



Physics Learning Innovation: Song and Animation-Based Media as a Learning Solution for Mirrors and Lenses for Junior High School Students

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ABSTRACT

Purpose of the study: This study aims to develop and assess the effectiveness of a physics learning media based on songs and animations to enhance motivation and understanding among Grade VIII students on the topics of mirrors and lenses..

Methodology: The study employed a mixed-methods approach, utilizing a procedural development model by Borg and Gall. Tools and software used include Adobe Audition 1.5, Wondershare Filmora, and Adobe Flash CS6. Data collection methods included questionnaires and expert reviews.

Main Findings: The song and animation-based learning media received a "Very Valid" rating from content experts (90%) and a "Valid" rating from media experts (70%), with teachers giving an average score of 90%. The t-test results showed a significant increase in students' motivation in the experimental group, with a mean score of 79.50 compared to 68.07 in the control group, indicating the positive impact of the developed media.

Novelty/Originality of this study: This study introduces an innovative approach by combining musical and animated elements in physics education, thereby stimulating both the left and right brain hemispheres. This dual-hemisphere engagement fosters a more interactive and enjoyable learning experience, bridging the gap in traditional physics instruction by addressing both logical and creative aspects of student learning.

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1. INTRODUCTION

Learning is a human effort to achieve various competencies, including cognitive, affective and psychomotor abilities [1], [2]. Humans learn to gain knowledge and fulfill their needs, so that through the learning process, a person can understand things that were previously not understood, and improve abilities such as the ability to count [3]-[5]. To achieve good quality learning, it is important for teachers or instructors to plan and design the learning process well, including preparation of materials, methods, learning resources, and use of learning media [6], [7]. One of the teacher's responsibilities is to carry out teaching activities, which is a learning process aimed at educating students.

An interactive and comfortable classroom atmosphere can facilitate an effective learning process, so that students can understand the material presented well. In the teaching and learning process, a teacher is expected to be creative in delivering material and interacting with students, as well as being able to optimize various opportunities that exist in the school environment, including the use of media as a tool in teaching activities [8], [9], [10]. In an era of increasingly advanced and modern development, conventional methods of delivering material

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(only relying on oral explanations from teachers without using media) are considered less effective [11], [12]. This is because this method can make it difficult for students to understand the core ideas of the material, which can ultimately lead to misconceptions between what the teacher conveys and the students' perceptions [13], [14]. Therefore, currently the use of appropriate media in delivering material is becoming increasingly important. This aims to achieve optimal learning outcomes and also allows active involvement of both sides of the brain, namely the right brain and the left brain.

Currently, there is a lack of attention to the maximum use of brain potential in exact subjects, especially physics. The learning process tends to focus more on the use of the left brain which is responsible for processing data based on numbers and symbols, without optimizing the work of the right brain which plays a role in processing data based on images and music [15], [16]. This can result in decreased student concentration, rapid boredom, and low learning motivation [17]. However, if learning activities are balanced by utilizing proper brain management, learning can be interactive and enjoyable. One effective method in learning is to involve music and animation, as a way to activate the right brain which usually tends to be passive when we focus on learning that only emphasizes the work of the left brain [18], [19]. The use of music in the context of education has a close relationship with increasing IQ and student academic achievement [20], [21]. Using songs that contain learning materials can improve the ability to remember information, encourage creativity, increase understanding, and create a more conducive learning environment [22], [23].

As a result, music can function as a link between the right brain and the left brain, so that both can work synergistically in an effective learning process. The use of music in learning media has a significant positive impact on the learning process [24], [25]. Music is one of the effective ways to stimulate students' minds, so that they can easily accept and understand the subject matter. In addition, music also has the ability to increase concentration, improve memory, and improve students' cognitive, physiological, and emotional intelligence aspects. Thus, music becomes an important element that can increase the effectiveness of learning as a whole. The influence of music on learning concentration is caused by at least seven factors, namely (1) certain emotions aroused by certain types of music, (2) students' musical preferences, (3) students' previous knowledge of the topic being studied, (4) Thinking techniques needed, (5) music volume, (6) music character, and (7) music playing time.

In the learning process, methods and tools are used that aim to make the delivery of messages or materials more interesting and enjoyable. Using simple, relaxed language and supporting appropriate learning media can increase students' learning motivation [26], [27]. The use of learning media in the form of songs and animations can be an effective alternative for teachers to create an interesting and meaningful learning atmosphere [24], [28]. This is because humans naturally respond well to audio and visual stimuli, such as moving images and music in the form of songs. According to Ali Abdul Halim Mahmud, learning media is every position, word, action, and use of materials by teachers to clarify the objectives of teaching and education in schools. In an article written by Husaen, quoting from the book *Shahihul Bukhari bi Haasyiati al-Imam as-Sindy* that the Messenger of Allah once drew a square which he used as a medium to illustrate. Learning media is anything that can be used to convey messages from the sender to the recipient so as to stimulate the thoughts, feelings, attention and interests and desires of students in such a way that the learning process occurs in order to achieve learning objectives and avoid failure of delivery.

Music is one way that can activate both hemispheres of the human brain. The learning process carried out side by side with music will have a different impact than without using music. Music is believed to give its own impressions to our brains, with certain music our brains can drift into alpha conditions, making it easier for us to absorb information when the learning process takes place. Many world-famous composers (music creators), such as Johan Sebastian Bach, George Friedrich Handel, have been involved in the field of classical music that is deliberately conditioned for the teaching and learning process. Research conducted by Mitha Dwi Anggraini in 2021 entitled "Development of Cartoon Animation Video Media in Thematic Learning for Grade IV Students of State Elementary School 114 Pekanbaru," obtained results in the form of learning media with animated videos that can help students in distance learning so that they can be accessed anywhere and anytime [29].

In line with previous research, it is known that animation as a communication medium must have the same style and tendency as the target audience so that this lyric video can attract listeners to watch and understand the meaning of the song [30]. The main gap between the two studies lies in the context of media application, namely music entertainment vs. education. Previous studies focused on entertainment and message delivery through music media, while the current study emphasizes the pedagogical application of music and animation to support scientific learning. The contribution of the previous studies to the current study lies in the use of animation and music-based media as effective communication tools. Although the purposes of both are different (entertainment vs. education), both utilize the potential of multimedia to communicate messages, both in the context of stories and educational information. Previous studies provide an important foundation in terms of the application of animation and music in conveying messages in an interesting and easily accepted way by the audience, which can then be adapted in the learning context to improve students' understanding and motivation.

The current study fills the gap from the previous studies by developing music and animation-based physics learning media that activate the left brain (for logical and numerical data processing) and the right brain

(through musical and visual elements), which makes learning more effective and interactive. In addition, the song-based approach that contains physics materials such as mirrors and lenses is intended to help students understand and remember physical concepts better. This overcomes the misconceptions that often occur with conventional oral approaches [31], [32]. This media is also relevant to the current student learning style which is more responsive to audio-visual stimuli [33], [34]. Therefore, this song and animation-based learning media can create a more enjoyable and effective learning environment.

The purpose of this study was to develop and test how effective song and animation-based physics learning media are in improving students' understanding and motivation to learn mirror and lens material at the junior high school level. This new innovation activates both hemispheres of the brain, left and right, through a combination of music and animation elements. This approach is intended to improve students' memory and understanding of physics concepts. The need for more interesting and effective learning media is the urgency of this research to overcome challenges in physics learning, especially those related to complex concepts such as mirrors and lenses, which are often difficult to understand through conventional approaches. Therefore, this media is expected to create a fun, interactive learning environment that is in accordance with the digital learning style used by students today.

2. RESEARCH METHOD

This study uses a mixed method. The development of learning media in this study uses a procedural development model, namely a descriptive model that shows the steps that must be followed in making a product. The development research method has three main components, namely: development model, development procedures and product trials [35]-[36]. Procedural models, which are descriptive models, show the steps that must be followed to produce a product [37].

The research and development procedure according to Borg and Gall can be done more simply by involving 5 main steps which can be seen in Figure 1 below.:



Figure 1. Development Procedure

The trial of the song-based and animation-based physics learning media product was conducted through three stages: expert testing, small-scale field testing, and large-scale field testing. This trial stage begins with an expert test or validation involving respondents from among experts in model or product design, aiming to review and provide input on the initial product in a process called expert judgment or the Delphi technique; in this study, validation was conducted by expert lecturers. Furthermore, a conceptual analysis was conducted to identify the structure and suitability of the material, followed by the first revision based on expert input. After that, the product was assessed by media experts, material experts, and science subject teachers at Junior High School/Islamic Junior High School to obtain a comprehensive assessment from various perspectives.

The next stage is a limited test, which is conducted on a small group of product users, in order to obtain direct input from students as users of this learning media. The next step is to revise the product, which is a further improvement made by the researcher and is used as a step to perfect the product from the initial field test. At this stage, a product is obtained that is ready to be tested to the next stage to obtain a final product whose effectiveness can be accounted for. The validators of the media development product in this study were four experts who were competent in their fields. The subjects of the assessment in this study were reviewers of song-based physics learning media and animation of mirror and lens material for junior high school students in grade VIII, three experts consisting of one material expert, one media expert, two junior high school science teachers and junior high school students in grade VIII.

The research and testing were carried out at Walisongo State Islamic University, Hasanudin 6 Semarang junior high school and K.R.M. Marzuki Cepogo Kembang Jepara junior high school. Data collection was carried out using two methods, namely the questionnaire method and the documentation method. A questionnaire is a data collection technique carried out by giving a set of questions or written statements to respondents. The questionnaire method is used to measure the quality of the media as assessed by respondents. This questionnaire is given to media experts, material experts, and junior high school physics teachers. The documentation method is used to obtain data regarding information related to the research to be conducted. The data that will be obtained from this method is data from media experts, material experts, and junior high school physics teachers who are used as respondents. The questionnaire to measure student motivation has the following outline:

Table 1. Student learning motivation questionnaire grid

No.	Aspect	Indicator
1	Learning Interest	Students are interested in studying physics
2	Engagement	Students participate actively in learning activities
3	Persistence	Students continue to study despite difficulties
4	Curiosity	Students ask questions related to the material
5	Usefulness Perception	Students believe the material is useful in real life
6	Enjoyment	Students enjoy learning with song and animation media

There are two data analysis techniques, namely data in the form of suggestions and input from validators, material experts, media experts and science subject teachers and data in the form of scores obtained from the assessment of the quality of learning media in the form of a checklist sheet assessed by material experts, media experts, and science subject teachers. The learning media quality assessment sheet uses a Likert scale with the provisions of 4 = very good, 3 = good, 2 = less, 1 = very less. The data is then analyzed to determine the quality of the learning media with the following steps:

$$\bar{X} = \frac{\sum X}{N} \dots (1)$$

Then the qualitative categories between the very good (VG) to very poor (VP) categories are presented in table 2 below.

Table 2. Module Assessment Categories

Mean Score ($\bar{X}$)	Category
$3.26 < \bar{X} \leq 4.00$	Very Good
$2.50 < \bar{X} \leq 3.25$	Good
$1.75 < \bar{X} \leq 2.50$	Poor
$1.00 \leq \bar{X} \leq 1.75$	Very Poor

Calculate the ideal percentage with the following equation:

$$\text{Ideal percentage} = \frac{\text{Research result score}}{\text{ideal maximum score}} \times 100\% \dots (2)$$

Student responses used the Guttman scale with statements of agreement and disagreement, with a score of 1 = agree and 0 = disagree for positive statements. So that the learning media assessment categories are obtained as shown in the following table:

Table 3. Learning Media Assessment Categories

Mean Score ($\bar{X}$)	Category
$0.5 < \bar{X} \leq 1.00$	Agree
$0 < \bar{X} \leq 0.5$	Disagree

If from the analysis of expert assessment data, consisting of material experts, media experts and science subject teachers, the results are in the very good (VG) or good (G) category, then the physics learning media based on songs and animations of mirrors and lenses for Junior High School/Islamic Junior High School students in grade VIII are ready to be tested on students. If it does not meet the very good (VG) or good (G) quality, then the learning media is revised so that it meets the quality that is worthy of being tested on students. If from the analysis of student response data, the results are in the agree category, then the product in the form of physics learning media based on songs and animations of mirrors and lenses for junior high school students in grade VIII is used as a physics learning media. If not, then the physics learning media is revised so that it meets the quality that is worthy of being used as a physics learning media.

Data analysis to measure student learning motivation uses a comparison test with SPSS 23. The assumptions that must be met are the normality and homogeneity tests with the condition that the data is normally distributed if the significance value obtained is > 0.05 if it is met, it is continued with the parametric independent sample t-test. If the data is not normally distributed or is not homogeneous, then it is continued with a non-parametric test, using Mann-Whitney. This comparison test is to see the differences between students in the class learning using learning media with the class learning as usual (without song-based physics learning media and animation on the material of mirrors and lenses).

3. RESULTS AND DISCUSSION

Preliminary research conducted by researchers consists of library studies [38], previous research journals on the use of song, animation or video media in school classrooms, and interviews at Hasanudin 6 Semarang junior high school. In the planning stage, the first step taken is to collect supporting materials for the discussion of mirrors and lenses from various sources, such as journals, modules, and physics books, both in e-book and print form. Furthermore, product design is carried out by designing appropriate learning media, determining the software and tools to be used, preparing and compiling song lyrics based on the material that has been developed, and collecting relevant icons and images to be processed into interesting physics learning media. In the product development stage, the process begins with recording musical instruments and song sounds, continued with making animated videos, until finally producing song and animation-based physics learning media on the material of mirrors and lenses for junior high school/ Islamic Junior High School grade VIII students.

This research produces a product in the form of song-based physics learning media and animation of mirror and lens material. Song-based and animation physics learning media in this study were developed through several stages in accordance with the procedure according to Akker, namely initial investigation, theoretical adjustment, and empirical testing which is limited to expert review. In the preliminary stage, the researcher found problems that would be the reason for choosing the development of learning media. The reasons are: from the results of the literature study conducted by the researcher, the researcher formulated that the use of songs and animations in learning can be used as supporting media for the learning process. Another reason is Based on the results of an interview on March 24, 2017 with Mr. M. Nur Hasyim A.Md as a science teacher at Junior High School Hasanudin 6 Semarang, information was obtained that in physics learning so far, learning media based on songs and animations have never been used. In general, teachers only use video media and accompanied by music and pictures or only explain in front of the class and write formulas on the board. The two reasons above made the researcher take the initiative to combine them in a song-based and animation-based learning media. This research was raised so that science learning can be fun and students do not seem tense and stiff in learning physics.

At this planning stage, the researcher took several steps so that the product was ready for production. The steps taken by the researcher are as follows: Collecting relevant materials and reviewing them to be converted into song lyrics and choosing tools and materials and software to be used such as guitar, piano, microphone and mixer to create musical instruments and songs; Adobe Audition 1.5 software as track record software, Wondershare Filmora software as video editing software and Adobe Flash CS6 software as animation maker software.

At this product development stage, the researcher took the steps that had been taken to produce song and animation-based physics learning media. The steps taken by the researcher are as follows:

1. Recording of musical instruments and song sounds using Adobe Audition 1.5 software
2. Creating animated videos using Wondershare Filmora software by combining songs, images and icons to produce good learning video effects.
3. Creating song-based physics learning media and animation of mirror and lens material for Junior High School/Madrasah Tsanawiyah class VIII by utilizing the features available in Adobe Flash CS6 software.

In this song and animation based physics learning media, there are 6 sub-materials and 6 types of songs.

Table 4. Songs and Animations on Mirrors and Lenses

Mirror and Lens Material	Songs and Animations
Light properties and flat mirrors	1
Convex mirror	1
Concave mirror	1
Convex lens	1
Concave lens	1
Refractive Index	1

In this study, research on song and animation-based physics learning media was conducted by 1 material expert, 1 media expert and 2 teachers, namely 1 natural science teacher from Hasanudin 6 Junior High School Semarang and 1 science teacher from K.R.M Marzuki Jepara Junior High School. The assessment of this product was carried out with the aim of obtaining assessments, suggestions and input from these experts. The assessment of material experts was carried out to determine the quality of the material in the learning media that had been developed. The following are the results of the assessment from material experts on song and animation-based physics learning media on the material of mirrors and lenses for Junior High School/Islamic Junior High School class VIII students. The assessment data can be seen in the table below.

Table 5. Data from Material Expert Assessment Results

NO	Sub Item	Validator
1	Suitability of material to learning outcomes	5

2	Suitability of song lyrics to physics concepts	4
3	Completeness of material presented	4
4	Depth of material presented	4
5	Ease of material delivery	5
6	Suitability of material as material for computer-based learning media	5
7	Material delivery makes face-to-face time more efficient	4
8	This learning media is interesting overall	5
Total		36
Percentage (%)		90%
Criteria		Very Valid

Media expert research was conducted to determine the media products that have been developed. The following is data from media expert assessment results on song-based and animation-based physics learning media on mirror and lens material for Junior High School/Islamic Junior High Schoolgrade VIII students. The assessment results data can be seen in the table below.

Table 6. Data Hasil Penilaian Ahli Media

NO	Sub Item	Validator
1	Clarity of song lyrics articulation	3
2	Balance of sound and music	4
3	Completeness of the material presented	4
4	Depth of the material presented	3
5	Ease of material delivery	3
6	Suitability of the material as material for computer-based learning media	3
7	Material delivery makes face-to-face time more efficient	4
8	This learning media is interesting overall	4
Total		28
Percentage (%)		70%
Criteria		Quite Valid

The development of this physics module is intended for students of Junior High School/Islamic Junior High School class VIII. The results of the physics teacher's assessment of the material on mirrors and lenses. Therefore, the researcher conducted a quality test of the learning media to science teachers who teach science subjects at Junior High School/Islamic Junior High School. The data from the assessment results by science teachers can be seen in the table below.

Table 7. Media Expert Assessment Results Data

NO	Sub Item	Assessor 1	Assessor 2
1	Suitability of song lyrics with Basic Competencies (KD) and learning objectives	5	5
2	Coverage of material and sequence of material and completeness of material	4	4
3	Variations of musical instruments used	4	4
4	Song and animation support for student involvement in the learning process	5	4
5	Suitability of language with students' thinking levels	4	4
6	Ability of media to increase student motivation in learning physics	5	5
7	Ability of media to broaden horizons	5	4
8	This learning media is interesting overall	5	5
Total		37	35
Percentage (%)		92.5%	87.5%
Criteria		Very Valid	Valid

The next step is product revision. At this stage there are 4 validators including 1 material expert, 1 media expert and 2 science teachers who provide revisions. At this stage, input and suggestions from the four validators become the material for product revision to produce better learning media. The development model in this study is a model development research according to Akker which consists of 3 stages, where at the empirical test stage the researcher carried out up to the expert review. Then the researcher measured student learning motivation using song-based and animation physics learning media on the material of mirrors and lenses. The data that had been

collected in the first analysis was tested for normality and homogeneity assumptions. The results of data analysis using the Kolmogorov-Smirnov normality test are presented in table 5 below:

Table 8. Results of the normality test of student learning motivation

Class	N	Asymp. Sig. (2-tailed)	Description
Experiment	28	.200	Normal
Control	28	.200	Normal

In table 5, the Asymp. Sig. (2-tailed) value for the experimental and control classes is 0.200. Since this value is greater than 0.05, the data for both classes are considered normally distributed. Furthermore, table 6 presents the results of the homogeneity test of students' learning motivation.

Table 9. Results of the homogeneity test of students' learning motivation Levene Statistic

Class	N	Sig.
Experiment * Control	56	0.795

In table 6, the results of the Levene's Test show a significance value (Sig.) of 0.795. Because this value is greater than 0.05, it can be concluded that the variance of the two groups (experimental and control classes) is homogeneous or the same, so that the assumption of equal variance can be used in the t-test analysis. Furthermore, in table 7, the following are the results of the independent sample t-test between the learning motivation of students in the control and experimental classes.

Table 10. Results of the independent sample t-test on learning motivation of students

Group	N	Mean Score	Standard Deviation	t	df	Sig. (2-tailed)	Conclusion
Experiment	28	79.50	4.18	8.878	54	0.000	Significant difference observed
Control	28	68.07	5.38				

Based on table 7 above, the t value is 8.878 with a degree of freedom (df) of 54 and a significance value (Sig. 2-tailed) of 0.000 indicating that there is a significant difference between students' learning motivation in the experimental class and the control class ($p < 0.05$). The average difference in learning motivation of 11.43 indicates that students in the experimental class have higher learning motivation compared to students in the control class. This shows that the use of song-based and animation-based learning media has a positive effect on increasing students' learning motivation on mirror and lens material. This study developed song-based and animation-based physics learning media for mirror and lens material aimed at Junior High School/Islamic Junior High School class VIII students. The evaluation results from material and media experts showed that the developed product had met very valid quality criteria with an average assessment of 90% from material experts and 70% from media experts. This study also shows that the use of song-based and animation-based media can significantly increase students' learning motivation, as seen from the significant difference in motivation between the experimental and control groups. With a higher average motivation score in the experimental group (79.50) compared to the control group (68.07), this shows that this learning media is effective in motivating students and increasing their involvement in learning physics, especially in materials that are often considered difficult and boring such as mirrors and lenses.

The implication of this study is the importance of using innovative learning media, such as songs and animations, in increasing students' motivation and understanding of physics subject matter. The results of the study showed that the media developed not only increased students' interest, but also accelerated the understanding of complex physics concepts. Thus, the use of this kind of media can be applied in schools as a more interesting alternative to traditional learning methods that only rely on lectures or textbooks [39], [40]. In the future, similar media can be developed for other learning materials, providing a more enjoyable and in-depth learning experience.

Previous research by Sintia & Dayurni [41] which developed animation-based learning media using Macromedia Flash 8 for Information and Communication Technology subjects at MA Madani Kota Serang, it is known that the media is suitable for use by grade XII students, with quality that is considered good by students. In line with previous studies, this study also found that the use of animation-based learning media is feasible and considered good by students in learning. However, this study does not only emphasize product development, but also evaluates its impact on student learning motivation, with results showing a significant increase in student learning motivation in the experimental class compared to the control group. The main difference lies in the context and approach of the media, where previous studies used animation as a tool in ICT learning, while the current study combines music and animation to increase student engagement in scientific materials.

The novelty of this study lies in the development of learning media that combines elements of music and animation for physics materials, especially on the topic of mirrors and lenses. This approach has not been widely applied before in the context of physics learning at the Junior High School/Islamic Junior High School level, thus providing a new contribution to a more interactive and enjoyable teaching method. This study also shows that the

combination of music with animation not only serves as entertainment, but also as an effective means to clarify scientific concepts, improve students' memory, and create a more positive and enthusiastic learning atmosphere.

However, this study has several limitations. One of them is the limited sample size which only includes two classes in two different schools, so the results may not be fully representative of the entire population of junior high school/Islamic junior high school students in Indonesia. In addition, this study only measures student motivation as an indicator of the success of learning media, while long-term understanding of the material and the impact on exam results or academic achievement have not been tested. For further research, it is recommended to expand the sample in various schools and measure the impact of song-based and animation-based learning media on students' academic outcomes. Research can also test the application of this media to other subjects and develop interactive elements to further increase student engagement.

4. CONCLUSION

The results of this study indicate that song-based and animation-based physics learning media on the topic of mirrors and lenses are effective in enhancing the learning motivation of Grade VIII students in Junior High Schools/Islamic Junior High Schools. The media, developed through various stages of testing, received very positive evaluations from material experts, fair evaluations from media experts, and high appreciation from science teachers. The test of differences in students' learning motivation showed significant results, with the learning motivation of students in the experimental class being higher than that of the control class. This song-based and animation-based media makes a positive contribution to increasing students' motivation to learn complex physics concepts. Further research is recommended to expand the sample coverage, measure the impact of this media on students' academic outcomes, apply it to other subjects, and develop interactive elements to enhance student engagement.

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