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# Development of Learning Media Using Livewire Application and Printed Circuit Board Wizard in Electronic Circuit Application Subject

**Diana Dewi[1], Tri Widayatsih[2], Muhammad Juliansyah Putra[2]**
[1]SMK Negeri 2 Kayuagung, South Sumatra, Indonesia, [2]Universitas PGRI Palembang, South Sumatra, Indonesia

Corresponding author e-mail: dinde754@gmail.com

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**Abstract:** This study aims to develop an interactive module using Livewire and PCB Wizard applications to facilitate students in designing electronic circuits in the subject of electronic circuit applications. The study employed the methods of analysis, design, development, implementation, and evaluation (ADDIE). Furthermore, there was an improvement in scores from the experimental class compared to the control class. Expert evaluations resulted in an average score of 4,24 with a percentage of 84,93%. The effectiveness questionnaire from students yielded a score of 4,53 with a percentage of 90,07%. These findings indicate that the interactive video is considered effective and practical for use, demonstrating that the use of Livewire and PCB Wizard applications can significantly improve students' abilities in designing electronic circuits.

**Keywords:** Development, Livewire, PCB Wizard, Video

## A. Introduction

In the 1945 Constitution, Article 31, paragraph 1 states, "Every citizen has the right to receive education," and paragraph 2 states, "Every citizen is obliged to follow basic education, and the government is obliged to finance it". In the fourth paragraph of the 1945 Constitution, the Indonesian government, among other things, is obliged to educate the nation's life. According to Lengeveld, education is an effort to influence, protect, and provide assistance aimed at the maturity of students. The goal is to help students to be able to carry out their own life tasks without the help of others. According to Dewey, education is a process of experience because life is growth (Dewey, 1938). Education helps inner growth without being limited by age (Green et al., 2020). This growth process is a process of adjustment at each phase of life and adds skills to a person's development. Meanwhile, education is an experience that provides understanding, insight, and adjustment for students, so that they can develop and grow (Kahu & Nelson, 2018).

In realizing the ideals of the Indonesian nation, education has a very strategic role in improving the quality of human resources, namely achieving general welfare and improving the life of the nation (Astomo, 2021). Human resources are a very important component in an organization (Herbeth & Barunwati, 2024). Education also plays a very important role in the formation, development, and improvement of the quality of human resources (Piwowar-Sulej, 2021). In other words, if a nation has quality human resources, then the quality of education in that nation must also be good, and vice versa (Hamdani et al., 2024). A good education system is an education system that can produce quality humans from an educator who can explain and educate his students well; besides that, facilities will also support the implementation of the learning process (Amelia et al., 2022). This is in accordance with (Wulansari & Maunah, 2024). Problems of the education system as a system an education system consists of factors including personnel, students, teaching, learning techniques, facilities, resources, and materials (Eze et al., 2018).

Vocational high schools are schools that prioritize areas of expertise where students study the chosen field and are given direction, as well as the existence of laboratories and workshop practices so that vocational high schools can be said to be producers of competent workers in their fields (Suharno et al., 2020). To determine the success of students, schools must set a standard of completion called learning completion in accordance with the National Education Standards Agency (Rasmitadila et al., 2020). To normalize the learning process, the vocational learning stage emphasizes the formation of student skills through learning activities by practicing (Astarina et al., 2020). The national education subsystem of vocational high schools must prioritize the preparation of students with the skills needed to make the right career choices, enter the world of work, compete, and succeed in a job market that continues to grow and is dynamic (Rizqiyana et al., 2023).

We conducted observations, collected data on the condition of the workshop/laboratory at Audio Video Engineering, SMK Negeri 2 Kayuagung, and conducted direct interviews with teachers and students. The data obtained during the learning process was that there were still many students who were still passive and did not understand the material when carrying out the practice, still looking at their gadgets, some playing games, or whispering to each other, so they did not understand how to make good drawings and did not know electronic symbols, how to draw, change component values, and simulate aesthetics, techniques for adjusting line sizes, design models, and PCB layouts. The factor causing students to not master the material is the lack of computer facilities to carry out practice in the workshop; there are only 3 computers, while according to the Norms and Standards for Audio Video Engineering Competency Laboratories/Workshops, the number of computers in one practice room is 36 units (Efendi, 2021). The existence of facilities and infrastructure will increase student motivation in learning and can help teachers in the learning process (Lisnawati et al., 2023).

So far, productive teachers have teaching materials in the form of learning modules and jobsheets that are used as a guide for student practice in learning (Triyanto et al., 2022). The obstacles to learning using existing teaching materials include the learning modules only being owned by the teacher, while during practice students are given jobsheets (Muslim et al., 2020). With jobsheets, students still find it difficult to understand; to help the practice process, the teacher will demonstrate and repeat the explanation when there are students who do not understand and must be given one by one or in groups so that the time needed is longer to explain until students understand so that the work results are less than optimal. The lack of application integration that allows direct simulation and implementation can be an obstacle in practical learning. To draw electronic circuits, students only draw manually using pencils, pens in books, and permanent markers on PCBs, so that the resulting images are not optimal in both shape and size, as seen in the image below.

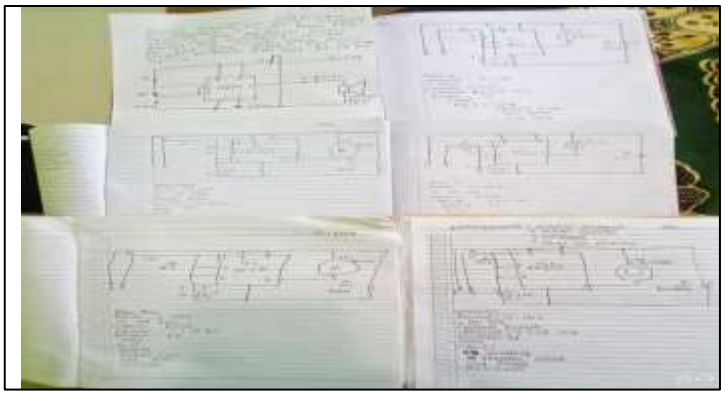

**Figure 1. Student's Manual Drawing Results**

In order for the resulting image to be more accurate in terms of line size and the distance between one line and another line to look neat and the same size, there is an application called Livewire and PCB Wizard. This application is made in the form of a module so that it is easy for students to understand. Learning media is very important to increase students' interest in learning. In delivering this application to students, learning videos are needed so that students can receive and absorb what is being conveyed from the livewire application so that students can produce better images.

Ideally, an audio-video Video Engineering major school has a complete workshop with facilities and infrastructure. The gap that occurs is the lack of computers as a tool to use the livewire and PCB Wizard applications, but students can still use the existing computers in turns. The lack of facilities such as computers and laptops does not reduce the enthusiasm of us to continue teaching materials about sensors or other materials that can train students' skills to make electronic products. Electronic products are produced through a process from making drawings or designs to the

finished form or final result of a project. The learning objectives in the research that are to be achieved are so that students can make a picture of a sensor circuit.

**Figure 2. Students are Paying Attention to What the Teacher is Saying a about the Livewire and PCB Wizard Applications**

Along with the development of technology, vocational education in the field of audio-video Video Engineering is expected to be able to follow the ever-evolving industry standards. However, limited facilities and equipment, especially computers, are the main obstacles that hinder the learning process. These limitations cause students to be unable to practice the necessary skills optimally, which has the potential to reduce the quality of graduates.

To overcome this problem, the audio video engineering expertise program at SMK has implemented a solution in the form of learning videos. Learning videos allow students to get technical materials and instructions without the need for a large number of computers (Yip et al., 2019). By using videos, students can learn independently and flexibly, accessing materials anytime and anywhere (Zainuddin & Perera, 2018). Learning videos cover a variety of topics, such as drawing tutorials with the Livewire and PCB Wizard applications, the use of video editing software, audio device simulations, image capture techniques, and so on. Thus, students can still develop practical skills even though computer facilities are limited. The use of learning videos also allows teachers to provide more structured instructions that can be repeated by students as needed.

In addition, learning videos allow for budget savings, because schools do not need to immediately replace or add a large number of computers. Existing resources can be focused on procuring other equipment that is also important to support the learning process, such as video cameras, microphones, and audio mixers. With this solution, it is hoped that the quality of education in the Audio Video Engineering expertise program can be improved, even with limited facilities. Learning videos are an effective alternative to ensure that students continue to get adequate learning experiences that are relevant to industry demands.

After conducting an inventory of the computer equipment available in the Audio Video Engineering department, it was found that currently there are only 3 computer units. Based on the guidelines from the Directorate of Vocational High School Development, there should be 36 computer units available to support the learning process optimally. The shortage of 33 computer units has a significant impact on the effectiveness and efficiency of teaching and learning activities, especially in practicums that require intensive use of computer devices. Therefore, it is urgent to increase the number of computers according to the needs that have been set so that the learning process can run well and according to the established educational standards. From the results of the 1st interview with one of the Productive Audio Video Engineering teachers, Mr. A (December 6, 2023), it was found that learning videos were very lacking and needed to be made to make it easier to understand the livewire and PCB Wizard applications. The 2nd interview with the Basic Competency subject teacher, Mrs. S (December 7, 2023), concluded that learning videos need to be used in learning to make it easier to use the Livewire application. Then the 3rd interview with a productive teacher who teaches in grade XII who teaches the subject of equipment maintenance and repair (December 8, 2023), it was found that students need learning videos to guide them in drawing circuits practically.

Likewise, the results of an interview with one of the students, G (December 11, 2023), found that students really like it when given learning videos by teachers to learn through gadgets about how to make electronic circuits about drawing with the Livewire and PCB Wizard applications. Then student F (December 12, 2023), by being given learning videos, it will be easy to understand electronic symbols; also student A (December 13, 2023), with learning videos, it can make it easier for students to understand and know how to simulate circuits before using a laptop or computer. Based on the description above, the researcher wants to conduct a study entitled "Development of Learning Media Using the Livewire and PCB Wizard Applications in the Subject of Application of Electronic Circuits for Class XI.1 Audio Video Engineering Students at SMK Negeri 2 Kayuagung".

**B. Methods**

We used the type of research and development (R&D). Audio Video Engineering of SMK Negeri 2 Kayuagung by presenting learning using learning media in the form of learning videos about making light sensors with the Livewire and PCB Wizard applications through gadgets to students through the Project Based Learning (PjBL) learning model and the development procedures used are analyze, design, develop, implement, and evaluate (ADDIE). The approach in this study is descriptive quantitative, with the R&D research method and the type of experimental research in class XI.1 TAV and the control class in class XI.2 TAV SMK Negeri 2 Kayuagung. The material presented is about sensors using the Livewire and PCB Wizard

applications. The researcher wants students to be able to use the application in making electronic circuits so that they produce good electronic circuit images that can be simulated.

## C. Results and Discussion

### 1. Discussion of Development Results

From the description above, this research and development uses the ADDIE model approach, namely analysis, design, development, implementation, and evaluation. The results of the development of learning media show a significant increase in students' understanding of electronic circuit design and simulation. This media is designed to provide a more practical and enjoyable learning experience, facilitating the exploration of electronic concepts with intuitive and interactive visualizations. Students can easily design, test, and modify their circuits, thereby improving problem-solving skills and creativity in the field of technology.

In this study, it was found that there was a shortage of computers; in one practice room there should be 36 computer units (Efendi, 2021), while there were only 3 computers (inventory data). However, a solution will be sought so that more computers can be added by submitting a proposal to the relevant parties, namely infrastructure and the principal at SMK Negeri 2 Kayuagung. learning media, especially in the form of learning videos related to the use of LiveWire and PCB Wizard software. This was obtained from the results of interviews with several teachers and students that have been explained above. LiveWire is a circuit simulation software that is often used in electrical and electronics engineering education. Although this software has many useful features, the lack of learning videos makes it difficult for students to understand how to use it and the practical application of this software.

Good learning videos can help students see how circuits are designed, tested, and modified in a simulation environment. PCB Wizard is a printed circuit board (PCB) design tool used to design and create PCB layouts. Similar to LiveWire, the lack of adequate learning videos causes obstacles in the student learning process. Effective learning videos can show the steps in designing a PCB, from creating a circuit schematic to creating a layout and producing a PCB. Video learning media has a very important role in the learning process because it provides clear visualization and practical demonstrations that facilitate student understanding. Without clear and structured learning videos, students tend to have difficulty understanding the concepts and practical applications of the software. This can slow down the learning process and reduce student motivation. With adequate learning videos, it is hoped that students can more easily understand and master the use of LiveWire and PCB

Wizard software, thereby improving the quality of their learning and learning outcomes.

Before conducting the research, we created an instrument for the learning video resulting from the development of learning videos that had been assessed by the validator and were suitable for use based on the assessment results from the validation team. The purpose of the validation was to determine the suitability of the learning video to be given to students as a trial in the research to see whether this product was suitable for use. Before being used, this learning video was validated by material experts, media experts, and information technology experts, as well as education practitioners. We created a questionnaire and then submitted it to material experts, media experts, information technology experts, and education practitioners.

The questionnaire consists of 30 assessment indicators grouped into 6 aspects, namely curriculum, suitability of materials, quality of learning, availability of additional resources, and evaluation. Then the media expert questionnaire, where the questionnaire for media experts has a questionnaire consisting of 30 assessment indicators from 5 aspects, namely user experience, performance and quality, circuit simulation, component relationship analysis, and interactive learning. The information technology expert questionnaire consists of 30 indicators that have 6 aspects, namely suitability to user needs, interactivity, ease of use, simulation quality, performance, and learning and understanding. Get improvements to the sentence section to be made as a statement sentence so that it is not confusing. In terms of the education practitioner questionnaire, it has 30 assessment indicators from 6 aspects consisting of content quality, interactivity, design and navigation, user involvement, learning effectiveness, and suitability to the curriculum.

Based on the validation data from the material experts, the average score of the curriculum aspect was 4.4 with a percentage of assessment of the learning video curriculum aspect of 88%, the average score of the material suitability aspect was 4.36 with a percentage of 87%, the learning quality aspect with a score of 4.5 and a percentage of 90%, the average score of the availability of additional resources aspect was 4.75 with a percentage of assessment of the learning video curriculum aspect of 95%, and then the evaluation aspect with a score of 4.5 with a percentage of 90%. From the five aspects, an average of 4.50 with a percentage of 90% was obtained and included in the "Very Appropriate" category. Revisions to the material expert questionnaire were made so that the sentences in the indicators were made concisely. And the calculation results used percentages.

Based on the assessment data from media experts, the average score of the user experience aspect was 4.3 with a percentage of the assessment of the learning video curriculum aspect of 86%, the average score of the performance and quality aspects

was 4.16 with a percentage of 83%, the circuit simulation aspect had a score of 3.6 and a percentage of 73%, the average score of the component relationship analysis aspect was 4 with a percentage of the assessment of the learning video curriculum aspect of 80%, and then the interactive learning aspect had a score of 5 with a percentage of 100%. Of the five aspects, an average of 4.21 was obtained with a percentage of 84.4% and was included in the "Very Eligible" category.

Based on the validation data from Information Technology experts, it can be seen that the average score of the Suitability aspect with user needs is 4.6 with a percentage of the assessment of the Suitability aspect with user needs of the learning video of 92%, the average score of the Interactivity aspect is 4 with a percentage of 80%, the ease of use aspect with a score of 4 and a percentage of 80%, the average score of the Simulation Quality aspect is 4 with a percentage of the assessment of the Simulation Quality aspect of the learning video of 80%, and then the performance aspect with a score of 3 with a percentage of 60%. Then the learning and understanding aspect with a score of 4 with a percentage of 80%. From the six aspects, an average of 3.93 was obtained with a percentage of 78.67% and is included in the "Eligible" category.

Revision of the results of the informatics expert questionnaire, sentences on the indicators to make more specific statements, not questions that will be broad. Based on data from education practitioners, the average score of the content quality aspect was 4.33 with a percentage of assessment of the learning video curriculum aspect of 86.66%, the average score of the interactivity aspect was 4.5 with a percentage of 90%, the design and navigation aspect had a score of 4.16 and a percentage of 83.33%, the average score of the user involvement aspect was 4.25 with a percentage of assessment of the learning video curriculum aspect of 85%, and then the aspect of learning effectiveness had a score of 4 with a percentage of 80%. Then the aspect of suitability with the curriculum with a score of 4.75 with a percentage of 95%. Of the five aspects, an average of 4.33 was obtained with a percentage of 86.67% and was included in the "Very Eligible" category.

In this study, a learning plan for the application of electronic circuits was made in a learning video as a guide to implementing teaching and learning activities in the classroom. The learning process begins with the implementation of providing a brief overview of the pre-test to measure students' initial knowledge of the Livewire and PCB Wizard material. After that, students took the pre-test on March 26, 2024, then followed the learning session that had been designed in the learning video. The learning video explains the steps of learning activities starting from the introduction, core activities, and closing. On March 27, 2024, in the learning activity, students were told about the components that would be used in the Livewire and PCB Wizard applications, and then students were given an interactive video before taking part in the practice using a computer or laptop that had the Livewire and PCB Wizard

applications installed. In the interactive video, students are introduced to the symbols used in the circuit that will be drawn on the image screen and how to move the components in the gallery menu.

At the next meeting on April 15, 2024, a picture of a light sensor circuit was given as an example to create a picture of a circuit that will be made by students or other sensor pictures agreed upon by each group as an assignment that must be completed by students. Then on April 3, 2024, learning with the Livewire and PCB Wizard applications, as well as group practice, allows students to understand basic concepts in electronics and circuit design in an interactive and practical way. April 16, 2024 Through Livewire, students can simulate electronic circuits and see how components work in real-time. On April 17, 2024, PCB Wizard material was given, which can help them design and produce printed circuit boards easily. Group practice improves collaboration and communication skills between students and provides a comprehensive learning experience, from theory to practical applications in the real world.

Group assignments using the Livewire and PCB Wizard applications allow students to work together to understand the basic concepts of electronics and circuit design. In groups, students can share ideas with each other, simulate circuits with Livewire, and design and produce printed circuit boards using PCB Wizard. Collaboration in this group not only improves technical understanding but also develops collaborative and communication skills that are important in the workplace. After the learning is complete, a post-test was conducted on April 23, 2024, to assess the increase in students' understanding of the material that has been taught. To ensure that the assessment instruments used are valid and reliable, an instrument validation process was carried out. Through this process, a value was produced that showed a good increase in students' understanding after following the designed learning.

In the teaching and learning activities of how to do the application at the beginning of the research in the class, the researcher conducted a pretest. From the results of the pretest conducted by the researcher in the experimental class on Tuesday, March 23, 2024, in class XI.1 TAV, an average of 74.23 was obtained with a percentage of completion of 80.76% (KKM 70). Then the researcher provided learning materials by implementing interactive videos about the PCB Wizard livewire so that students understand how to make electronic circuits and their simulations, and then the posttest on April 23, 2024, obtained an average of 79.23 with a percentage of completion of 92.3%. From the data Classical Completeness Assessment Classification, the percentage is included in Very Good.

For the control class, the pretest results conducted by the researcher in the control class on Wednesday, March 28, 2024, in class XI.2 TAV, obtained an average of 66.54 with a completion percentage of 50% (KKM 70) with a fairly good assessment

classification. Then the material in the control class was given using conventional learning methods involving theoretical explanations in front of the class, focusing on the Livewire and PCB Wizard applications. Then at the meeting on April 4, 2024, without using interactive learning videos, the functions and benefits of each application were explained in the design and simulation of electronic circuits. The use of a whiteboard and slide presentations helped clarify the steps for using the two applications.

During the learning process, students were encouraged to ask questions and discuss to deepen their understanding. Then on April 18, 2024, practical examples and practice questions were given to ensure that students could apply the theories learned using Livewire and PCB Wizard in real situations. This method aims to build a strong foundation in understanding the concept of control and the application of these technologies before moving on to more complex projects. The pretest results showed a difference between the control class and the experimental class. Students in the control class who received material about the Livewire and PCB Wizard applications through conventional learning methods tended to have a strong basic understanding but lacked in terms of practical application. In contrast, students in the experimental class who used both applications directly and collaborated in groups showed an increase in understanding both theoretically and practically, as well as better collaborative skills. This difference in results highlights the effectiveness of a more interactive and practical learning approach in improving student competence. Then the posttest on April 24, 2024, obtained an average of 71.92 with a completion percentage of 73%. From data Classical Completion Assessment Classification, the percentage is good.

**2. Discussion of Effectiveness Results**

From the results of the questionnaire given to students to assess the effectiveness of learning videos, the results of the data obtained with a total value of 1179 divided by the maximum questionnaire value of 1300, then multiplied by 100%, the percentage obtained was 90.07%. With an average score obtained from the total score per item divided by the number of students, it was 4.53. So that learning videos can be categorized as effective and practical.

**3. Benefits for Students and Teachers**

Learning videos are easy to share via WhatsApp so that students can learn anytime, anywhere, using their gadgets. And for teachers, it is easier to convey material when there is not enough time to study at school. Effective learning video design is a crucial element in supporting the teaching and learning process, especially for technical software such as LiveWire and PCB Wizard. A good learning video not only explains the concept but also provides practical demonstrations that make it

easier for students to understand and apply the knowledge. In this video, the basics of using LiveWire to simulate electronic circuits are learned.

To ensure that students in the control class can achieve good grades, here are some steps that can be taken:

1. Provide a more in-depth review of important concepts related to the Livewire and PCB Wizard applications. Emphasis on the basic understanding and working principles of these applications is important to ensure that all students have a strong foundation.
2. Provide additional exercises and assignments that focus on the application of theory in various practical scenarios. These exercises can help students deepen their understanding and prepare them for the exam.
3. Encourage discussions in small groups to facilitate better understanding through collaborative learning. Students can exchange ideas and solutions to problems given.
4. Although the control class does not use direct applications in learning, structured practical sessions can be held in the workshop to provide students with hands-on experience.
5. Provide time for students to get individual or small group guidance and consultation with the lecturer, helping them overcome difficulties or confusion they face.
6. Use simulations and case studies in the learning materials to connect theory to real situations that students may encounter in using Livewire and PCB Wizard.
7. Provide constructive and detailed feedback on each assignment and exercise so that students can know the areas that need improvement and how to improve.

With these steps, it is expected that students in the control class can improve their understanding and get good grades. Then the researcher distributed a questionnaire to students in class XI.1 TAV as an experimental class to assess how effective the learning videos given to students were, and the results obtained were that the average score was 4.53 with 90.07% effective.
To ensure that the experimental class can achieve better results, here are some steps that can be taken:

1. Make sure students have full access and a deep understanding of the features in Livewire and PCB Wizard. Holding additional tutorial or workshop sessions on how to use the application can be very helpful.
2. Divide students into small groups and provide clear and structured projects so that each group member has a specific role. This will encourage more effective collaboration and individual responsibility.

3. Implement a PBL approach where students work on real projects that require the use of Livewire and PCB Wizard. This will provide practical context and relevance to students.
4. Provide regular feedback throughout the learning process and projects, helping students understand their strengths and areas for improvement. This feedback should be specific, detailed, and constructive.
5. Conduct reflection sessions after each assignment or project, where students can discuss what they have learned, the challenges they faced, and how they overcame them.
6. Implement an approach where students are given real-world problems to solve using Livewire and PCB Wizard. This can improve their analytical and problem-solving skills.
7. Provide additional resources such as video tutorials, user guides, and sample projects that students can access at any time to help them with their self-study.
8. Provide opportunities for students to get mentoring and coaching from lecturers or professionals who are experienced in using Livewire and PCB Wizard.
9. Conduct regular evaluations and assessments to monitor student progress and provide encouragement or intervention as needed.

The pretest results showed a difference between the control class and the experimental class. Students in the control class who received material about the Livewire and PCB Wizard applications through conventional learning methods tended to have a strong basic understanding but lacked in terms of practical application. In contrast, students in the experimental class who used both applications directly and collaborated in groups showed an increase in understanding both theoretically and practically, as well as better collaborative skills. This difference in results highlights the effectiveness of a more interactive and practical learning approach in improving student competence. With these steps, it is hoped that the experimental class can improve the effectiveness of learning and achieve better results. Thus, the learning video that has been developed into a learning video has proven effective in improving students' understanding of Livewire and PCB Wizard and can be used as a useful guide in teaching and learning activities in the classroom.

## D. Conclusion

From the description of the Research and Development (R&D) development research above, the following conclusions can be drawn:

1. To find out the validation results from material experts, media experts, information technology experts, and education practitioners, the development of learning media in the form of making learning videos from the

development of existing learning videos was carried out. The validation results from education experts and practitioners averaged a score of 4.24 with a percentage value of 84.93%, so this learning media in the form of learning videos is included in the "Very Eligible" category.

2. The results of the validation of the effectiveness of learning videos were obtained by distributing questionnaires to 26 students; a score of 1179 was obtained, divided by the maximum score of 1300, a percentage of 90.07% was obtained with a score of 4.53, so that learning videos are said to be effective and practical to use.
3. Learning videos are easy to share via WhatsApp so that students can study at home. And for teachers it is easier to convey material if the study time at school is not enough time.

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