Development of animation-based learning media to increase student’s motivation in learning physics

D Sastradika1∗, I Iskandar1, B Syefrinando2 and F Shulman2

1 Faculty of Science and Technology, UIN Sultan Thaha Saifuddin, Jambi, Indonesia
2 Faculty of Teaching and Education, UIN Sultan Thaha Saifuddin, Jambi, Indonesia

*dedisastradika@gmail.com

Abstract. The difficulty of students in understanding concepts in physics has a significant effect on students' motivation. The purpose of this study is to develop animation media that make students easier to understand the abstract concept of Newton's law and find out students' responses to the use of instructional media. The 4D framework is used to develop animation-based learning media, which consists of four-phase, namely: define, design, develop, and disseminate. The instruments used are a questionnaire and interviews. The results showed that (1) Based on expert judgment Animation-based learning media was appropriate and feasible to be implemented in the physics class; (2) used of media animation in learning physics could facilitate students in understanding the abstract concept of Newton's Law, especially in describing the direction of the force and gave opportunity to the student's to increase their motivation to learning physics where average score of the motivation was 70% in the “High” category.

1. Introduction

Physics is one of the lessons that are difficult for students to understand and apply in everyday life. This is because learning physics has many abstract concepts and formulas. The characteristics of the physics material have an effect on the low motivation to learn and student learning outcomes [1], another reason is learning implementation in schools used traditional methods, the implementation of the learning has not facilitated the students to understand the physics concept and has not provided opportunities for the students to collaborate technology in learning [1,2].

The use of technology in learning at this time is a need to adapt to current technological developments and one of the efforts in preparing human resources who have high ICT literacy [3]. The use of technology in learning is also one of the solutions to solve the learning problems in the classroom especially in helping students to understand abstract concepts [4–6]. Learning by using animation in physics is better than traditional learning or under teacher-based environment [7]. Animation-based learning media is learning that includes text, images, sound and video that are applied interactively to facilitate students in building their understanding [8]. By applying animation media in learning, students will have the opportunity to increase their achievement or learning outcomes [9]. The application of learning by using animation-based media is also an effective solution to the implementation of practicum, independent learning and as an interactive media presentation [10].

Learning motivation is important in learning physics because motivation plays an important role in building students' conceptual processes [11]. Besides learning motivation is also one of the important
factors in increasing students' interest in independent learning [12]. Thus, with the increase in student motivation, it is expected that this will affect the achievement of learning outcomes because motivation and learning have a significant correlation [13]. There are several important aspects in students' learning motivation; Self-efficacy, active learning strategies, value learning science, performance goals, achievement goals, and learning environment stimulation [11]. Thus, increasing student-learning motivation is very important to be recognized and enhanced to maximize student-learning outcomes. However, based on the results of observations in SMA N 11 Kerinci teachers still using conventional methods in physics learning. This is because of the limitations of teachers in developing and using interactive media even though the facilities provided by schools are adequate.

The physics learning outcomes of grade X in SMA N 11 Kerinci are still below the minimum graduation standard. This shows that students have difficulty in understanding the concepts of physics. Based on the results of interviews; the student has difficulty understanding abstract concepts so students feel not interested in learning physics. The teacher needs to solve this problem to help students to understand abstract concepts in physics learning. One of the solutions that can be used is to use technology to describe abstract physical concepts [14–16]. This can be applied by developing animation-based learning media [17]. The application of animation-based learning media is also a way to assist students in conducting virtual physics experiments [18]. Based on the problem above, the purpose of this study is To Produce animation-based learning media that can help students understanding the abstract concepts of Newton's law, to know the effect of using animation-based learning media on student learning motivation.

2. **Methods**

This study is a research and development using 4D Development Design (Define, Design, Develop and Disseminate). At the Define stage, the researchers conducted discussions with the teacher, made observations to get information about the application of learning and learning problems on Newton's law material. The design stage is carried out to get the initial draft of the animation media and the preparation of student learning motivation questionnaires. The aspects of learning motivation in this study will only measure three aspects of the six aspects namely: Active Learning Strategies, Science learning values, Performance, and learning achievement [11].

In the Develop Phase, it is conducted to produce appropriate animation-based learning media based on validation conducted by Learning Experts, Media Experts, and Material Experts. Animation media developed will be validated by seven Validators, including Lecturers from UIN STS Jambi, Teachers at schools who have more than 10 years of teaching experience and colleagues. The validation instrument uses a five scale questionnaire. Validation data analysis is done by comparing qualitative data with conversion criteria of validity.

After the animation-based learning media on Newton's Law was appropriate and feasible by the validator then a limited try-out was conducted which involved 10 students of class XI who had learned and understood Newton's law. Limited try-out tested aimed to know students' responses to the animation-based learning media. After the media was revised based on the information obtained, further large try-out was conducted to determine student motivation by used a scale 5 questionnaire that had been developed previously. Field try-out including 60 students of grade X SMA N 11 Kerinci by applying the pre-experimental method with one group design only, the data were analyzed using descriptive qualitative analysis techniques by means of the presentation then converted with the categories [19].

After the animation learning media developed is appropriate and feasible based on validation and field try-out, the next stage is disseminated where the developed media will be given to teachers in several high schools to be applied and tested widely.

3. **Results and discussion**

Animation-based learning media developed are validated by learning experts, media experts, and material experts. The results of the validation using a five-scale questionnaire showed that the developed
learning media was appropriate and feasible to be tested in learning physics in Newton's Law material. Where all aspects of the animation learning media developed were categorized as "Very good" with several revisions.

The field try-out involved 60 students in grade X SMA N 11 Kerinci used pre-experimental method with one group design only where students will be taught Newton's law about motion used animation-based learning media that have been developed and then given a five-scale questionnaire to determine student motivation. The aspects of student motivation measured in this study are only limited to the three aspects from six aspects of motivation learning namely Active Learning, the Value of Science Learning, performance and achievement. The results of the analysis of student learning motivation in the aspects of active learning can be seen in table 1:

| No | Question                                                                 | Item Number | Score | Percentage | Criteria |
|----|---------------------------------------------------------------------------|-------------|-------|------------|----------|
| 1  | Media content is relevant to Newton's legal material.                     | 1           | 72    | 70 %       | High     |
| 2  | Media content is easy for students to understand                          | 2           | 77    | 77 %       | High     |
| 3  | The media presents an attractive appearance (color, font, image, animation) | 3           | 61    | 61%        | High     |

**Average 70% High**

Student's motivation achievement on the Active learning aspect categorized "High" where the average presentation of this aspect is 70% shows that the developed media contributes to students in building newton's legal understanding and provides opportunities for students to do independent learning so students can learn about the material before entering the class. In addition, the animation that is displayed gives the original form of Newton's law experiment so that it can provide direct experience to students to know the concept of Newton's law about motion. The results of the analysis of student learning motivation on aspects of the value of science learning can be seen in table 2:

| No | Question                                                                 | Item Number | Score | Percentage | Criteria |
|----|---------------------------------------------------------------------------|-------------|-------|------------|----------|
| 1  | The use of instructional media makes me eager to learn.                   | 4           | 73    | 73%        | High     |
| 2  | This learning media makes learning physics more fun                       | 5           | 72    | 72%        | High     |
| 3  | Learning media makes me feel not bored to study.                          | 6           | 76    | 67%        | High     |
| 4  | Learning media makes me more interested in learning physics.              | 7           | 66    | 66%        | High     |
| 5  | The use of instructional media added to my curiosity                      | 8           | 70    | 70%        | High     |

**Average 71% High**

The percentage in the aspect of Science learning values average score obtained is 71% categorized as “High”, this indicates that students have problem-solving competencies based on the media used in the classroom, provide stimulation to students in developing understanding and applied science learning, especially learning physics in life daily. The results of the analysis of student learning motivation on performance and achievement follow table 3:
Table 3. Percentage of performance and achievement aspects.

| No | Question                                                                 | Item Number | Score | Percentage | Criteria |
|----|---------------------------------------------------------------------------|-------------|-------|------------|----------|
| 1. | Learning media can help students learn independently.                     | 9           | 48    | 48%        | Medium   |
| 2  | Learning media can increase student participation in learning physics.    | 10          | 76    | 76%        | High     |
| 3  | Learning media helps students solve problems in learning physics.         | 11          | 79    | 79%        | High     |
| 4  | Learning media can help students think more creatively                     | 12          | 70    | 70%        | High     |
|    | Average                                                                   |             |       | 68%        | High     |

The percentage of students' performance and achievement aspects is 68%, which shows that the developed media provides opportunities for students to learn independently, be able to compete with other students and feel learning by animation media can increase their competency and achievement. The application of animation-based learning media can encourage students to understand Newton's law about motion, especially in understanding and drawing the direction of forces on objects. Students can see the direction of the abstract force with real animation through applied media so as to reduce misconceptions. Animation-based learning media images developed on Newton's law material can be seen in Figure 1:

![Figure 1. Animation-based learning media on Newton's law.](image)

The development of animation-based learning media is developed based on real images of the motion on objects and illustrates the forces on these objects. Each slide has a play and stops button that can be used to start the animation and stop the animation. This animation media is also provided several menus, namely instructions for use, Newton's law material, examples, and exercises. Developed media designs are based on pictures in the student textbooks at school then made into an animation. In the practice menu, the questions are used multiple-choice questions and equipped with an assessment menu so students can find out the score obtained after completing the exercise and the teacher easily evaluates students. The application of animation learning media not only makes students easier to understand the concept of Newton's law but also facilitates teachers and students to apply and utilize technology in learning.
The use of technology in learning can provide new changes in learning media and communication and can improve the quality of learning [20]. This can be seen from the high motivation of the students after learning. Based on interviews with students stated that; “animation media used in Newton’s law material provides a complete explanation of how force affects the movement of an object. I can understand this because the motion of the objects shown seems to be real and the direction of the force is clearly depicted so that the material of Newton Law looks not difficult to understand”.

This statement shows that used this animation media is one of the solutions to increase student understanding [21]. In addition, the use of animation media in learning can help students increase motivation and higher-order thinking[22,23]. this is because learning using animation media provides real experiences so that it can make students easier to understand physics concepts [22]. developed learning media provides opportunities for students to apply physics concepts in everyday life and possible to facilitate students to improve scientific literacy [24,25]. Animation-based learning media developed can only be operated using a computer so that its use is not flexible. Although using this media can increase student motivation, it requires further research to get more information about the influence of learning media to increase physics learning achievement.

4. Conclusion

The development of animation-based learning media in this study was conducted to help students to understand the concept of Newton’s law material, especially in describing the direction of the forces on objects and to know student motivation after used animation-based learning media. Based on the validator judgment of the developed media was appropriate and appropriate to applied in the classroom. Analysis of student learning motivation after the application of animation-based learning media in learning was 70% with categorized “high” shows that students are interested in animation media and can help students to understand and describe the direction of the force. This media has disadvantages, one of them is can only be operated via a computer. It makes this media inflexible. The next research is expected to develop Android-based learning media so that the developed media can be easily operated anywhere and anytime.

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