P-ISSN: 2338-8617
E-ISSN: 2443-2067

Jurnal Ilmiah PEURADEUN

Vol. 9, No. 3, September 2021

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JIP
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DOI Prefix Number: 10.26811

ACCREDITED "B" by the Ministry of Ristekdikti
from October 30, 2017 until October 30, 2022

JURNAL ILMIAH PEURADEUN
The International Journal of Social Sciences
p-ISSN: 2338-8617/ e-ISSN: 2443-2067
www.journal.scadindependent.org

Vol. 9, No. 3, September 2021
Pages: 681-702

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Article *in* Jurnal Ilmiah Peuradeun

Available at : https://journal.scadindependent.org/index.php/jipeuradeun/article/view/557
DOI : http://dx.doi.org/10.26811/peuradeun.v9i3.557

How to Cite this Article

APA : Jabaliah., Adlim, M., Syukri, M., & Evendi. (2021). Learning of Multimedia-Based Physics Concept Applications to Improve Students' Motivation and Science Process Skills. *Jurnal Ilmiah Peuradeun, 9*(3), 681-702. doi:10.26811/peuradeun.v9i3.557

Others Visit : https://journal.scadindependent.org/index.php/jipeuradeun

Jurnal Ilmiah Peuradeun
The International Journal of Social Sciences
doi: 10.26811/peuradeun.v9i3.557

Jurnal Ilmiah Peuradeun
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LEARNING OF MULTIMEDIA-BASED PHYSICS CONCEPT APPLICATIONS TO IMPROVE STUDENTS' MOTIVATION AND SCIENCE PROCESS SKILLS

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Received: Jun 19, 2020	**Accepted:** May 25, 2021	**Published:** Sep 30, 2021
Article Url: https://journal.scadindependent.org/index.php/jipeuradeun/article/view/557		

Abstract

Physics concept application is widely applied in daily life but students have a lack of knowledge concerning the concept of physics application. This research aimed to examine the motivation and skills of the scientific process through learning the concept of multimedia-based physics applications. This is experimental research, conducted on Year IX students of Islamic Senior High School. Samples were taken with purposive sampling techniques and divided into two groups of Mastery Learning Scores (MLS), MLS ≥ 70 and MLS< 70. Data were collected from Pre-test and post-test. The motivational data was presented through the category table, while the science process skills were analyzed using the Independent sample t-test. After the treatment, the initial motivation of the MLS class ≥ 70 was increased from 66.1% to 81.9%, while it was from 63% to 82.5% for the MLS class< 70. Besides, the final science process skillswere significantly different between the two classes, indicating byt count >t table 2.14 > 1.65. This study suggested that learning concepts of multimedia-based physics applications can improve student motivation in both classes, while the science process skills only affect the students of the MLS group ≥ 70.

Keywords: *Physics Application; Multimedia; Motivation; Science Process Skills.*

A. Introduction

Physics is the science underlying the development of advanced technology and the harmony concept with nature (Ikramatul Atiyah et al., 2016; Novita, A.I., Pratowo, B.H.S., & Wahyuni, 2017). Physics is a lesson explaining knowledge about the universe that requires the ability to should be continuously trained to increase the thinking power and reasoning ability; however, not all students can learn the concepts of physics well (S. P. Astuti, 2015; Jumini, 2016). Physics is one of the subjects students find challenging and avoid because it requires perseverance, seriousness and a lot of practice; students find it difficult to understand it due to its many formulas, so they are less enthusiastic about learning (Bancong, 2017; Ornek et al., 2007). Students consider physics to be complicated, especially because learning takes place conventionally where students are required to memorize abstract formulas (Rosdianto, 2019). On the contrary, learning physics and science is easy using materials found around the environment as learning resources (Savitri, 2020), supported by interesting learning methods to provide ease of learning (Annisa, A. I., & Mundilarto, 2020; Fajriani, 2020; Paudi, 2019).

Currently, the process of learning physics in schools requires students to understand concepts, calculations, and formula, resulting in students assume that learning physics is similar to learning mathematics surrounded by many calculations; however, physics learning should deliver not only concepts but also the process of discovery and concept application (Utami, 2014; Zahara et al., 2018). Physics learning will be more interesting and meaningful if natural phenomena or applied physics are presented to students, such as physics applications in daily life. Real events seen will facilitate students when they encounter real incidents, and it can also foster students' scientific process skills (Artayasa, 2020; Darmaji, Astalini, et al., 2019; Nopitasari et al., 2012).

The results of the interview during the preliminary observation with (Zakiati, 2019; Nuriza, 2019; Imelda 2019), the teachers from one of the Islamic Senior High School in Aceh Besar, Indonesia, revealed that the student's motivation in studying physics was lacking because they had less interest in learning physics. This finding was also supported by information obtained directly from students. They complained about the difficulty in learning physics because they had to memorize abstract formulas and many calculations. Teachers contributed to this issue as they only explained the concepts of physics accompanied by formulas in the form of notes and powerpoints followed by examples of questions. Thus, students assume that learning physics is only learning concepts, formulas, and calculations, and these are among the factors influencing the low motivation of students on physics lessons. Furthermore, the student's lack of motivation in learning physics can be seen from the data of the school studied from the academic year of 2015/2016 to 2018/2019, where only 3.8% of students chose physics for the national exam (hereafter UN).

Innovations in learning physics are required to overcome these problems, to increase learning motivation, and to provide a positive impression that physics is related to life and can be a solution to technological problems. One innovation to do by physics teachers is multimedia use to trigger learning motivation and science thinking process in students (Liew & Tan, 2016; Macleod, 2019; Martiningsih et al., 2018; Warsono et al., 2020). The use of multimedia aims to facilitate learning physics and change the paradigm among many students who assume that physics only about learning formulas and are not aware that many daily events and incidents related to science and technology in human life involve physics and the application of physics (Astalini et al., 2018; Siahaan et al., 2017). Real physics concepts, when presented through multimedia in the learning process, can help students to implement them in life. Introducing the applications of physics that are commonly used in life, both household appliances and those around them, such as solar panels, solar cooker, and other physics applications, will provide an impression to students that learning physics is necessary, which in turn will improve students' motivation to learn physics.

Motivation is crucial in the learning process to support optimum learning outcomes. The more precise the motivation provided, the more successful the lesson will be (Kartikasari, 2016). Motivation will always determine the magnitude of the students' learning effort. Changes in the teaching and learning patterns and the use of multimedia are necessary to foster motivation and science process skills of students, especially in the era of the industrial revolution 4.0 (Duda et al., 2019). Multimedia is also an effective medium to enhance student motivation (Francis, 2017; Ikawati, 2017; Kusmanto et al., 2014; Rafmana et al., 2018). Student learning activities are improved, and students are more motivated when learning using multimedia compared to conventional learning (Iskandar et al., 2018). Furthermore, (Silalahi et al., 2018) reported that multimedia-based learning affected the students' motivation and achievement in the experimental group significantly higher than in the control group, with a significance level of 5%. In addition, multimedia can create a positive mood for students (Khan et al., 2019; Liew & Tan, 2016; Warsono et al., 2020), so they are more engaged in learning physics. This argument is supported by (Puspitasari et al., 2019), who found that 88% of multimedia can motivate students in learning physics. (Nurnasari & Nurindah, 2018) also argued that the use of multimedia would facilitate the teacher in the learning process and students in participating in learning resulting in the increased motivation.

The use of multimedia not only increases students' learning motivation but also supports the improvement of students' thinking and science process skills (Fonna, Teuku, et al., 2013; Nugroho & Surjono, 2019; Syawaludin et al., 2019; Warsono et al., 2020). This finding is in line with (Darmaji, Kurniawan, et al., 2019; Haryadi et al., 2019), who reported in their research results that the use of multimedia learning influences the development of students' science process skills. Thus, the advantages of using multimedia in the physics learning process, especially the learning of multimedia-based physics concept application, is improving motivation and science process skills of students.

Studies concerning multimedia-based physics learning have been investigated by previous researchers, for example, multimedia-based learning in science or physics (Anas, 2019; Kurniawati & Nita, 2018; Syahputra et al., 2020; Widada & Rosyidi, 2017), in chemistry (Nazalin & Muhtadi, 2016), and in biology (Habibi, 2018; Lamalewa & Istanto, 2018). However, as far as this study was conducted, the discussion on "Learning of Multimedia-Based Physics Concept Application to Improve Students' Motivation and Science Process Process Skills" is new and has never been studied by other researchers. Thus, this study focused on two important issues: students' motivation and science process skills.

B. Method

This research employed an experimental method with a quantitative approach. The population in this study were all Year 11 students in one of the Islamic Senior High School in Aceh Besar, Indonesia during the second semester of the 2019/2020 academic year. The sample was selected by purposive sampling technique (Arikunto, 2003; Sulaiman et al., 2020), which was determined based on the Mastery Learning Scores (MLS) of each student, namely students with the MLS ≥ 70 and the ones with the MLS <70. The purposive sampling resulted in two Year 11 classes involved in the study, and each class consisted of 30 students.

The data collection was undertaken using test and non-test techniques. The test consisted of 13 multiple choice questions measuring the students' science process skills. It was validated using proanaltes, and only ten items were categorized as valid, with the r count being higher than the r table (0.728 > 0.444). At the significant level of 5%, the ten items were valid and reliable (Cronbach alpha =0.816). Besides, the discrimination index was excellent (0.80) for four items, good (0.60) for five items, adequate (0.40) for two items, and inadequate (0.20) for two items. The difficulty index of the items was medium, with an average of 0.450.

The non-test instrument used was a motivational questionnaire adopted from (Maisarah et al., 2015), with a Likert scale, to measure students' motivation. This multimedia-based learning product design was made by collecting the materials or content consisting of text, images, videos, and others that support the product making. The materials were then put together in a video and were validated by two validators. The motivational data were presented by a learning motivation category table (Syaifuddin, 1999). Meanwhile, the data of students' science process skills were analyzed using parametric analysis techniques: normality, homogeneity, and independent sample t-tests to compare the initial and final ability of the students.

C. Result and Discussion

1. Result

Multimedia-based learning applications in Madrasah Aliyah Negeri 4 Aceh have positive implications for increasing student motivation. Research data, the use of multimedia in learning physics concepts applications 82.5% has positive implications for student motivation.

Furthermore, the application of learning the concept of multimedia-based physics applications in Madrasah Aliyah Negeri 4 Aceh Besar also has positive implications for improving Science Process Skills (SPS). This refers to the indicators presented in Table 1.

Table 1 Recapitulation of Student SPS Capability Achievement for Each Indicator in the MLS Class ≥ 70

Indicator	Percentage of Each Indicator	
	Pretest	Postes
Skill in observation	0,37	0,82
Classification skills	0,37	0,72
Skills in defining	0,40	0,83
Interpreting skills	0,38	0,77
Skill in predicting	0,55	0,78

The SPS indicator and after tests on Madrasah Aliyah Negeri 4 Aceh Besar students in the MLS class ≥ 70 showed a significant increase in scores between pretest and posttest. The test results also indicate the application of physics application concept learning has a positive impact on the improvement of SPS Madrasah Aliyah Negeri 4 Aceh Besar students.

2. Discussion

The multimedia used in this research was the utilization of solar energy presented in a video about physics applications in the forms of solar panels and solar stoves. The video explained their uses, ways of working, and the simple making process. The advantages of this video are that it can display data audiovisually and is supported by animation, text, graphics, images, photos, and audio. It is in line with the research results of a study by (Rosamsi et al., 2019), that found the use of multimedia is effective for mastering concepts. That significant differences between students who used multimedia and those who did not (Aldridge, 2019). Meanwhile, (Putri, 2020) revealed that interactive multimedia based on educational games was appropriate to improve student interaction in the learning process. The results showed there was an increase in student engagement in learning physics by applying the learning of multimedia-based physics concept application. Thus, the advantages of the application of this learning compared to the use of multi-media-based physics learning media, the comparison is presented in Table 2.

Table 2 The Comparison of the Multimedia-Based Physics Concept Application and the Multimedia-Based Physics Learning Media

Aspect	**Multimedia-Based Physics Application**	**Multimedia-Based Physics Learning Media (Research Results of** (A. S. R. Maulida, 2019)**)**
Time-wise	It is very optimal. Students can immediately see how physics applications work, how to use them in daily life, and how to make them.	It is recommended to prepare the tools to use in the learning process so as not to reduce the duration of teaching and learning.
Learning activities	Not based on a predetermined textbook.	Based on the textbook, and the appropriateness of the material presented in the media must be adjusted.
Content	Explaining the use of physics applications in everyday life, for example, the physics applications of sunlight for solar panels and solar stoves.	Not explaining the physics application but explaining the sun and exercise problems
Curriculum	Do not stick to the curriculum	In line with the curriculum
Learning scope	Presented as w whole in a video, starting from the making, how it works, and its use in everyday life.	Presented in Macromedia Flash application, consisting of concept maps, instructions, materials, and sample problems.
Student learning activities	Students learn individually or in group	Students learn individually or in group
Advantages	It can display data audiovisually and is supported by animation, text, graphics, pictures, photographs, and audio, and it	It also can display images, text, and photos, but it takes time for students to

	makes it easy for students to understand what the teacher explains. In addition, it can open the insight of students who have assumed that learning physics is only by equations and calculations.	understand the sample questions presented.
Validation	Validation is conducted by assessment instruments of learning media, validated by two expert validators (lecturer and teacher)	Validation is carried out by the assessment questionnaire of a multimedia physics-based learning media, done by teachers and students.

The comparison table (Table 2) indicates that the implementation of the learning of multimedia-based physics concept application can encourage student learning motivation, and stimulate students to engage in learning activities, and develop students' science process skills. Therefore, teachers should facilitate the learning process of physics using tools or objects easily found in the environment to be applied as multimedia in physics learning to facilitate students in understanding the concepts of physics applications. Thus, they can change students' mindset that learning physics is not always identical to formulas and numbers, learning physics is learning useful applications instead.

Figure 1 presents an example of an overview of the display of multimedia in this study.

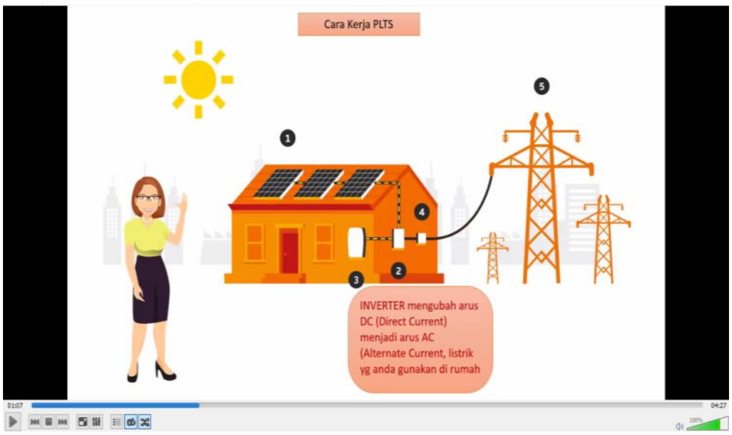

Figure 1 How Solar Energy Changing Into Electrical Energy

Figure 1 explains how electrical panels produced from solar energy are transformed into electrical energy that we can use every day, and students can directly see the process of the solar panels.

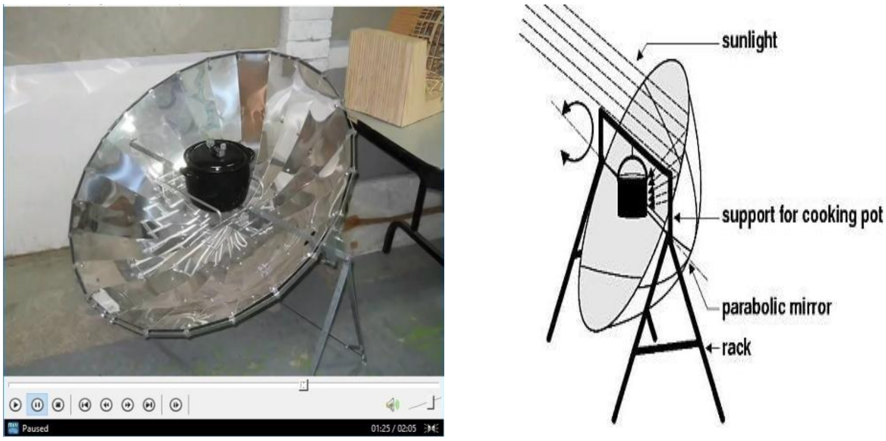

Figure 2 How a Solar Cooker Works

Figure 2 shows how a solar cooker works for cooking food as a substitute for fuel or LPG produced from sunlight. The presentation through multimedia is useful for developing students' science process skills. The use of multimedia is beneficial for learning physics applications related to daily life, to increase students' motivation and science process skills in learning physics (Gunawan et al., 2019; Plotnikova & Strukov, 2019; Wiwin & Kustijono, 2018). Learning physics is not merely a calculation that frightens students, but it can be interesting and can be applied in daily life. Generally, based on information from physics teachers, the use of multimedia-based physics applications affects the motivation and science process skills of students (Zakiati, 2019; Nuriza, 2019).

The information related to motivation is supported by the results of the pretest and posttest of the learning motivation scale from the MLS class of ≥70 and MLS class of <70. The motivation scale is presented in a table of learning motivation categories to describe and clarify the data of the study and to compare the means. The pretest and posttest categories of student learning motivation scale in both are presented in Table 3.

Table 3 The Pretest dan Posttest Categorization of the Motivation Scale for MLS Class of ≥70.

Score Range		Category	Frequency		Percentage	
Pretest	Postest		Pretest	Postest	Pretest	Postest
77≤ X	91≤ X	High	2	17	6,7 %	57 %
67 ≤ X < 77	87 ≤ X < 91	Medium	15	13	50 %	43 %
X < 67	X < 87	Low	13	0	43.3 %	0 %

Table 3 presents the pretest and posttest of learning motivation scale 2 MLS class of ≥70. It can be concluded that there was an increase in the percentage in the high category after the implementation of learning of multimedia-based physics concepts application, from 6.7% to 57%. Overall, the average pretest score of learning motivation was 66.2% or included in the medium category. After the implementation of learning of multimedia-based physics concepts applications by showing a learning video about the use of energy in daily life and the technology resulting from the application of the material, the overall average of the learning motivation was 81.9%, a high category. Figure 3 displays the increase in student motivation in MLS class of ≥ 70.

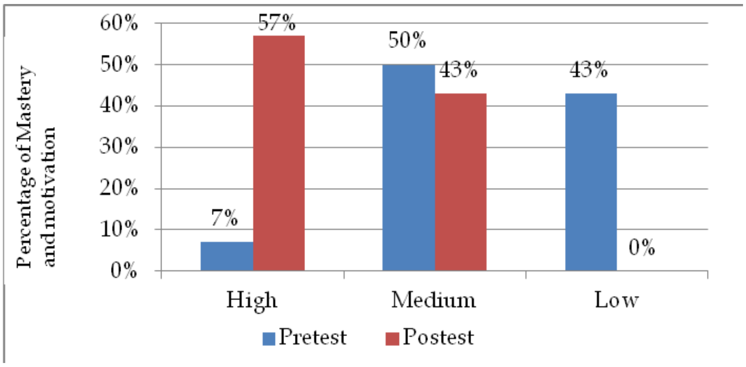

Figure 3 The Graph of Students' Learning Motivation of MLS Class of ≥70

The learning motivation in the MLS class of <70 was also increased. The learning of multimedia-based physics concepts application was also applied in this class. The results of the pretest and posttest of learning motivation for the MLS class of<70 are presented in Table 4.

Table 4 The Pretest dan Posttest Categorization of the Motivation Scale for MLS Class of <70

Score Range		Category	Frequency		Percentage	
Pretest	Postest		Pretest	Postest	Pretest	Postest
73≤ X	91≤ X	High	4	13	13 %	43 %
63≤X<73	87≤X<91	Medium	15	14	50 %	47 %
X<63	X<87	Low	11	3	37 %	10 %

According to Table 4, the pretest and posttest of learning motivation in the MLS class of<70 increased by 43% after applying the learning of multimedia-based physics concepts application. The overall average score of the learning motivation pretest also increased to 63%, the medium category. Meanwhile, after applying the learning of multimedia-based physics concepts application by presenting a learning video about the use of energy in daily life and technology from the application of the material in the learning process, the overall motivation was 82.5%, a high category. Figure 4presents a graph of the increasing student motivation in the MLS class of<70.

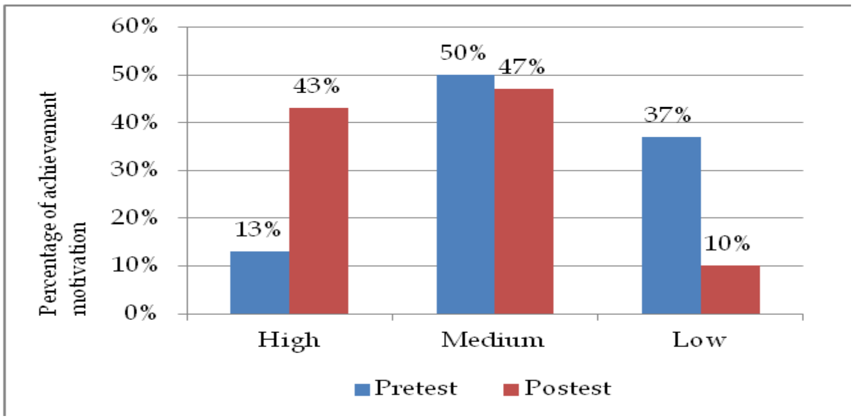

Figure 4 The Graph of Students' Learning Motivation in MLS Class of<70

The results of the data analysis revealed that the learning motivation in both classes (MLS ≥70 and MLS <70) increased to a high category after applying the learning of multimedia-based physics concepts application. This is in line with the results of research conducted by (Ikawati, 2017), who reported the use of multimedia learning influences students' motivation. The increased learning motivation occurred because students were more enthusiastic in the learning process, and they understood the application of physics concepts in real life. In addition, students were eager to ask questions and more curious. This is consistent with (Nopitasari et al., 2012). The use of multimedia has implications for increasing interaction, motivation, and science process skills (S. A. S. R. P. Astuti, 2018; Febriani et al., 2018; Mahidin, 2017; M. Maulida et al., 2019).

The application of real physics concepts in the learning process can facilitate students to implement them in life, which ultimately increases student learning motivation. This finding is also supported by the research of (Arafah et al., 2020; Patandung, 2017; Winata & Yuliani, 2017; Yasin & Husain, 2019), who reported that learning using video positively influence students' motivation. Multimedia also motivates students to create and construct knowledge (Rante et al., 2013; Sarowardy & Halder, 2019; Sary et al., 2018). Furthermore, (Mkimbili & Ødegaard, 2019), in their research results, argued that one way to increase students' scientific motivation in schools is by linking science in students' daily lives and utilizing real-life examples in teaching science. This finding is in line with the results of this study; after the teacher facilitated the practice of learning physics by using materials that are available locally and easily utilized and considering the effectiveness of learning, the motivation and science skills process of the students in the school studied were increased.

The data concerning science process skills in this study were gathered from the test consisting of 10 multiple-choice items administered to both classes (MLS ≥ 70 and MLS<70). Testing was undertaken twice, namely: pretest and posttest. The pretest was given before the multimedia-based physics learning, and the posttest was conducted after the learning. The results of the measurement and analysis of science process skills (Figure 5) show that the average score of the pretest of science process skills were 31.56 and 37.33 for both classes, respectively, while the posttest average scores for each class were 72 and 78.

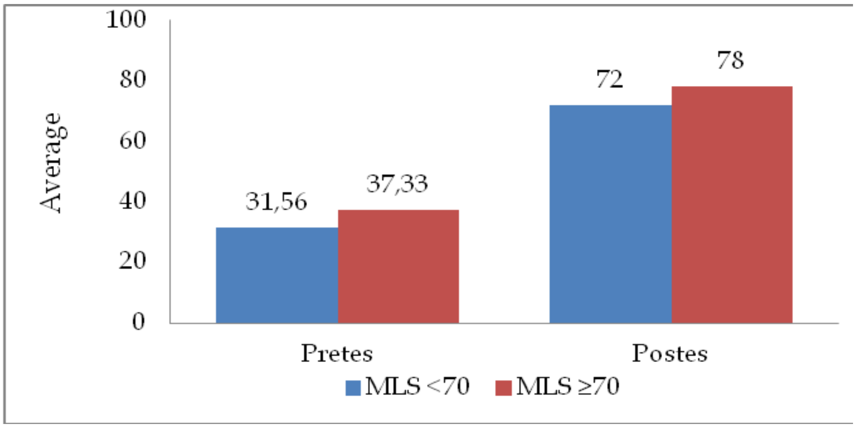

Figure 5 The Graph of Pretest and Posttest Average Score of Students Science Process Skills

Figure 5 indicates an increase in science process skills in both classes, as seen in the initial and final scores of each class. The pretest scores were 31.56 and 37.33, respectively, and the posttest scores were 72 and 78, respectively. The analysis of data showed that the pretest and posttest data were normally distributed and homogeneous. Thus, hypothesis testing can be continued using the t-test. The recapitulation of the analysis results of the t-test for both classes is presented in Table 5.

Tabel 5 The t-Test Results of Pretest and Posttest of Science Process Skills (SPS) in the MLS Class of ≥70 and MLS Class of<70

SPS	Class	Normality	Homogeneity	Hypothesis testing t-test	Information
Pretest	MLS ≥70	X^2_{count} (1,92) < X^2_{table} (9,21)(Normal)	F_{count}(1,13) <F_{table} (2,41) Homogen	t_{count}(1,34) < t_{table} (1,65)	Not significantly different
	MLS <70	X^2_{count} (8,43) < X^2_{table} (9,21) (Normal)			
Postest	MLS ≥70	X^2_{count} (0,29) < X^2_{table} (9,21(Normal)	F_{count} (1,86) <F_{table} (2,41) Homogen	t_{count}(2,14) > t_{table}(1,65)	Significantly different
	MLS <70	X^2_{count} (1,59) < X^2_{table} (9,21) (Normal)			

The increasing science process skills in students with MLS ≥ 70 is because during the learning process students were diligently listening to the teacher's explanation, enthusiastic to answer the questions, and do assignments given by the teacher. However, some of the students with MLS <70 were less enthusiastic about listening to the teacher's explanation. This finding is in line with (Maryam et al., 2020; Siswono, 2017; Sriningsih, 2019), who stated that the lack of enthusiasm in learning could affect student learning outcomes.

Furthermore, learning of multimedia-based physics concept application is different compared to other physics learning media because students can directly see how the physics applications works and their use in everyday life (Imelda, 2019; Zakiati 2019). In addition, the learning of multimedia-based physics concept application is interesting for students as it is new for students and has never been used by physics teachers at the school studied.

D. Conclusion

Based on the research results, data analysis, and discussion, it can be concluded that learning of multimedia-based physics concept application can enhance the students' motivation in both classes investigated. However, it only affected the science process skills of students in the Mastery Learning Scores (MLS) group of ≥70, with a significant difference (t count (2.14)> t table (1.65). Besides, multimedia-based learning eases the teachers in explaining the application of physics to students during the learning process.

Bibliography

Aldridge, A. C. J. (2019). Multimedia: A Means of Improving Students' Engagement in Mathematics Classrooms? *International Journal for Mathematics Teaching and Learning*, *20*(2), 193–211.

Anas, L. (2019). Pengembangan Sistem Aplikasi Multimedia Interaktif Pada Pelajaran (Fisika Energy) Untuk Tingkat Sekolah Menengah Atas. *JTP - Jurnal Teknologi Pendidikan UNJ*, *21*(1), 24–41. https://doi.org/https://doi.org/10.21009/jtp.v21i1.10570

Annisa, A. I., & Mundilarto, M. (2020). Developing an Instrument for Assessing the Physics Cognitive Learning Achievement of High School Students through Local Wisdom-Based Fieldwork. *Jurnal Ilmiah Peuradeun*, *8*(2), 299–312.

Arafah, K., Arafah, A. N. B., & Arafah, B. (2020). Self-Concept and Self-Efficacy's Role in Achievement Motivation and Physics Learning Outcomes. *Opcion*, *36* (Special Edition 27), 1607–1623.

Arikunto, S. (2003). *Manajemen Penelitian*. Rineka Cipta.

Artayasa, A. R. I. P. (2020). Keterampilan Berpikir Kreatif Mahasiswa Dalam Pembelajaran IPA Menggunakan Model Inkuiri Terbuka. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *8*(1), 1–9. https://doi.org/10.24815/jpsi.v8i1.15394

Astalini, A., Kurniawan, D. A., & Sumaryanti, S. (2018). Sikap Siswa Terhadap Pelajaran Fisika di SMAN Kabupaten Batanghari. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *3*(2), 59. https://doi.org/10.26737/jipf.v3i2.694

Astuti, S. A. S. R. P. (2018). Powerpoint Development As Mpi (Interactive Multimedia Learning) To Create Learning Motivation In Optical Instruments. *Journal of Curriculum Indonesia*, *1*(1), 8–15.

Astuti, S. P. (2015). Pengaruh Kemampuan Awal dan Minat Belajar terhadap Prestasi Belajar Fisika. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *5*(1). https://doi.org/10.30998/formatif.v5i1.167

Bancong, A. D. S. H. (2017). Pengaruh Pendekatan Multiple Intelligences Melalui Model Pembelajaran Langsung Terhadap Sikap Dan Hasil Belajar Fisika Peserta Didik Kelas XI IPA SMA Negeri 11 Makassar. *Jurnal Pendidikan Fisika Universitas Muhammadiyah Makassar*, *5*(1), 51–60.

Darmaji, Astalini, Kurniawan, D. A., Parasdila, H., Iridianti, Susbiyanto, Kuswanto, & Ikhlas, M. (2019). E-Module Based Problem Solving in Basic Physics Practicum for Science Process Skills. *International Journal of Online and Biomedical Engineering*, *15*(15), 4–17. https://doi.org/10.3991/ijoe.v15i15.10942

Darmaji, D., Kurniawan, D. A., & Suryani, A. (2019). Effectiveness of Basic Physics II Practicum Guidelines Based On Science Process Skills. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *4*(1), 1. https://doi.org/10.26737/jipf.v4i1.693

Duda, H. J., Susilo, H., & Newcombe, P. (2019). Enhancing Different Ethnicity Science Process Skills: Problem-Based Learning Through Practicum and Authentic Assessment. *International Journal of Instruction*, *12*(1), 1207–1222. https://doi.org/10.29333/iji.2019.12177a

Fadli, F., Prestwich, A., & Sykes-Muskett, B. (2018). Assessing Mediating Effect of Motivation Types on Competition Intervention For Physically Inactive Adults. *Jurnal Ilmiah Peuradeun, 6*(1), 1-16. doi:10.26811/peuradeun.v6i1.156

Fajriani, S. M. A. G. M. S. T. E. N. (2020). Penerapan Model Problem Based Learning pada Materi Alat-Alat Optik untuk Meningkatkan Kepercayaan Diri dan Kemampuan Menyelesaikan Masalah Kontekstual. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *8*(1), 105–113. https://doi.org/10.24815/jpsi.v8i1.15666

Febriani, F., Supriyati, Y., & Cahyana, U. (2018). Multimedia Learning Science Development in Improving the Problem Solving Skill of Elementary School Student. *International Journal of Multidisciplinary and Current Research*, *6*(04). https://doi.org/10.14741/ijmcr/v.6.4.17

Fonna, Teuku, M., Adlim, & M. Ali, S. (2013). Perbedaan Keterampilan Berpikir Kritis Siswa Melalui Penerapan Media Pembelajaran Laboratorium Virtual Pada Konsep Sistem Pernapasan Manusia Di Sma Negeri Unggul Sigli. *Jurnal Biotik*, *1*(2), 124–128. https://www.jurnal.ar-raniry.ac.id/index.php/biotik/article/view/223

Francis, J. (2017). The Effects Of Technology On Student Motivation And Engagement In Classroom-Based Learning. *Technology On Student Motivation And Engagement In Classroom-Based Learning*, 1–60. http://dune.une.edu/theseshttp://dune.une.edu/theses/121

Gunawan, Harjono, A., Hermansyah, & Herayanti, L. (2019). Guided Inquiry Model Through Virtual Laboratory To Enhance Students'science Process Skills On Heat Concept. *Cakrawala Pendidikan*, *38*(2). https://doi.org/10.21831/cp.v38i2.23345

Habibi, M. (2018). Pengembangan Multimedia Pembelajaran Interaktif Pada Materi Protista Mata Pelajaran Biologi Kelas X MIA 2 SMA Negeri 1 Depok Sleman. *E-Jurnal Prodi Teknologi Pendidikan*, *7*(2), 178–188.

Haryadi, R., Vita, M., Utami, I. S., Ihsanudin, I., Setiani, Y., & Suherman, A. (2019). Briquettes Production As Teaching Aids Physics For Improving Science Process Skills. *Journal of Physics: Conference Series*, *1157*(3). https://doi.org/10.1088/1742-6596/1157/3/032006

Ikawati, M. S. F. H. D. (2017). Penggunaan Multimedia Untuk Meningkatkan Motivasi Belajar Siswa. *Jurnal Teknologi Pendidikan: Jurnal Penelitian Dan Pengembangan Pembelajaran*, *2*(2), 35–43.

Ikramatul Atiyah, R., Roviati, E., Tadris IPA Biologi, J., & Perjuangan Bypass Sunyaragi Cirebon, J. (2016). Penggunaan Lembar Kerja Siswa (LKS) Berbasis Keterampilan Proses Sains (KPS) Untuk Meningkatkan Literasi Sains Siswa Pada Konsep Kingdom Plantae Kelas X DI SMAN 3 Kuningan. *Scientiae Educatia: Jurnal Sains Dan Pendidikan Sains*, *5*(2), 144–155. www.syekhnurjati.ac.di/jurnal/index.php/sceducatia

Iskandar, A., Rizal, M., Kurniasih, N., Sutiksno, D. U., & Purnomo, A. (2018). The Effects of Multimedia Learning on Students Achievement in Terms of Cognitive Test Results. *Journal of Physics: Conference Series*, *1114*(1). https://doi.org/10.1088/1742-6596/1114/1/012019

Jumini, S. (2016). Kerangka Kualifikasi Keilmuan Fisika UNSIQ. *Jurnal Penelitian Dan Pengabdian Kepada Masyarakat UNSIQ*, *3*(1), 39–44.

Kartikasari, G. (2016). Pengaruh Media Pembelajaran Berbasis Multimedia Terhadap Motivasi dan Hasil Belajar Materi Sistem Pencernaan Manusia. *Jurnal Dinamika Penelitian*, *16*(1), 59–77. https://doi.org/10.21274/dinamika.2016.16.1.59-77

Khan, A. G., Shetu, S. H., Islam, M. N., & Moudud-Ul-Huq, S. (2019). Multimedia Instructions and Academic Performance of Students. *International Journal of Smart Education and Urban Society*, *11*(1), 23–40. https://doi.org/10.4018/ijseus.2020010103

Kurniawati, I. D., & Nita, S.-. (2018). Media Pembelajaran Berbasis Multimedia Interaktif Untuk Meningkatkan Pemahaman Konsep Mahasiswa. *DOUBLECLICK: Journal of Computer and Information Technology*, *1*(2), 68. https://doi.org/10.25273/doubleclick.v1i2.1540

Kusmanto, A., Suparmi, & Sarwanto. (2014). Pendekatan Learning By Doing Dalam Pembelajaran Fisika Dengan Media Riil Dan Multimedia Interaktif. *Jurnal Inkuiri*, *3*(Iii), 65–74.

p-ISSN: 2338-8617
e-ISSN: 2443-2067

Lamalewa, L., & Istanto, T. (2018). Media Pembelajaran Biologi Untuk SMP Kelas IX Berbasis Multimedia. *Musamus Journal Of Research Information and Communication Technology*, *1*(1), 1–11. https://doi.org/10.35724/mjrict.v1i1.1004

Liew, T. W., & Tan, S. M. (2016). The Effects Of Positive And Negative Mood On Cognition And Motivation In Multimedia Learning Environment. *Educational Technology and Society*, *19*(2), 104–115.

Macleod, D. M. C. M. M. (2019). Multimedia Web-Based Intervention And Implementation Of Motivational Factors In Incentive Strategies On Learning Motivation. *Multimedia Tools and Applications*, 1–19.

Mahidin, Z. A. (2017). Pengaruh Media Pembelajaran Interaktif Terhadap Peningkatkan Keterampilan Berpikir Kritis Siswa. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *5*(1), 72–80.

Maisarah, S., Adlim, A., & Yusrizal, Y. (2015). Pengembangan Pembelajaran Berbasis Inkuiri Untuk Meningkatkan Keterampilan Proses Sains Da Motivasi Belajar Siswa Pada Materi Gaya. *Jurnal Pendidikan Sains Indonesia*, *3*(1), 218–229.

Martiningsih, I., Mulyani, S., & Susilowati, E. (2018). Development of Module Based on Scientific Contextual Additives Material to Increase Learning Outcomes and Science Process Skills in Junior High School. *Journal of Innovative Science Education*, *7*(2), 372–381.

Maryam, M., Kusmiyati, K., Merta, I. W., & Artayasa, I. P. (2020). Pengaruh Model Pembelajaran Inkuiri Terhadap Keterampilan Berpikir Kritis Siswa. *Jurnal Pijar Mipa*, *15*(3), 206. https://doi.org/10.29303/jpm.v15i3.1355

Maulida, A. S. R. (2019). Perancangan Media Pembelajaran Fisika Berbasis Multimedia (Studi Kasus: SMK TI Swasta Budi Agung Medan). *JTIK (Jurnal Teknik Informatika Kaputama)*, *3*(1), 15–21.

Maulida, M., Gimin, G., & Kartikowati, S. (2019). Powerpoint and Wondershare Quiz Creator Interactive Multimedia Development to Improve Student Learning Motivation. *Journal of Educational Sciences*, *3*(3), 390. https://doi.org/10.31258/jes.3.3.p.390-400

Mkimbili, S. T., & Ødegaard, M. (2019). Student Motivation in Science Subjects in Tanzania, Including Students' Voices. *Research in Science Education*, *49*(6), 1835–1859. https://doi.org/10.1007/s11165-017-9677-4

Nazalin, N., & Muhtadi, A. (2016). Pengembangan Multimedia Interaktif Pembelajaran Kimia Pada Materi Hidrokarbon Untuk Siswa Kelas XI SMA. *Jurnal Inovasi Teknologi Pendidikan*, *3*(2), 221. https://doi.org/10.21831/jitp.v3i2.7359

Nopitasari, A., Indrowati, M., & Santosa, S. (2012). Pengaruh Metode Student Created Case Studies Disertai Media Gambar Terhadap Keterampilan Proses Sains Siswa Kelas X SMA Negeri 1 Mojolaban Sukoharjo. *Pendidikan Biologi*, *4*(3), 100–110.

Novita, A.I., Pratowo, B.H.S., & Wahyuni, S. (2017). Peran Bahan Ajar Multimedia Interakif Terhadap Keterampilan Proses Sains (KPS) Siswa Kelas X SMA. *Seminar Nasional Pendidikan Fisika*, 5.

Nugroho, T. A. T., & Surjono, H. D. (2019). The Effectiveness Of Mobile-Based Interactive Learning Multimedia In Science Process Skills. *Journal of Physics: Conference Series*, *1157*(2). https://doi.org/10.1088/1742-6596/1157/2/022024

Nurnasari, E., & Nurindah, N. (2018). Karakteristik Kimia Serat Buah, Serat Batang, dan Serat Daun. *Buletin Tanaman Tembakau, Serat & Minyak Industri*, *9*(2), 64. https://doi.org/10.21082/btsm.v9n2.2017.64-72

Ornek, F., Robinson, W., & Haugan, M. (2007). What Makes Physics Difficult. *Science Education International*, *18*(3), 165–172.

Patandung, Y. (2017). Pengaruh Model Discovery Learning Terhadap Peningkatan Motivasi Belajar IPA Siswa. *Journal of Educational Science and Technology (EST)*, *3*(1), 9. https://doi.org/10.26858/est.v3i1.3508

Paudi, Z. I. (2019). Penerapan Metode Role Playing Pada Pembelajaran Fisika Untuk Meningkatkan Hasil Belajar Siswa. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *7*(2), 111–120. https://doi.org/DOI: 10.24815/jpsi.v7i2.14022

Plotnikova, N. F., & Strukov, E. N. (2019). Integration Of Teamwork And Critical Thinking Skills In The Process Of Teaching Students. *Cypriot Journal of Educational Sciences*, *14*(1), 1–10. https://doi.org/10.18844/cjes.v14i1.4031

Puspitasari, D. N., Indriyanti, D. R., & WH, N. (2019). Development of Interactive Multimedia for Human Reproduction System in Junior High School. *Journal of Biology Education*, *8*(2), 238–245. https://doi.org/10.15294/jbe.v8i2.28016

Putri, R. G. P. P. T. N. N. (2020). Multimedia Interaktif Berbasis Game Edukasi sebagai Media Pembelajaran Materi Sistem Pernapasan di Kelas XI SMA. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *8*(1), 141–151. https://doi.org/10.24815/jpsi.v8i1.16062

Rafmana, H., Chotimah, U., & Alfiandra. (2018). Pengembangan Multimedia Interaktif Berbasis Articulate Storyline untuk Meningkatkan Motivasi Belajar Siswa pada Mata Pelajaran PKN Kelas XI di SMA Sriwijaya Negara Palembang. *Jurnal Bhinneka Tunggal Ika*, *5*, 52–65. https://doi.org/https://doi.org/10.36706/jbti.v5i1.7898

Rahmi, R., Fitriati, F., & Fachraini, S. (2019). An Analysis of Teachers' Perceptions toward the Role of ICT Based Media in Teaching and Learning Process among Primary Schools' Teachers. *Jurnal Ilmiah Peuradeun, 7*(3), 469-482. doi:10.26811/peuradeun.v7i3.335

Rante, P., Sudarto, & Ihsan, N. (2013). Pengembangan Multimedia Pembelajaran Fisika Berbasis Audio-Video Eksperimen Listrik Dinamis Di SMP. *Jurnal Pendidikan IPA Indonesia*, *2*(2), 203–208. https://doi.org/10.15294/jpii.v2i2.2724

Rosamsi, S., Miarsyah, M., & Ristanto, R. H. (2019). Interactive Multimedia Effectiveness in Improving Cell Concept Mastery. *Journal of Biology Education*, *8*(1), 56–61. https://doi.org/10.15294/jbe.v8i1.28154

Rosdianto, H. (2019). Students' Science Process Skills Through Generative Learning Model In the Topic of Light. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *4*(1), 8. https://doi.org/10.26737/jipf.v4i1.792

Sarowardy, M. H., & Halder, D. P. (2019). The Issues and Challenges of Using Multimedia at a District Level, Specialized Girls' College in Bangladesh. *Creative Education*, *10*(07), 1507–1524. https://doi.org/10.4236/ce.2019.107110

Sary, S. P., Tarigan, S., & Situmorang, M. (2018). *Development of Innovative Learning Material with Multimedia to Increase Student Achievement and Motivation in Teaching Acid-Base Titration*. https://doi.org/10.2991/aisteel-18.2018.91

Savitri, P. E. N. (2020). The Influence of Science, Environment, Technology, and Society In Creative Industries on Scientific Based Business Designing Skills of Pre-Service Science Teachers. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *8*(1), 27–38. https://doi.org/10.24815/jpsi.v8i1.15362

Siahaan, P., Suryani, A., Kaniawati, I., Suhendi, E., & Samsudin, A. (2017). Improving Students' Science Process Skills through Simple Computer Simulations on Linear Motion Conceptions. *Journal of Physics: Conference Series*, *812*(1). https://doi.org/10.1088/1742-6596/812/1/012017

Silalahi, A., Hutabarat, W., Tarigan, S., & Chandra, Y. (2018). Impact of Multimedia-Based Off-Line Learning on Student Motivation and Outcomes. *Asian Journal of Social Science Studies*, *3*(4), 1. https://doi.org/10.20849/ajsss.v3i4.471

Siswono, H. (2017). Analisis Pengaruh Keterampilan Proses Sains Terhadap Penguasaan Konsep Fisika Siswa. *Momentum: Physics Education Journal*, *1*(2), 83. https://doi.org/10.21067/mpej.v1i2.1967

Sriningsih., H. (2019). *Pengaruh Pelaksanaan Pendekatan Pembelajaran Keterampilan Proses Terhadap Antusiasme Siswa*. http://eprints.unm.ac.id/13362/

Sulaiman., Walidin, W., Yusuf, M., Usman, J., & Masrizal. (2020). The Implication Of Lecturers' Academic Competency On Malaysian And Indonesian Students' Satisfaction. *Opcion*, *36* (Special Edition 27), 517–532.

Syahputra, A., Suparno, S., Giatman, M., & Maulida, R. (2020). Perancangan Media Pembelajaran Interaktif Berbasis Model Pembelajaran Problem Based Learning Mata Kuliah Fisika Dasar. *Jurnal Media Informatika Budidarma*, *4*(1), 245. https://doi.org/10.30865/mib.v4i1.1974

Syaifuddin, A. (1999). *Penyusunan Skala Motivasi*. Pustaka Pelajar.

Syawaludin, A., Gunarhadi, & Rintayati, P. (2019). Enhancing Elementary School Students' Abstract Reasoning In Science Learning Through Augmented Reality-Based Interactive Multimedia. *Jurnal Pendidikan IPA Indonesia*, *8*(2), 288–297. https://doi.org/10.15294/jpii.v8i2.19249

Utami, U. (2014). Efektivitas Pemanfaatan Media Pembelajaran Animasi Untuk Meningkatkan Motivasi Dan Hasil Belajar Fisika Siswa Madrasah Aliyah Negeri Wonosobo. *Prosiding Pertemuan Ilmiah XXVIII HFI Jateng & DIY*, 334–337.

Warsono, W., Nursuhud, P. I., Darma, R. S., Supahar, S., Oktavia, D. A., Setiyadi, A., & Kurniawan, M. A. (2020). Multimedia Learning Modules (MLMs) Based on Local Wisdom in Physics Learning To Improve Student Diagram Representations in Realizing the Nature of Science. *International Journal of Interactive Mobile Technologies*

p-ISSN: 2338-8617
e-ISSN: 2443-2067

(iJIM), *14*(06), 148. https://doi.org/10.3991/ijim.v14i06.11640

Widada., & Rosyidi, A. (2017). Perancangan Media Pembelajaran Fisika SMP Berbasis Multimedia Interaktif. *Jurnal IT CIDA, 3(2)*, 53–68.

Winata, H., & Yuliani, K. (2017). Media Pembelajaran Mempunyai Pengaruh Terhadap Motivasi Belajar Siswa (Learning Media Has an Influence on Motivation to Learn). *Pendidikan Manajemen Perkantoran*, *2*(1), 259–265.

Wiwin, E., & Kustijono, R. (2018). The Use Of Physics Practicum To Train Science Process Skills And Its Effect On Scientific Attitude Of Vocational High School Students. *Journal of Physics: Conference Series*, *997*(1). https://doi.org/10.1088/1742-6596/997/1/012040

Yasin, Z., & Husain, R. (2019). *The Effect of The Using of Learning Multimedia and Motivation to The Result of Arabic Learning*. https://doi.org/10.4108/eai.19-10-2018.2281391

Zahara, S., Haji, A. G., & Syukri, M. (2018). Improving the Concept Understanding and Scientific Attitudes through the Implementation of Scientific Approach. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *3*(1), 55. https://doi.org/10.24042/tadris.v3i1.2513