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Development of a flipped classroom learning with a drill and practice approach to improve the students psychomotor skills in class motorbike engineering

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Abstract: This study aims to develop learning to improve psychomotor skills in the practical subjects of class XI motorcycle engineering students. The development in this study uses the ADDIE model. The research subjects consisted of three experts and 33 class XI motorcycle engineering students in the learning design trial. Data collection used a content expert validation questionnaire, a media expert validation questionnaire, a learning design expert validation questionnaire, and a test. Data processing was carried out by calculating scores and validity percentages, while the influence test used the t test. The findings of the validity level of the development of flipped class learning designs with the drill and practice approach received an assessment from content experts of 100% (very valid), media experts of 100% (very valid), and learning design experts of 97% (very valid). Furthermore, the findings of the influence test using the t test obtained a significance value of 0.000. From the calculation results, the significance of 0.000 is less than 0.05, meaning that there is a significant difference in the use of a flipped class learning design with a real and practice approach and not using a flipped class with a drill and practice approach.

Keywords: Design learning, drill and practice, flipped classroom, psychomotor

Abstrak: Penelitian ini bertujuan untuk mengembangkan pembelajaran untuk meningkatkan kemampuan psikomotorik pada mata pelajaran praktik siswa kelas XI teknik sepeda motor. Pengembangan pada penelitian ini mengunakan model ADDIE. Subjek penelitian terdiri dari tiga orang ahli dan 33 siswa kelas XI jurusan teknik sepeda motor pada uji coba desain pembelajaran. Pengumpulan data mengunakan angket validasi ahli isi, angket validasi ahli media, angket validasi ahli desain pembelajaran dan tes. Pengolahan data dilakukan dengan menghitung skor dan presentase validtas, sedangkan uji pengaruh mengunakan uji t. hasil tingkat validitas pengembangan desain pembelajaran *flipped classroom* dengan pendekatan *drill and practice* mendapatkan penilian dari ahli isi sebesar 100% (sangat valid), ahli media sebesar 100% (sangat valid) dan ahli desai pembelajaran sebesar 97% (sangat valid). Selantutnya hasil uji pengaruh dengan mengunakan uji t memperoleh nilai signifikansi 0,000. Dari hasil hitung signifikansi 0,000 lebih kecil dari 0,05, artinya terdapat perbedaan yang signifikan terhadap penggunaan desain pembelajaran *flipeed classroom* dengan pendekatan *drill and practice* dan tidak menggunakan *flipeed classroom* dengan pendekatan *drill and practice.*

Kata kunci: Desain pembelajaran, latihan dan praktik, kelas terbalik, psikomotorik

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INTRODUCTION

The development of digital technology in this era has provided various benefits to everyone in accessing various information and being able to connect without any limitations of space and time (Du et al., 2019). Digital technology has influenced the world of education, especially the learning style of students where they spend a lot of time using various kinds of technological media such as smartphones, computers, or laptops to search for various learning references from the internet, communicate with educators, interact with friends. The advantages of the development of digital technology have influenced technological

developments in the world of education, and have replaced the use of blackboards and chalk with online learning videos (Collins & Halverson, 2010).

Lecture learning that tends to require students to listen to long lectures in delivering material from teachers has the disadvantage of boring learning and making students less active in learning activities (Helmiati, 2012). Both teachers and lecturers who use conventional learning models tend to dominate the class and act more actively in delivering lectures (Nasir et al., 2020; Utomo & Ubaidillah, 2018). Implementing a teacher-centered teaching and learning model provides little space for students to interact with their peers and inhibits them from thinking critically and learning independently (Luo, 2019). In the world of education, to improve the learning process, it has been integrated with digital devices (Raja & Priya, 2021). The use of technology in learning offers various advantages, such as providing many choices of teaching methods, increasing enthusiasm in the learning process, and making it easier to find information. Technology has become an alternative to developing a learning process that has deeper meaning (Dita et al., 2024; Escueta et al., 2020; Fuada et al., 2020). The use of technology in education has several benefits, including the enhancement of instructional techniques, the amplification of learner engagement, and the facilitation of information accessibility. However, training educators and students to integrate technology into the teaching and learning process is a major challenge at this time (Kimmons, 2020).

Vocational education at the vocational high school level makes a huge contribution in providing workers with special skills in various industrial fields, including in the realm of automotive engineering. Automotive engineering vocational education requires a holistic approach that includes the integration of theory and practice to ensure that graduates not only have academic knowledge, but also practical skills needed in the industrial world (Parhusip & Wijanarka, 2018). In addition, rapid changes in the world of technology require adaptation and innovation in vocational education. Previous relevant research by Nurcahyono et al. (2020), and Pramono et al. (2023) highlighted the importance of integrating theory and practice in vocational education as well as the need to deepen skill competencies as a strategy to increase the competitiveness of graduates in the job market, like research by Yani et al. (2020), and Saputra et al. (2024) who conducted vocational competency improvement training for vocational school students. The results of the research showed that there was a significant increase in vocational knowledge and skills and engine repairs after attending the training. A literature review shows that a number of previous studies have been carried out to evaluate various approaches to improving the quality of vocational learning, but there is not yet complete consensus regarding the best method for achieving deepening of skills competencies at the vocational school level. Thus, there is a knowledge gap that needs to be filled to detail its practical implementation and effectiveness. Therefore, a deep understanding of how to combine technologies is required. and learning models is needed to deepen theoretical understanding and practical abilities. One of the most important aspects in implementing technology into the teaching and learning process is the role of educators (Dogan et al., 2021; Setyantoko et al., 2023). Among the efforts that are being made to build learning and teaching processes that have profound significance is the utilization of technology (Alfiansyah et al., 2022). Integrating technology into the learning and teaching process is important to support educational changes in developing skills in this century (Latifa et al., 2024).

One of the learning models that integrates technology in learning is the flipped classroom learning model, the flipped classroom model is a pedagogical approach in which students learn material at home through online videos and other digital resources, allowing class time to be used for interactive and practical learning activities that deepen understanding (Bergmann & Sams, 2012). The flipped classroom is a learning strategy that minimizes the amount of direct instruction but maximizes one-on-one interaction (Johnson & Johnson, 2013). The flipped classroom model changes the learning process that should be carried out outside of face-to-face meetings by students in the form of assignments to be carried out in face-to-face meetings with guidance from educators and what should be carried out in face-to-face meetings in the form of the process of delivering material by educators to be carried out outside of face-to-face meetings by studying the material by watching learning videos, or studying material that has been prepared independently Basically, the flipped classroom learning concept is a learning model that reverses the traditional learning process, where the learning process that is usually carried out in the classroom in the flipped classroom learning concept is carried out at home, while homework is done in class (Bergmann & Sams, 2012). The simple learning method is to reverse the approach to the learning process in class, students study the learning material at home before entering the class, so that the learning that takes place in the class, the educator no longer delivers the learning material but directly carries out activities such as practice questions, discussions, presentations, and debates (Chandra & Nugroho, 2016).

An online learning space is needed to implement asynchronous learning in flipped classroom learning. One of the online learning media platforms that can support the delivery of material in flipped classroom learning is Google Classroom. Google Classroom can function as a learning management system in educational institutions such as schools and universities. Google Classroom makes it possible to create online learning spaces in cyberspace (Shaharanee et al., 2016). Google Classroom provides several benefits, including: 1) Facilitation of class preparation, enabling educators to establish classes, invite students and teaching assistants, and disseminate information such as assignments, announcements, and inquiries during class activities. The efficiency of time and paper use, since instructors may design courses, assign tasks, communicate, and manage all activities on a singular platform. 3) Enhanced organizational management, enabling students to access assignments via the assignment page, class activity stream, or class calendar (Brock, 2015).

In-class activities within the Flipped classroom model need a pedagogical design that enhances students' comprehension and capabilities; one effective learning model for augmenting psychomotor abilities is the drill and practice model. Drill and practice is a learning model that provides a lot of repetitive training to improve abilities or skills both cognitively and psychomotorically, improving understanding of a particular material concept. Drill and practice directs students through exercises to improve dexterity/agility and fluency/fluency in a skill drill and practice is a teaching method that emphasizes a lot of practice (Smaldino et al., 2014). Increased practice correlates with enhanced learner skills (Sanatun & Sulisworo, 2016). According to the learning theory drill and practice is an exercise that is carried out repeatedly and continuously to gain conceptual knowledge and proficiency in questions (Wahyuni et al., 2017). The purpose of learning and practice is to instill learning habits in the form of continuous training, by providing continuous

independent learning experiences, because students will always be asked to repeat the material if they have not completed or reached the minimum assessment limit at that stage (Rusman, 2018). In engine learning, the psychomotor aspect of practicing is very important to support learning outcomes in the cognitive and attitude domains. Practical activities can improve experience (Jones et al., 2016). Practice can improve knowledge and experience (Dittrich et al., 2016). Learning outcomes in the psychomotor domain are related to learning outcomes obtained through skills that use muscles and physical strength. The psychomotor domain is a person's ability to perform movements or skills (Hutapea, 2019).

In flipped classroom learning, careful planning is needed to provide advantages to the learning design. This requires innovation and the right support system to increase the positive impact in its implementation. One effort that can be made is to integrate the concept of drill and practice learning into the flipped classroom, by utilizing the principle of repeated practice in learning activities, especially in the learning and teaching process. Based on this, the researcher plans to design learning for vocational high school students majoring in motorcycle engineering using the flipped classroom model with a drill and practice approach to improve psychomotor skills.

METHOD

The method applied in this research is the Research and Development (R&D) method. In this study, the implementation stage in the learning development process has not been carried out in this study, because the trial conducted is still at the development stage (formative assessment), and has not reached the summative assessment stage. In the development using the ADDIE model (Sari et al., 2021). Figure 1 shows the stages outlined in the ADDIE model.

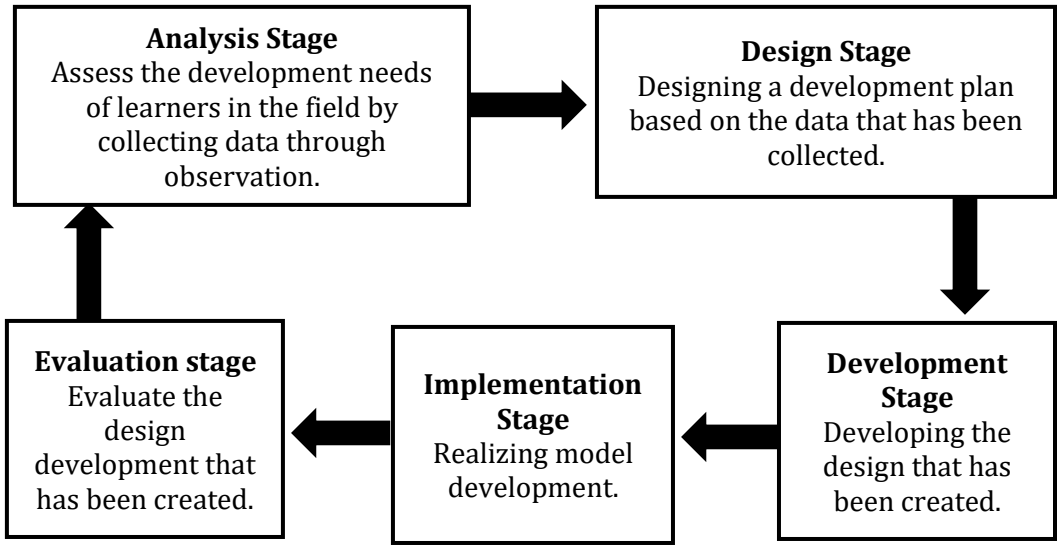

Fig.1. ADDIE model steps

Analysis

The analysis stage consists of two stages, namely:

- Performance analysis, developers analyze students' skills and knowledge in the learning process.

- Needs analysis, in this step the developer analyzes needs and problems, namely in the form of relevant materials, teaching materials, learning strategies, learning motivation and learning conditions.

Design

In this step, the developer engineers a flipped classroom learning model with a drill and practice approach using Google Classroom in such a way as to formulate both general and specific learning objectives. Next, develop test items or questions that are used to measure the level of student progress and the level of achievement of the goals that have been formulated. And finally develop the learning design. The development of a flipped classroom learning design with a drill and practice approach using Google Classroom was also designed by taking into account the principles of message design so that it can attract students' attention. The results of developing a flipped classroom learning design using a drill and practice approach can be seen in the learning activity Table 1.

Table 1. Learning Activities

Activity	Activity Description	Educator Activities	Learner Activities
(Opening) Out class	Educators open the class and convey the learning outcomes and rules for learning activities in the online class.	Educators share google classroom links.	Learners understand the learning objectives and rules learning activities in online classes.
		Educators direct learners to enter in to google classroom	Learners ask the teacher if there is something they don't understand via chat if there is something they don't understand
		Educators explain learning outcomes	
		Educator conveying the rules of learning activities in online classes.	
(Core) Out class	Educators measure students' prior knowledge before delivering learning materials through Google Classroom. Next, educators provide relevant assignments on	The educator directs the learners to work on the pre-test.	Learners work on the pre-test.
		Educators direct students to study learning materials in the form of videos and text. Reading that has been uploaded in google classroom.	Learners watch learning videos that have been uploaded to Google Classroom.
		Educators open discussion forums or chat groups to discuss	Learners read learning materials that have been uploaded to Google classroom.

	the platform, followed by providing materials and problems that must be solved by students in groups. During the process, educators facilitate the learning discussion through the online platform, ensuring that interaction and collaboration between students can run smoothly.	problems and questions raised by students.	
		The educator directs the learners to start a discussion about the findings from the material the learners are studying.	Learners understand the learning material.
		Educators direct students to record the results of discussions during learning.	Learners discuss findings in learning materials.
		Educators direct students to work on the test independently	Learners record findings in discussions.
			Learners work on tests independently.
(Closing) Out class	Learning activities are closed by the educator.	The educator directs students to ask WhatsApp if there is something they don't understand.	Learners ask questions about things they don't understand to educators via chat.
		Educators close learning activities.	
(Opening 15 minutes) In class	Educators opens the class and conveys the learning outcomes and rules for learning activities in the class.	The educators opens the lesson by saying hello.	Learners respond to greetings.
		Educators check student attendance	Learner respond presence educator.
		The educator conveys apprecation.	Learners listen to the delivery of apperception.
		Educators explain learning outcomes.	Learners understand the learning objectives and regulations during the learning process in class.
		Educators convey activity regulations during the learning process in class.	Learners ask the teacher about something they don't understand or don't understand.
(Core 370 minutes) In class	Educators discuss the findings of students in online classes to deepen their abilities and	Leading a discussion of learner findings from learning in online class Demonstrate practical steps for motorcycle valve maintenance directly.	Discuss learning findings from learning in online class.

	understanding of the material on motorcycle valve mechanisms. Furthermore, educators form students into several groups to carry out practice, which aims to deepen their understanding of motorcycle valve mechanisms directly through practical experience.	Divide students who have achieved the minimum passing grade into groups of 5-6 people.	Pay attention to the instructions and demonstration of practical steps for motorcycle valve maintenance.
		Direct students who have not achieved the minimum passing criteria score to retake the test.	Forming groups to carry out practice.
		Direct learner for do the exercises alternately,	Practice motorcycle valve maintenance steps alternately according to the teacher's instructions.
		Accompanying and guiding the course of valve maintenance practice motorcycle.	Ask the educator directly if there are any obstacles or misunderstandings during the practice process.
(closing 15 minutes) In class	Learning activities are closed by the educator.	Educators provide opportunities for students to ask questions about things they do not understand.	Learners ask questions to educators about things they don't understand.
		Educators deliver assignments that must be completed in Google Classroom	
		The educator closes learning activities	

Development

Development seeks to compile and engineer learning models based on information obtained from various previous stages. Developers modify learning models and strategies to suit student characteristics to improve students' psychomotor abilities. In this step, the flipped classroom learning design using a drill and practice approach is tested for product feasibility by first validating it with experts, namely content experts, design experts and learning media experts. Prior to development, the resultant product will undergo validation by experts to evaluate its suitability. Validation was conducted by media, instructional design, and subject matter experts. This study aims to assess the level of product validity. Testing is carried out using an assessment instrument using a Likert scale.

Eligibility and validation assessments are computed on a percentage basis. The subsequent formula is employed to determine the outcomes of data processing:

$$X = \frac{\sum \text{Score results}}{\sum \text{Maximum score}} \times 100\% \quad (1)$$

The interval value is referred to as the X value, and it is responsible for determining the validity of the learning design development. Quantitative analysis employs percentage techniques (Dainamang et al., 2024). Next, the percentage values that have been obtained are interpreted into a table of eligibility criteria guidelines using a Likert scale.

Table 1. Criteria validation

No	Formula	Category
1.	81 %≤ X ≤100%	Very Valid
2.	61 %≤ X ≤ 80 %	Valid
3.	41 %≤ X ≤ 60 %	Quite Valid
4.	21 %≤ X ≤ 40 %	Less Valid
5.	0 %≤ X ≤ 20 %	Not Valid

(Riduwan, 2010)

Furthermore, after conducting a product feasibility test, the researcher conducted a product trial involving 33 vocational high school students in grade XI of the motorcycle engineering study program to analyze the impact of flipped classroom learning design with a drill and practice approach on improving students' psychomotor abilities.

The data source for this study was primary data that was directly collected from grade XI students of vocational high schools in motorcycle engineering in Malang City. A total of 33 students participated in the product trial, and one material and design validator and one media expert validator were involved. Learners are requested to engage in the learning process on a voluntary basis. Data is collected through the administration of tests at the commencement of the learning process and final exams that are administered to students in the form of queries and practice.

In this study, data were analyzed using quantitative analysis to process data from expert reviews and product needs, and the impact of developing a flipped classroom with a drill and practice approach developed to improve students' psychomotor abilities. The Paired Sample t-test was used to test the relationship between the flipped classroom with a drill and practice approach developed to improving students' psychomotor abilities.

RESULTS AND DISCUSSION

This section presents the findings of the analysis and development stage, which includes validation by three competent experts: content, design, and media experts. Additionally, the results of the trial of the flipped classroom learning design with the drill and practice approach at the development stage are presented. In order to determine whether the learning design to be developed is pertinent and necessary for the learning process, student needs analysis is conducted by administering a questionnaire to identify student requirements.

Table 3. Identification of student needs

No	Question	Answer		
		Yes	Sometimes	No
1	Have you ever had difficulty in learning the material and practice of valve clearance adjustment ?	22	6	5
2	In the delivery of motorcycle engine maintenance subject material, does the teacher deliver the material directly in class ?	33		
3	Does the delivery of material in class by the teacher make you happy ?	10	8	15
4	Does studying learning materials online make you excited and happy in learning ?	27	6	
5	Online learning will use audio, images, and video. Are you joyful and excited if the delivery of material is done online and can be accessed anywhere ?	29	4	
6	Do you agree that the delivery of valve clearance adjustment material is done online ?	33		
7	In the valve clearance adjustment practice activity, do you practice repeatedly ?	18	5	10
8	Does the valve clearance adjustment practice in class make you happy?	30	3	
9	Can you master the material by practicing valve clearance adjustment repeatedly ?	33		
10	Do you agree that the adjustment practice learning is carried out repeatedly ?	33		
	Total	268	32	30
	%	89%	11%	10%

Based on the results of the questionnaire identifying students' needs for the flipped classroom learning design with a drill and practice approach with 10 questions displayed in (Table 3) overall, the number of scores obtained for the "yes" option was 268 (89%), for the "sometimes" option as much as 32 (11%), and for the "no" option as much as 30 (10%). Based on the results of the analysis of learner needs, it can be concluded that both educators and students consider the development of flipped classroom learning designs with a drill and practice approach important, which allows materials to be accessed outside the classroom and is equipped with repeated exercises.

The researcher underwent the development stage in this study to produce a valid learning design product. Before testing the level of validity of the learning design, the researcher first developed a flipped class learning design with a drill and practice approach to produce a product that was ready to be tested. This validity analysis process aims to determine the extent to which the learning design created is in accordance with the learning needs of students and the applicable learning objectives, and to ensure that the information

conveyed is relevant to the level of knowledge and needs of students. After the learning design has been developed, the next stage is to validate it by involving experts according to their fields of expertise. Testing by these experts aims to assess the feasibility of the flipped class learning design with a drill and practice approach that has been developed.

Table 4. Results of the three validators

Validators	Rated aspect	Results
Content Expert	Compliance content	100%
	Eligibility content	
	Use Language	
Media Expert	Convenience	100%
	Attraction	
	Quality	
	Motivation	
Design Expert	Identity	97.6%
	Systematics	
	Substance RPS	
	Time	

The data presented in Table 4 illustrates the results of the assessment by three experts, namely content experts, media experts, and design experts, on various aspects related to the development of materials and designs. Each group of experts evaluated based on certain criteria, with the results showing a high level of suitability and quality. Content experts indicated that the materials presented were very appropriate, feasible, and used the right language. All criteria assessed by content experts received a score of 100%, indicating that the tested materials had met the established standards without significant deficiencies. This indicates that the content aspect is fully in accordance with the goals and needs of users. Media experts gave a score of 100% on all criteria assessed, namely ease of use, attractiveness, quality, and motivation. The assessment by design experts included four criteria: identity, systematics, RPP substance, and time. All of these criteria received a score of 97.6%, based on the results of the design expert assessment indicating that the overall design was very good, with only a few aspects that needed to be improved.with their competence, product trials were carried out on 33 class XI motorbike engineering students. The objective of the testing is to ascertain the impact of the results obtained from a reversed classroom learning design that employs a drill-and-practice approach to enhance psychomotor abilities. Trials were carried out to obtain data on the relationship between the drill and practice learning design and psychomotor abilities before and after the design was tested.

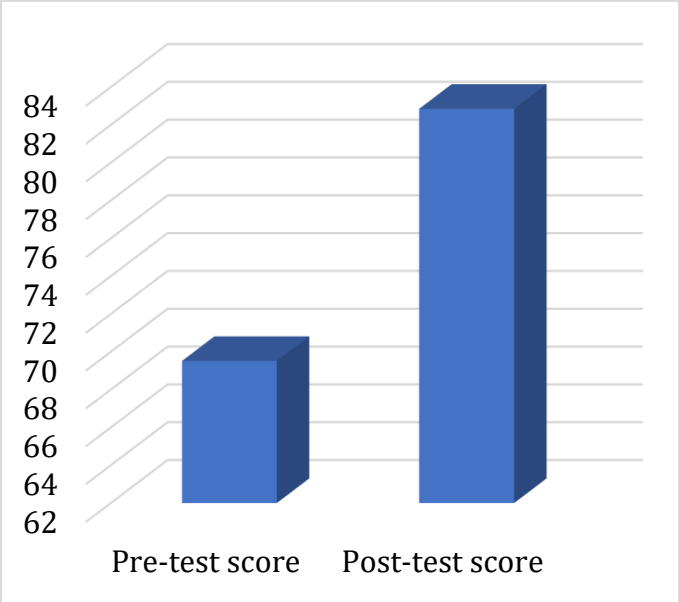

Fig 2. learning outcomes

Figure 2 shows data on students' pre-test and post-test results before and after they studied using a flipped classroom learning design with a drill and practice approach. Research findings show an increase in the psychomotor learning outcomes of class XI motorbike engineering students after using a flipped classroom learning design with a drill and practice approach.

Table 5. Results of pre-test and post-test normality test

	Normality	
	Statistics	**Decision**
Pre-test	0.085	Normal
Pos-test	0.158	Normal

Table 5 shows the calculation of data from the trial results of the flipped classroom learning design with a drill and practice approach using the Kolmogorov Smirrnov test with SPSS, showing that the pre-test and post-test data in this class are normally distributed. The results of the calculations are 0.085 and 0.158 which are greater than 0.05 so it is stated that the data is normally distributed.

Table 6. Results of pre-test and post-test paired samplet test

Post-tes – Pre-test	
Sig. (2-tailed)	0.000

Table 6 shows the SPSS calculation results of trials using the flipped classroom learning design with a drill and practice approach. The results of the paired sample t-test calculations also show the significance and correlation values of the relationship between the pre-test and post-test in this research. The significance value from the significance calculation results shows 0.000, which is smaller than 0.05, meaning that there is a

significant difference in using the flipped classroom learning design with a drill and practice approach and not using the flipped classroom with a drill and practice approach.

The development of flipped classroom learning design products with a drill and practice approach to improve students' psychomotor skills The process begins by analyzing the learners' needs to determine whether the product to be developed aligns with the learning characteristics and needs of the learners in the classroom. At the student needs analysis stage, it was found that some students had difficulty in learning and practicing valve clearance adjustment material, and 29 respondents out of 33 respondents said that the delivery of the material was done online and could be accessed anywhere using images, audio, and video making them excited and happy. As many as 33 respondents said that by repeatedly practicing valve clearance adjustment they could master the material.

Based on the assessment of students' needs, this study develops a flipped classroom learning design with a drill and practice approach to enhance students' psychomotor skills, which has been validated. The results of the validation test by experts indicate that this learning design meets the criteria set in terms of content, media, and instructional design. Flipped classroom is designed to study learning materials before carrying out practical activities in class, the material presented can include learning videos or reading texts. Flipped classroom is one of the learning strategies that changes traditional learning from what was originally a routine of teachers providing material in class then changing to giving assignments to be done in class and outside class (Rindaningsih, 2018). The flipped classroom learning model is a strategy that involves two stages, namely interactive group learning activities during class hours and computer-based individual instruction carried out before class begins (Diningrat et al., 2020). The heart of the flipped classroom is "transferring" material outside the formal classroom through appropriate videos or notes and using the formal classroom to collaborate and carry out relevant activities (Butt, 2014).

The flipped classroom learning design with a drill and practice approach is designed to encourage students to practice repeatedly to understand the learning material well before carrying out practice in class. The flipped classroom learning model has the potential to enhance conceptual comprehension (Savitri & Meilana, 2022). Based on the research conducted on the development of the reversed classroom learning model, the model impacted the comprehension of concepts (Khofifah et al., 2021). There is an influence between understanding the material and practicums to improve psychomotor abilities, with mastery of the material, students are able to carry out practicums well. There is a positive relationship between cognitive understanding and psychomotor abilities (Dachfid, 2015).

Design flipped classroom learning with a drill and practice approach is designed to push students to practice repeatedly to increase the ability of psychomotor students. This can be seen from test results showing a significant difference between using a flipped classroom learning design with a drill and practice approach and not using a flipped classroom with a drill and practice approach. The drill and practice model is a method that guides students in applying activity exercises so that pupils have good abilities in what is being pursued (Roestiyah, 2010). Method learning: Drill and practice their own objective so that participants are educated in control skills motor, among them writing, remembering words, using tools for produce creation, and doing movement sports (Nabila & Azhar, 2024). Drill and practice This can deliver messages to users to make it easier and improve their ability (Sari et al., 2021) with practice students in a way that is repeated and earnest in the

form of activities, such as oral, written, and physical, so that students have the dexterity or high skills. This study focuses on selecting and applying the right method by an educator to learn the vocational competency of motorcycle engineering and achieve predetermined goals. In the teaching and learning process, educators need to continue to develop themselves to improve the quality of education, considering the important role of teachers as one of the main elements in education. This study uses a literature study method, which involves collecting data through understanding and studying relevant theories from various literature sources related to the research topic. The drill and practice method is a teaching technique that allows students to practice continuously to improve their skills and dexterity. In other words, drill and practice emphasize the importance of practice, where the more practice is done, the more skilled students are in achieving learning goals (Latipah et al., 2024). With repetition, students can obtain skills from the lessons they learned (Omar, 2007).

CONCLUSION

Based on the findings and analysis in the research on the development of flipped classroom learning design with a drill and practice approach, it can be concluded that the product developed has been valid for implementation. This validation is based on the results of tests conducted by media, content, and learning design experts. The learning design developed provides facilities for students to learn material independently outside the classroom and do repeated practice in the classroom.

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