway for motorcycle engine practical learning. The engine was based on a Yamaha Mio-type scooter with an engine displacement of approximately 113.7 cc. The product was designed to expose selected internal components that are commonly hidden in a closed engine assembly, including the piston, cylinder, combustion chamber, crankshaft, valve mechanism, lubrication passages, pulley, belt, clutch, and power-transfer mechanism.

The cutaway positions were determined based on two considerations: the relevance of the components to motorcycle engine practical competencies and the need to maintain the structural integrity and safety of the media. The cutaway sections were made on the cylinder block and cylinder head to expose the piston, cylinder, combustion chamber, and valve mechanism; on the crankcase area to show the crankshaft and lubrication passages; and on the automatic transmission section to display the pulley, belt, clutch, and power-transfer mechanism. The main stages of product development are presented in [Figure 2](#).



(a)



(b)

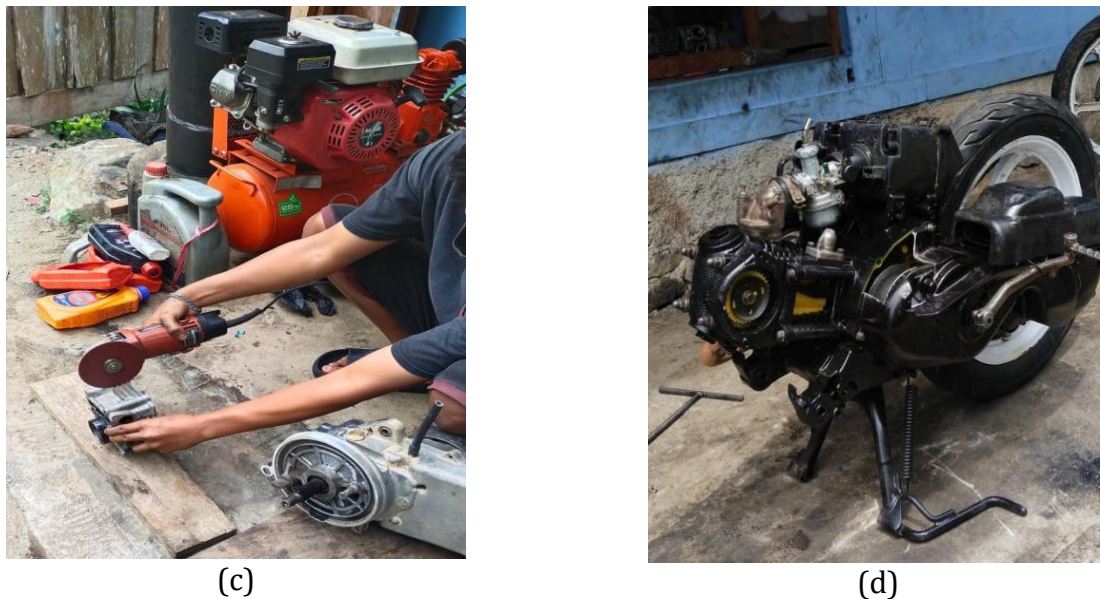


Figure 2. Development process of the 110 cc-class automatic motorcycle engine cutaway: (a) engine disassembly, (b) component cleaning, (c) cutting of selected engine parts, and (d) painting of the cutaway sections.

The completed product exposed several internal engine components in a visible form. These exposed sections enabled the main combustion, valve, lubrication, and automatic transmission components to be observed directly during practical learning. Furthermore, media expert validation was conducted to assess the physical and technical quality of the developed product. The assessed aspects included media design and appearance, component visibility, construction and stand strength, occupational safety, and ease of use and mobility. The results are presented in [Table 1](#).

Table 1. Media expert validation results

No.	Assessment aspect	Obtained score	Maximum score	Percentage (%)	Category
1	Media design and appearance	9	10	90	Highly feasible
2	Component visibility	9	10	90	Highly feasible
3	Construction and stand strength	8	10	80	Feasible
4	Occupational safety	8	10	80	Feasible
5	Ease of use and mobility	9	10	90	Highly feasible
	Total	43	50	86	Highly feasible

Based on [Table 1](#), the media expert validation obtained a total score of 43 out of 50, resulting in a feasibility percentage of 86%. This percentage was categorized as highly feasible. The highest percentages were obtained for media design and appearance, component visibility, and ease of use and mobility, each reaching 90%. Construction and stand strength, as well as occupational safety, each obtained 80% and were categorized as feasible.

Material expert validation was conducted to assess the suitability of the product for motorcycle engine practical learning. The assessed aspects included conformity with learning

objectives, accuracy of component names, accuracy of component functions, relevance to motorcycle engine practice materials, and clarity of four-stroke engine operating principles. The results are presented in [Table 2](#).

Table 2. Material expert validation results

No.	Assessment aspect	Obtained score	Maximum score	Percentage (%)	Category
1	Conformity with learning objectives	9	10	90	Highly feasible
2	Accuracy of component names	9	10	90	Highly feasible
3	Accuracy of component functions	9	10	90	Highly feasible
4	Relevance to motorcycle engine practice materials	9	10	90	Highly feasible
5	Clarity of four-stroke engine operating principles	9	10	90	Highly feasible
Total		45	50	90	Highly feasible

As shown in [Table 2](#), the material expert validation obtained a total score of 45 out of 50, resulting in a feasibility percentage of 90%. All assessment aspects obtained the same percentage of 90% and were categorized as highly feasible. These results show that the media was positively assessed in relation to learning-objective conformity and relevance to motorcycle engine practice materials, which are important aspects for supporting practical curriculum implementation.

The limited implementation of the 110 cc-class automatic motorcycle engine cutaway was conducted in one 120-minute motorcycle engine practical learning session involving 25 Automotive Engineering students. During the session, students observed the exposed engine components, identified component names and functions, discussed the four-stroke operating principle, traced the lubrication flow, and examined the relationship between the combustion system and the automatic transmission power-transfer mechanism. The implementation activities are shown in [Figure 3](#).



(a)



(b)



Figure 3. Limited implementation of the 110 cc-class automatic motorcycle engine cutaway in practical learning: (a) installed engine cutaway display, (b) exposed automatic transmission section, (c) lecturer explanation, (d) student observation and product documentation, (e) guided group discussion, and (f) completion of the student response questionnaire.

After the practical session, students completed a response questionnaire to evaluate the media in terms of attractiveness, ease of understanding engine components, ease of understanding four-stroke engine operating principles, relevance to motorcycle engine practice, and motivation and interest in learning. The results are presented in [Table 3](#).

Table 3. Student response results

No.	Assessment aspect	Number of respondents	Number of items	Obtained score	Maximum score	Percentage (%)	Category
1	Media attractiveness	25	1	112	125	90	Very good
2	Ease of understanding engine components	25	1	110	125	88	Very good
3	Ease of understanding four-stroke engine operating principles	25	1	111	125	89	Very good
4	Relevance to motorcycle engine practice	25	1	114	125	91	Very good

No.	Assessment aspect	Number of respondents	Number of items	Obtained score	Maximum score	Percentage (%)	Category
5	Motivation and interest in learning	25	1	115	125	92	Very good
	Total / Overall percentage	25	5	562	625	90	Very good

Based on Table 3, the overall student response percentage was 90%, which was categorized as very good. The highest percentage was obtained for motivation and interest in learning at 92%, followed by relevance to motorcycle engine practice at 91%. Media attractiveness obtained 90%, while ease of understanding four-stroke engine operating principles and ease of understanding engine components obtained 89% and 88%, respectively.

A summary of the three main assessment sources is presented in Figure 4 to show the comparison between media expert validation, material expert validation, and student responses.

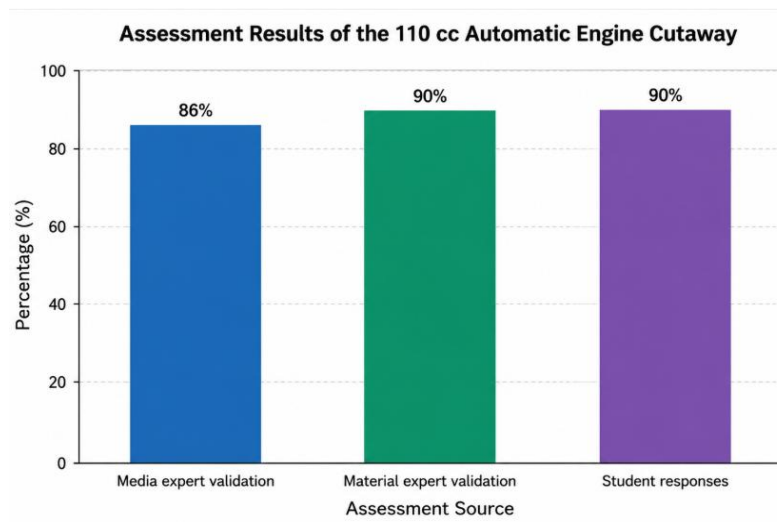


Figure 4. Assessment results of the 110 cc-class automatic motorcycle engine cutaway based on media expert validation, material expert validation, and student responses.

Figure 4 shows that the media expert validation reached 86%, the material expert validation reached 90%, and the student response reached 90%. Based on the predetermined interpretation criteria, the expert validation results were categorized as highly feasible, while the student response result was categorized as very good.

Discussion

The findings indicate that the 110 cc-class automatic motorcycle engine cutaway achieved an acceptable feasibility level as a practical learning medium. The media expert validation in Table 1 shows that the product obtained 86%, while the material expert validation in Table 2 reached 90%. These two results suggest that the product was considered feasible not only in terms of its physical construction and usability but also in terms of content relevance and technical accuracy. This pattern is comparable to other vocational learning-media development studies in which feasibility evidence was obtained from expert judgment and user responses before broader implementation, such as application-based automotive learning media and trainer-kit development for vocational technical subjects [19], [20].

The media expert validation result in [Table 1](#) also shows that media design and appearance, component visibility, and ease of use and mobility obtained the highest scores. This indicates that the cutaway design was able to present hidden engine components in an observable form and could be used practically in a workshop context. However, construction and stand strength, as well as occupational safety, obtained lower percentages than the other media aspects. Although both aspects were still categorized as feasible, these scores indicate that the product requires continued attention to mechanical robustness, user safety, and long-term durability. This is important because vocational learning media are not only expected to be visually informative but also safe, stable, and suitable for repeated use in practical learning environments.

The material expert validation result in [Table 2](#) reached 90% across all assessed aspects. This result indicates that the exposed components, component names, component functions, and four-stroke engine operating principles were considered aligned with motorcycle engine practical learning. From an instructional perspective, this alignment is important because learning media in vocational education must support the connection between technical content, practical tasks, and the learning objectives expected in workshop-based instruction. Studies on vocational teachers' use of technology also emphasize that learning media are more likely to be accepted when they are perceived as useful and relevant to teaching needs [21], [22]. Therefore, the material validation result in this study suggests that the engine cutaway has appropriate content relevance for supporting the explanation of automatic motorcycle engine mechanisms.

From a practical curriculum implementation perspective, the developed cutaway can be positioned as a learning resource that supports the delivery of motorcycle engine competencies in workshop-based automotive vocational education. The media expert and material expert validation results indicate that the product was considered feasible in terms of design, component visibility, technical accuracy, and relevance to motorcycle engine practice. These aspects are important because practical curricula require not only written competency standards but also appropriate learning resources that allow students to observe, identify, and relate engine components to their operating principles. Therefore, the developed cutaway may support the management of practical learning resources within motorcycle engine courses. However, this implication should be limited to curriculum implementation and learning-resource support, because the present study did not evaluate curriculum planning, curriculum governance, or curriculum effectiveness at the institutional level.

The student response result in [Table 3](#) provides additional evidence of user acceptance. The overall response percentage reached 90%, with the highest score found in motivation and interest in learning, followed by relevance to motorcycle engine practice. This indicates that students perceived the media as attractive and relevant to their practical learning experience. Nevertheless, the lowest score was found in ease of understanding engine components. Although this aspect was still categorized as very good, the lower relative score suggests that component visibility alone may not be sufficient. Students may still need lecturer guidance, clearer component labels, structured worksheets, or supporting explanations to interpret the visible mechanisms correctly. This interpretation is consistent with vocational learning literature, which emphasizes that workplace-relevant learning requires guided practice, structured interaction with tools, and alignment between educational activities and real occupational tasks [23], [24].

The comparison in [Figure 4](#) shows a relatively consistent pattern among the three assessment sources: media expert validation reached 86%, material expert validation reached 90%, and student responses reached 90%. This consistency supports the interpretation that the developed product was positively assessed from both expert and student perspectives. However, the difference between expert validation and student response should be interpreted

carefully. The student response reflects perception and acceptance after limited use, whereas expert validation reflects judgment of media quality and content suitability. Therefore, the three data sources complement one another but do not measure the same construct. Broader educational technology studies also show that learning media adoption depends on design quality, perceived usefulness, user readiness, and learning-context support rather than the media format alone [25], [26].

The specific contribution of this study lies in the development of an automatic motorcycle engine cutaway that visualizes not only combustion and valve mechanisms but also the automatic transmission and power-transfer section. This feature extends earlier engine cutaway studies that mainly focused on manual or non-automatic motorcycle systems, such as manual motorcycle transmission cutting-engine media and valve-mechanism cutaway media [9], [10]. It also complements other automotive trainer studies that focused on fuel-flow systems, four-stroke injection systems, and engine-based training media [7], [8], [12]. In this sense, the present product addresses a more specific practical need in automatic motorcycle engine learning, especially because automatic motorcycle systems involve component relationships that are difficult to observe in closed engine assemblies.

The visual exposure provided by the cutaway is also pedagogically relevant because mechanical learning often requires students to connect abstract explanations with observable component movement, shape, position, and functional relationships. Studies on visual and simulation-based learning in TVET and mechanics education indicate that visualization media can help learners access technical processes that are otherwise difficult to observe directly [27], [28]. Unlike digital or augmented-reality media, however, the product developed in this study uses an actual engine as the learning object. This gives students direct contact with a real mechanical assembly, which is particularly relevant for workshop-based automotive education. Therefore, the cutaway can be understood as a tangible visualization medium that bridges theoretical explanation and practical observation.

Despite these positive findings, the scope of interpretation must remain limited. The study measured expert feasibility and student acceptance, but it did not measure learning gains, skill improvement, retention, or transfer of knowledge through an experimental or pretest-posttest design. Therefore, the results should not be interpreted as evidence that the media improves learning outcomes. The findings only support the conclusion that the 110 cc-class automatic motorcycle engine cutaway is feasible and accepted as a practical learning medium in the limited implementation context. Future research should examine its effectiveness using a stronger research design, include comparison groups or pretest-posttest measures, and evaluate whether the media improves students' conceptual understanding, component identification accuracy, and practical diagnostic skills.

CONCLUSION

This study developed and evaluated a 110 cc-class automatic motorcycle engine cutaway as a practical learning medium in automotive vocational education. The product was designed to expose key internal components, including the piston, cylinder, combustion chamber, crankshaft, valve mechanism, lubrication passages, and automatic transmission section, allowing students to observe the structure and working relationships of an automatic motorcycle engine more concretely during practical learning. The feasibility evaluation showed that the media obtained 86% from media experts and 90% from material experts, both categorized as highly feasible, while student responses reached 90%, categorized as very good. These findings indicate that the developed cutaway is feasible and well accepted as a practical learning medium, particularly in terms of component visibility, content accuracy, instructional relevance, usability, mobility, and student acceptance. The main contribution of this study is

the development of a real-object learning medium that specifically visualizes the internal structure and power-transfer section of an automatic motorcycle engine; however, the findings should be interpreted as feasibility and acceptance evidence, not as evidence of learning effectiveness. In relation to practical curriculum implementation, the developed cutaway may serve as a workshop-based learning resource for supporting motorcycle engine competencies that require direct observation of internal automatic engine components.

Future research should evaluate the effectiveness of the 110 cc-class automatic motorcycle engine cutaway using an experimental or quasi-experimental design, such as a pretest-posttest control group design, to measure its effect on students' conceptual understanding, component identification accuracy, practical skills, and learning outcomes. Further development may also focus on improving stand strength, occupational safety, long-term durability, component labels, and color coding to support repeated workshop use. The media can also be integrated with digital learning resources, such as QR codes, video explanations, digital modules, or interactive worksheets, to support independent learning before and after practical sessions. Broader implementation in different automotive vocational education settings is recommended to examine the practicality, scalability, and adaptability of the media across various student groups, workshop conditions, and motorcycle engine practice courses.

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