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Development of Physics Demonstration Videos on Youtube (PDVY) as Physics Learning Media

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Abstract

The availability of physics demonstration videos relevant to curriculum needs is still limited. The aims of this study were (1) to develop physics learning media in the form of demonstration videos; (2) testing the feasibility of using demonstration videos as a medium for learning physics; and (3) knowing student responses to demonstration videos. The name of this demonstration video is Physics Demonstration Videos on YouTube (PDVY). This video is available on the PDVY Indonesia YouTube channel with open access. This research uses research and development methods. The steps for making this demonstration video consist of analyzing the core standards and competency standards of physics subjects, designing storyboards, taking pictures, editing, initial testing, revising initial test results, field trials and revising the results of field trials. The trial was conducted on 129 high school students in Garut, Indonesia. The results showed that (1) the physics demonstration video was composed with input from the validator, two physics lecturers, and two physics teachers; (2) the demonstration video is suitable for use as a physics learning medium from the material and media aspects; and (3) excellent response from high school students and teachers. Based on the validation of both the content validator and the media validator, it shows that the design of the parabolic motion demonstration video is very valid. The benefit aspect gets the highest score. This shows that the video developed has a high use value in the learning process.

Key words: Demonstration Videos, Learning Media, Physics Learning Media, YouTube

INTRODUCTION

Physics is a science that has an important role in life. Physics subjects have been given from junior high school and have an important role in the field of education (Nurhayati, 2014). The essence of learning physics is to provide knowledge and understanding to students about natural phenomena that occur in everyday life and solve problems that occur.

Nonetheless, the fact is that the understanding of students in Indonesia towards science is very low. One indicator is the low PISA results, especially in understanding science. It can be seen from the relatively low learning outcomes of physics compared to other subjects (Naufaina, 2016). Physics is often seen as a difficult subject. The results showed that students had difficulty understanding physics. Most students said that these difficulties were often experienced when they got physics lessons using the lecture method (Azizah, 2015).

A good learning process can be carried out by learning that cannot be separated from learning resources or a supportive learning environment (Sani, 2016). In learning activities, Physics material combines theory and practice which are packaged together. This requires the development of a visualization learning resource to strengthen students' understanding (Zakirman, 2017). One of them is by visualizing the material

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using information and communication technology (Anggraeni,2013). This is an alternative for schools that do not have complete practical tools and can support the learning process without being limited by space and time.

Students' understanding of science can be realized through learning that presents phenomena and problems that often occur in everyday life. These activities can be presented through observation, demonstrations, and experiments. The easiest activity to do is demonstration. The use of the demonstration method in learning physics gives a tendency for student achievement to be in the high category (Pantas, 2016). In this demonstration activity, students can interact with objects or concrete learning media (Hernawati, 2018) Demonstrations can be done directly. To do a live demonstration, props or practicum tools are needed. However, the problem is that not all schools have complete practicum equipment, and even do not have laboratories.

In improving the quality of education in physics learning, including referring to the competence of the 21st century, its implementation requires consideration of the aspects of ease of administration and technology implementation (Abyadati, 2017). The American Association of Colleges of Teacher Education (AACTE) states that the use of technology in learning acts as a tool for researching, organizing, evaluating, and communicating information. Technology is currently growing; it is possible to use learning media that can be accessed via the internet. This rapid technological development allows students to be able to independently access technology-assisted learning (Putri, 2016). A popular site whose monthly access traffic is very large in Indonesia is YouTube. There are not too many demonstration videos related to physics lessons on YouTube. Demonstration videos that can be accessed anywhere can be an alternative to distance learning.

The use of YouTube as a learning media is one solution to implement learning that can be carried out anywhere. The results of research conducted by Puwandari (2019) on high school students show that more than half of the respondents have used YouTube as a learning resource. YouTube is a tool that is very close to students' daily lives so it will be very easy for teachers to direct it to the learning process. YouTube can be used as a learning medium but must be adapted to the material, age, and psychological development of students (Rahmatika, Yusuf, & Agung, 2021).

Nuzuliana (2015) in her research revealed that based on data obtained from three schools in Jakarta, it was shown that 88% of students stated that the use of video was one of the interactive media used as a learning medium in learning. 91% of students stated that the use of instructional videos in physics learning could help students understand physics concepts, especially videos related to the application of the concepts being studied (Nuzuliana, 2015). Other studies have revealed the benefits of video viewing, namely that it can show real-life and practical activities, where the video can be repeated as needed (Donkor, 2011). The results showed that there was a significant increase in student understanding, before and after using video and animation teaching materials in physics learning (Zakirman, 2017). The results of other studies reveal that the use of video can improve student-learning habits (Nimavathi & Gnanadevan, 2009).

Physics learning videos that are currently available are still not in accordance with the needs and goals of learning physics, it is necessary to develop learning videos that can meet the needs and become an alternative for students in making it easier to understand physics learning. Based on the background that has been described, this study develops demonstration videos as a physics learning aid that can be used in class but can also be accessed by students and teachers at any time via mobile. The video was uploaded on the YouTube channel under the name PDVY (Physics Demonstration Videos on YouTube). The aims of this research are to find out how students respond to the demonstration videos developed.

METHOD

This study uses the Research & Development (R&D) method. In implementing this method there were seven procedures performed. The procedure is taken from ten procedures formulated by Gall et al. (2003). The seven steps are (1) preliminary study, (2) planning, (3) initial production, (4) initial testing, (5) revision of initial trial results, (6) field trials, (7) revision of field trial results.

The development process involved four validators, including two physics content experts and two media experts. For the content section, there are five aspects that are measured, namely: (1) relevance, (2) accuracy, (3) presentation completeness, (4) basic concepts, and (5) suitability. Meanwhile, for the media section, there are three aspects that are measured, namely: (1) media quality, (2) language use, and (3) layout.

In the first stage, a preliminary study was carried out to determine the situation in the field regarding the use of demonstration videos as a medium for learning physics. Data were collected using a survey method which was given to 140 physics teachers in West Java. To strengthen the initial data, a literacy study was carried out through previous studies related to physics demonstration videos.

The second stage is planning to design the product. To design a demonstration video that can be used in physics learning, the first step begins with analyzing Basic Competencies (KD). The basic competencies used in this study are the basic competencies in physics material for class X on the topic of parabolic motion. The results of the KD analysis are then used to make a video storyboard.

In the third stage, namely the initial stage of production, video was taken with reference to the storyboard and followed by the editing process. After the editing process was complete, a demonstration video was produced through a judgment process by content and media experts. After providing the validation and revised them according to the judgement results, the next step was initial trial stage. This initial trial was limited to two teachers and ten high school students in Garut Regency.

There are two testing mechanisms for students, namely the initial test mechanism or limited trial and the field trial mechanism. The initial trial mechanism was carried out by randomly selecting 10 grade X students from one of the schools in Garut Regency. This trial was used to determine student responses to demonstration videos, readability, and appropriateness of the content in the developed videos. Students were randomly selected from all heterogeneous classes. At this stage students are asked to watch a demonstration video, then fill out a questionnaire in the form of a Likert scale.

The trial results are then used for the fifth stage, namely the revision of the initial trial results. At this stage, the video takes the missing frames and editing the second stage. Then the next stage is field trials. Field trials were conducted on ten teachers and 129 high school students in Garut Regency who were selected by purposive sampling method.

The mechanism for field trials to students is carried out in three stages, namely: (1) student selection, (2) use of demonstration videos in learning, (3) filling out a video demonstration eligibility questionnaire. The students involved in this field trial came from two high schools in Garut Regency. There were five classes from the two schools that were selected to use demonstration videos in learning. This selection is made based on the appropriate material agenda at the school. The five classes were studying parabolic motion when this demonstration video was tested. Therefore, the time suitability factor is a consideration in the selection of students.

In the next stage, students use demonstration video media in learning parabolic motion in their respective classes with a series of lessons from their respective teachers. This demonstration video is used as a learning tool that supports the learning process.

After learning is complete, the next stage in this field trial is filling out a questionnaire as a form of student response. All students who took part in the learning using demonstration videos filled out a questionnaire via a google form. The results of this questionnaire will be one of the feasibilities analyzes of the demonstration video that has been made.

After the field trial, the results of the reflection were used for the final stage, namely the revision of the field trial results. After the revision was completed, the demonstration video was then published through a channel on YouTube.

The demonstration video was made by a team of researchers and assisted by students of the physics education study program at the University of Garut. The topic of the demonstration video is about the motion of the parabola. This material is the result of the analysis of the basic competence of physics in class 10 in high school.

The instrument used to determine the response of students and teachers was a multilevel scale questionnaire with a scale of 1 to 4. The instrument consisted of 10 statements regarding the demonstration video that had been made. Each statement item has been tested and declared statistically valid. Not only having passed the validity test, but the instrument has also passed the reliability test with a Cronbach's Alpha value of 0.77.

RESULT AND DISCUSSION

The results of a preliminary study conducted on physics teachers in West Java show that demonstration activities are very important in learning because they can increase students' attention in learning. More than 80% agree that demonstration videos can be used as an alternative media for learning physics, especially in online learning. However, 68.6% of teachers stated that the demonstration video circulating on the internet had not met the needs of the prevailing curriculum in Indonesia.

The results of the preliminary study are in line with several previous research results that support the process of developing demonstration videos as learning media. As the results of research by Fatwamati, et al (2018) which show that teachers and students feel the importance of learning media and the use of demonstration videos in learning affects student learning outcomes in a positive direction. In addition to improving student learning outcomes, the use of demonstration videos in learning is also able to improve science process skills (Putri, 2019). Learning models that utilize video are also able to improve creative thinking skills, analytical skills, and problem-solving abilities (Firdaus, et al., 2017). Therefore, the development of this demonstration video has strong support so that it is continued in the planning process.

At the planning stage, video development is carried out by analyzing basic competencies to describe the concepts to be conveyed in the video. The results of the analysis were transformed into the video storyboard. The storyboard was used as a reference in the making and editing of the first video. The editing process is done with Adobe Premiere Pro software. An important part of editing this parabolic motion demonstration video is the motion tracking using the frame holding method as shown in Figure 1.

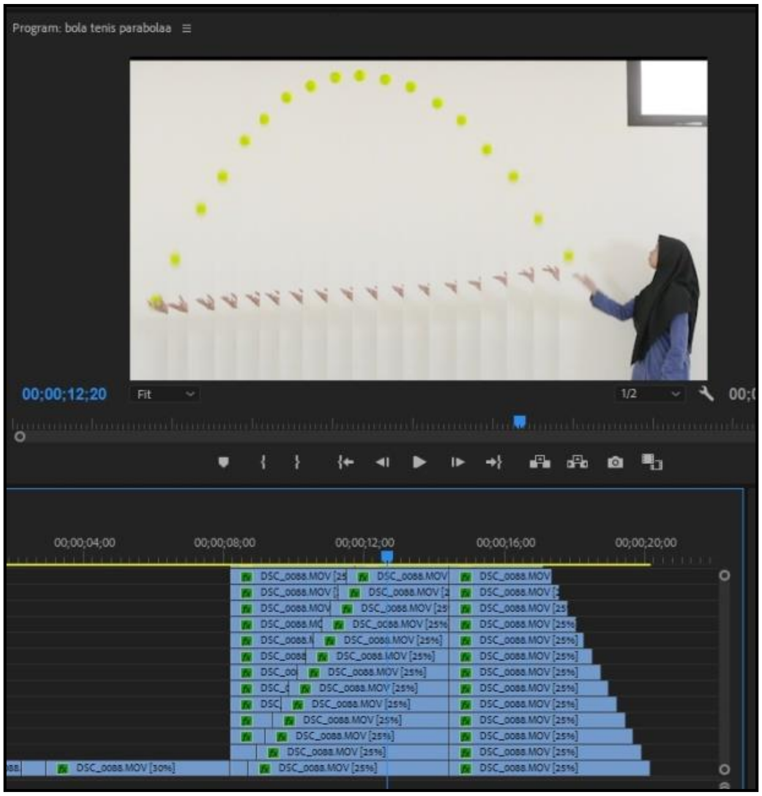

Figure 1. Video Editing Using The Frame Holding Method

This first stage video then goes through the design validation process by content expert validators and media experts before being tested. The results of the validation can be seen in Table 1. Based on Table 1, it was found that the validation score by the physics content expert was 4.45 and the validation score by the media expert was 4.25.

Table 1. Validation Results of Physics Content Experts

Validator	Average Score	Criteria	Interpretation
Content Experts	4.45	89.0%	Very Valid
Media Expert	4.25	85.0%	Very valid

This score is the average value of each assessment indicator. As explained in the method section, content validation has five aspects and media validation has three aspects.

A description of the results of content validation for each aspect can be seen in Figure 2. The maximum score for each aspect is 5. The greatest score is in the second aspect, namely accuracy. This aspect includes two indicators, namely (1) the material presented is in accordance with scientific truth, and (2) the material presented is in accordance with everyday life. Thus, the content of the content in terms of accuracy is in accordance with science and applications in everyday life. This can train students in understanding themselves, their surroundings, and solving problems in everyday life (Putri, 2020). The suitability between content and context becomes a strength for students in practicing problem solving in everyday life. This is in line with the research of Febrianti, et al. (2017) which states that media that displays content in the context of everyday life allows students to understand the function of learning itself.

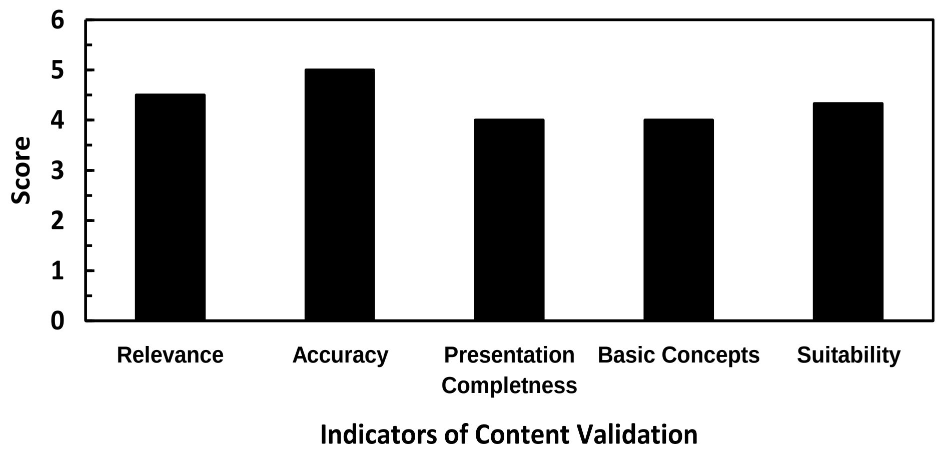

Figure 2. The Results of The Validation by Physics Content Experts for Each Aspect

In the third and fourth aspects, the validator gave a score of 4. The third aspect is the completeness of the presentation. The completeness of the presentation is described in the indicator which states that the media must present the competencies that must be mastered by students. Meanwhile, the fourth aspect is the basic concept. This basic concept is explained in the indicator which states that the video content is in accordance with the concept of parabolic motion. The concept of parabolic motion used has been analyzed based on the basic competencies in the curriculum. This basic competency analysis is important to ensure that the media used can support the learning process in accordance with the objectives. The objectives of learning are listed in the basic competencies in the curriculum.

The scores on this third and fourth aspect get the lowest score compared to other aspects. However, when viewed from the criteria, this score is still classified as valid. So that the validator only provides input for minor improvements to the demonstration video content. This means that the completeness of the presentation and the basic concepts in the demonstration video are in accordance with the expected competency standards. By adding minor improvements, the completeness of the presentation and the basic concepts will further strengthen the demonstration video as a learning medium that leads students to achieve the expected learning objectives.

Advice from physicists related to basic concepts of physics. In the first design, the video will show the relationship between free fall and parabolic motion. According to experts, it should be emphasized that the shape of the graph obtained from tracing the position of the ball at the same time interval is similar to the trajectory of the parabola. This can be used as the basis for parabolic motion analysis. So that the scene is emphasized by the narrative.

Affirmation through narration can build conceptual understanding of the events shown in the video. So that the demonstration video that is used as a learning medium is able to improve students' understanding of concepts. Media plays an important role in understanding students' concepts. So that in designing media, it is necessary to pay attention to details that affect student understanding. Many studies have shown that the use of instructional media can improve students' conceptual understanding. As the results of research Hidayat, et al. (2019) which shows that the use of simulation media in physics learning is able to significantly influence concept understanding compared to students who do not use it. In addition, research conducted by Yulisa, et al. (2020) also showed an increase in students' understanding of concepts through physics learning videos.

The results of validation by media experts for each aspect can be seen in Figure 3.

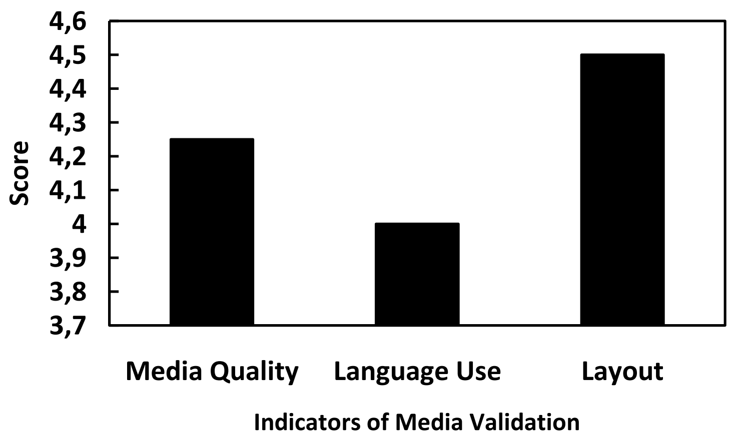

Figure 3. The Results of The Media Expert's Validation For Each Aspect

The results of the validation from media experts showed that the three aspects that were assessed were declared valid with a score above 4. In the second aspect, it got a smaller score than the other aspects because the narrative video content that was conveyed was only text. Even so, the text submitted is in accordance with the concepts and contexts that have been designed in the storyboard. This can be considered for the development of further demonstration videos to add voice narration to further strengthen the content of the video. The use of text narration is used with the consideration that demonstration videos are used as visual media. So, students are required to use the sense of sight to take advantage of this video.

The advice from media experts is related to the visualization of the time graph of the ball's position which should show the distance and time scale. This input is still related to input from content experts. It is just that the advice from media experts is more on the visuals and graphics that appear on the video. The image shown must show that the position of the object is stopped at equal intervals. So that in that section the line scale and time marker are added. With lines and time markers, students will understand that there is a relationship between uniform straight motion, uniformly changing straight motion, and parabolic motion. The results of improvements based on input from content expert validators and media experts can be seen in Figure 4.

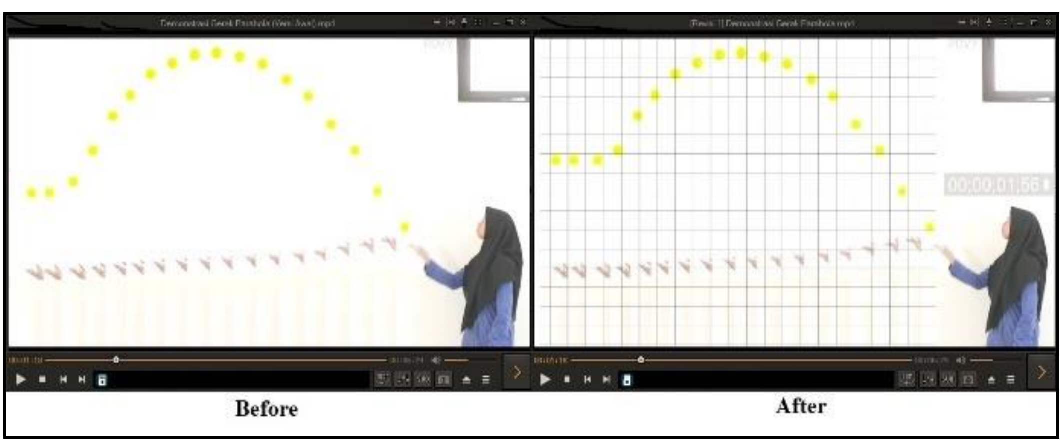

Figure 4. Video Revision Results Based on Input from The Validator

The revised first stage video is then uploaded via YouTube with the channel name "PDVY Indonesia" as in Figure 5. PDVY stands for Physics Demonstration Videos on YouTube.

Figure 5. PDVY Indonesia's YouTube Channel Display

This video was then tested limited to two teacher respondents and ten high school student respondents. The trial mechanism has been carried out in accordance with the established methodology. The selected students come from the same school but in different classes. The results of this initial stage trial are displayed in Table 2 for teachers and Table 3 for students.

Table 2. Results of the First Stage Trial to Teachers

Respondents	Eligibility Score	Criteria
1	3.8	Very Eligible
2	3.7	Very Eligible

Table 3. Results of the First Stage Trial to Students

Respondents	Eligibility Score	Criteria
1	3.0	Eligible
2	3.5	Very Eligible
3	3.3	Very Eligible
4	3.3	Very Eligible
5	3.5	Very Eligible
6	3.5	Very Eligible
7	3.0	Eligible
8	3.3	Very Eligible
9	3.4	Very Eligible
10	3.4	Very Eligible

The results of the first phase of the trial showed that the demonstration video that had been made was feasible to use. The input given by the teacher and students in the first phase of the trial was used to revise the video for further testing in the second stage.

There were two suggestions obtained from the teacher in the first phase of the trial. The first suggestion relates to the difference between the straight and parabolic trajectories at the beginning of the video. One of the teachers suggested that this section be clarified by showing a picture of the trajectory of the motion. The revision results based on these inputs can be seen in Figure 6.

Figure 6. Revision Results Based on Input from Teacher A in The First Trial

One of the other teachers gave suggestions on the demonstration section of parabolic motion which shows the effect of elevation angle on the reach of objects. In that part, so that the difference in the final position of the object is clearer, it needs to be clarified again. These suggestions are then applied by making edits in that section. Editing is done by placing an arrow at the point where the difference falls. The results of these edits can be seen in Figure 7. In the uncorrected video (Figure 7 on the left), the position of the object when it falls is not clearly visible. So it is fixed by adding arrows to clarify the position of objects (Figure 7 on the right).

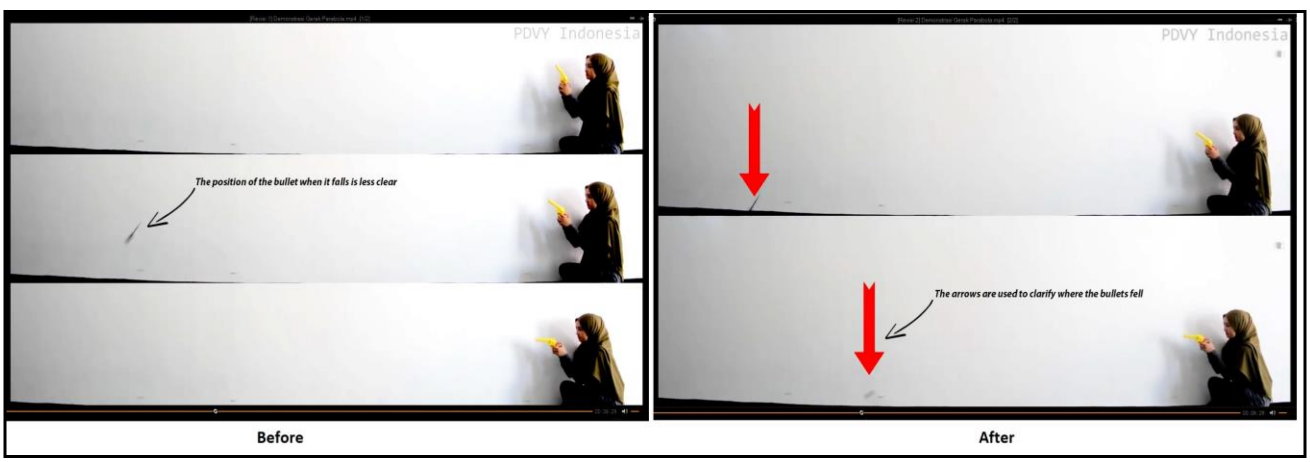

Figure 7. The revision results based on input from Teacher B on the first try

The second phase of the trial was carried out on more respondents, namely 10 teachers and 129 students. The results of teacher and student responses for each aspect can be seen in Table 4 and Table 5.

Table 4. Results of the Second Stage Trial to Teachers

Aspect	Eligibility Score Average	Criteria
Content	3.6	Very Eligible
Expediency	3.8	Very Eligible
Convenience	3.6	Very Eligible
Attractiveness	3.6	Very Eligible
Conformity	3.6	Very Eligible
Presentation	3.6	Very Eligible
Average	3.6	Very Eligible

Table 5. Results of the Second Stage Trial to Student

Aspect	Eligibility Score Average	Criteria
Content	3.36	Very Eligible
Curiosity	3.38	Very Eligible
Attractiveness	3.39	Very Eligible
Mastery	3.43	Very Eligible
Presentation	3.51	Very Eligible
Average	3.41	Very Eligible

The results of the second stage trial showed that in all aspects, both teachers and students got very good eligibility criteria. From the results of the teacher's response, the highest average is from the aspect of benefit. This demonstration video will greatly assist teachers in the learning process, especially in online learning during a pandemic like today. Video demonstrations can also be used as flexible learning materials for students so they can be studied anywhere. Video demonstrations can also be used as one of the learning media that can increase students' learning motivation. In line with the research of Salim, et al. (2020) that one of the benefits of media in the student learning process is to foster student learning motivation.

Based on the results of student responses, the aspect that obtained the largest feasibility score was presentation. This shows that students enjoy and understand the presentation of physics demonstrations in the form of videos. This aspect of the presentation relates to image quality, audio quality, and language legibility. Images and audio have been professionally shot and subjected to editing with the appropriate equipment. This is directly proportional to student responses. Good video quality is one of the factors to attract students' attention in the learning process. Wisada, et al. (2019) states that one indicator of the quality of a learning video is said to be good if the video is packaged with interesting and concrete pictures.

At the end, the product is revised again based on input from the results of the second phase trial. There are minor revisions based on the suggestions obtained from the second pilot activity. The revision is in the section on the comparison of straight motion and parabolic motion. This section shows two videos that are combined in one frame. The first video shows an object moving in a straight line, while the second video shows an object moving on a parabola trajectory. In this section, it is necessary to clarify that there are two videos that were recorded separately. The editing results can be seen in Figure 8.

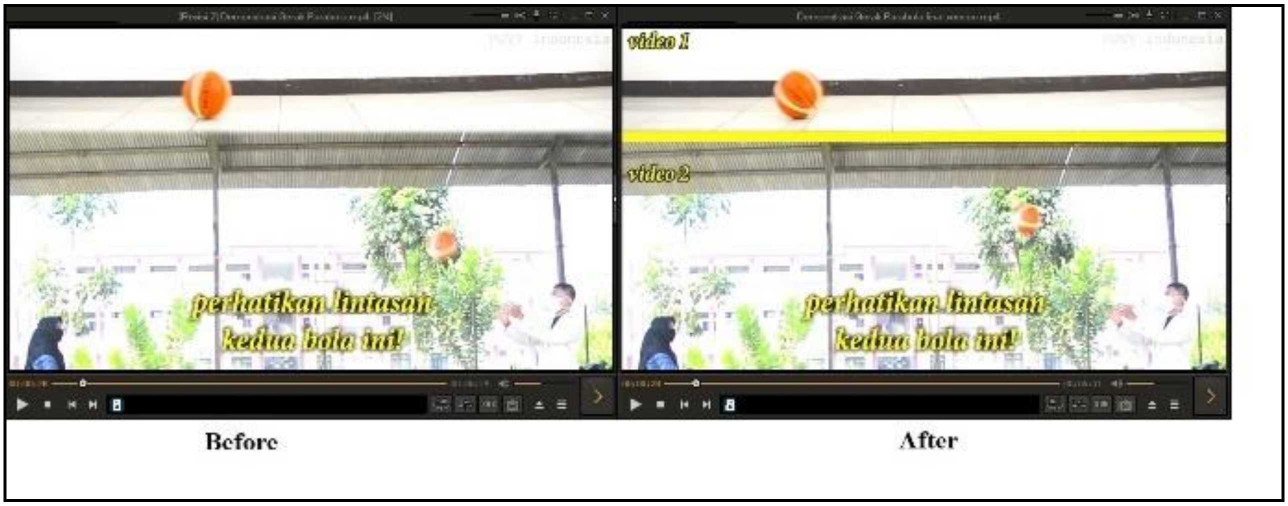

Figure 8. Revision results based on suggestions in the second trial

The final revision results are then publicly displayed on the youtube channel via the link: https://youtu.be/BEUPJZAU7Hs.

CONCLUSION

Demonstration videos that are in accordance with curriculum needs will complement learning that is in accordance with the objectives. Through appropriate development stages, the resulting video can be used as a valid learning medium. Therefore, validation and test results in the development process are important in this demonstration video.

Based on the validation of both the content validator and the media validator, it shows that the design of the parabolic motion demonstration video is very valid. While the results of the final trials conducted on teachers and students showed a response with very decent criteria.

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