The Effectiveness of QR Code-based Interactive Learning Media for Science Subjects

Dwi Widiyanto, Sri Surachmi W., Khamdun

Universitas Muria Kudus
khamdun@umk.ac.id

Abstract
This study aims to analyze the effectiveness of Qr code-based interactive learning media for science subjects for fifth grade students. This research method uses a quasi-experimental design with a non-randomized control group, pretest-posttest. This research was conducted at SDN 4 Blingoh as an experimental class with learning activities using interactive learning media based on Qr code for science subjects and SDN 3 Blingoh as a control class with conventional learning activities. The data analysis technique used in this research is descriptive analysis and inferential analysis. Data collection techniques using observation techniques and the results of pretest-posttest scores. Data on the effectiveness of Qr code-based interactive learning media for science subjects were analyzed using the N gain test and sample test assisted by the SPSS program. From the data obtained, it is known that there is a significant influence on the use of Qr code-based interactive learning media for science subjects. In the t-test, the value of Sig. (2-tailed) $0.020 < 0.050$, it can be concluded that there is an average difference in student learning outcomes between the development of Qr code-based interactive learning media and conventional models.
Keywords: *interactive learning media, qr code, learning outcomes, science*

Abstrak
Penelitian ini bertujuan untuk menganalisis keefektifan media pembelajaran interaktif berbasis Qr code pada mata pelajaran IPA bagi siswa kelas V. Metode penelitian ini menggunakan desain quasi eksperimen dengan rancangan non randomized control group, pretest-posttest. Penelitian ini dilaksanakan di SDN 4 Blingoh sebagai kelas eksperimen dengan aktivitas pembelajaran menggunakan media pembelajaran interaktif berbasis Qr code pada mata pelajaran IPA dan SDN 3 Blingoh sebagai kelas kontrol dengan aktivitas pembelajaran konvensional. Teknik analisis data yang digunakan dalam penelitian ini adalah analisis deskriptif dan analisis inferensial. Teknik pengumpulan data menggunakan teknik observasi dan hasil skor pretest-posttest. Data keefektifan media pembelajaran interaktif berbasis Qr code pada mata pelajaran IPA dianalisis menggunakan uji N gain dan uji sample yang dibantu program SPSS. Dari data yang diperoleh diketahui bahwa terdapat pengaruh yang signifikan terhadap penggunaan media pembelajaran interaktif berbasis Qr code pada mata pelajaran IPA. Pada uji t diperoleh nilai Sig. (2-tailed) $0,020 < 0,050$, maka dapat disimpulkan bahwa terdapat perbedaan rata-rata hasil belajar siswa antara pengembangan media pembelajaran interaktif berbasis qr code dengan model konvensional.
Kata kunci: media pembelajaran interaktif, qr code, hasil belajar, IPA

INTRODUCTION

Natural Science (IPA) has a broad definition. According to Rustaman, (2011: 1.1) Science is a process that produces knowledge. The process relies on a process of careful observation of phenomena and on theories of findings to interpret the results of these observations. So natural science is the result of activities in the form of discoveries based on experiences gained from observations. For this reason, a learning model is needed that can be an alternative to learning science in order to provide a new atmosphere in the learning process. Science plays an important role in increasing human understanding of the universe, life, and the basic principles that govern the universe. Through observation, experimentation and theory testing, science allows us to gain new insights into the world around us and design more advanced technologies for the future.

Online learning in science subjects raises a problem because in essence, science learning is learning that includes abstract concepts and events that require observation, so students must be required to see what can be learned (Rusman, 2019). Online learning creates obstacles for students who do not understand science lessons so that they have difficulty learning science besides that science also has practicum which aims to further clarify teaching material that can be observed directly. Based on observations obtained from several schools used in the study, the learning used by teachers is still conventional learning. The teacher is still the center or source of learning. The use of learning methods is still using lectures only. Where teachers still want students to sit and listen to explanations of material to avoid noise in the classroom. This makes students tend to be silent and less able to understand the material during class learning activities because students feel afraid and confused. This results in student learning outcomes, especially science lessons, many of which have not been completed.

To be able to achieve goals, supporters are needed in the learning process. One of the supporters of learning activities is the media. According to Bovee (in Sanaky, 2009: 3) a tool that functions in conveying learning messages and helping communicate between teachers and students is learning media. In understanding the material students have different learning styles, as a teacher is able to choose suitable media for students used in learning activities.

Learning media is used to stimulate students' interest and motivation to be more active in learning, so that it can improve students' abilities. One of the learning media used is interactive learning media based on Qr code for science subjects for grade V students which is a learning media that is delivered to students to make learning more interesting. Thus it is hoped that students will be more active in participating in the learning process. With learning will be more fun then, Learning is not only fixated on the teacher but on the media and groups as well. In the 2013 curriculum, teachers and students have the same role as communicators. Teachers and students must be able to build good communication for the success of learning activities.

In addition to the learning model, to determine the success of a lesson, teachers should use interesting learning media. According to Yunardi (Kurniadi, Purwaningrun, 2018: 10) shows that learning aided by teaching aids can help improve student learning outcomes on the material they learn. Learning media will trigger students to become more active and interested in learning the material being studied. It is intended that the message conveyed in the form of subject matter can be more easily understood and understood by students.

With the various concepts above, students are expected to be proficient in understanding human respiratory organs. Because human respiratory organ material is the basic material to be able to understand other human organ material. With the students' proficiency in understanding the material, they are expected to be able to follow further

learning activities. With this student understanding, learning outcomes will be obtained in accordance with expectations. According to Sudjana (Setyani, et al, 2021: 45) has an opinion that learning outcomes are the abilities that students have after experiencing the learning process. Therefore, the success in learning activities depends on student learning outcomes.

Based on the above problems, this study was conducted to determine the effectiveness of the use of learning media used, namely interactive learning media based on Qr code for science subjects for grade V elementary school students.

Yaman (2016) revealed that "Natural Science (IPA) is related to how to find out about nature systematically, science is not only about mastering a collection of knowledge in the form of facts, principles or concepts but also a discovery process".Wisudawati and Sulistyowati (2015: 22) state, science is a family of sciences, which basically has special characteristics, namely studying factual natural phenomena, either in the form of reality or events and causal relationships. So it can be concluded that science is the study of natural phenomena that occur in nature in the form of facts, concepts and principles in the process of discovery.

Learning and teaching are the main activities in the educational process. Learning and learning is a complex process by bringing together components that have characteristics, are interrelated and influence to achieve a goal or expected competence. Learning components include goals, materials, students and educators in the learning process, methods, media and environment (Hanafy, 2014). Educators in higher education are lecturers and education support personnel, namely education personnel. So that during the post-COVID-19 pandemic, limited face-to-face learning was implemented.

Education is said to be good if learning objectives are achieved, material is delivered so that students easily understand. Because technology is increasingly developing, to achieve success in learning activities there is an increase in human resources. Teachers must have good skills and abilities in using technology. According to Wagner (2021), innovation is one of the seven key skills students need to succeed in the 21st century. According to him, teachers must be able to create learning experiences that challenge and arouse students' interest in learning.

According to Schram (Susilana et al, 2017: 5) states that media is a messenger technology that can be utilized for learning purposes. According to Gerlach and Ely (Aditya, 2018: 65) state that media are people, materials or events that build conditions so that students are able to acquire knowledge, skills and attitudes. So that the media can be interpreted as tools, materials and strategies to help students understand knowledge, skills and attitudes. Gagne (Samura, 2016: 71) defines that media are various types of components in the student's environment that can stimulate him to learn.

Media is an intermediary or messenger from the sender to the recipient of the message. (Arif S. Sadiman, et al., 1990: 6). Umar Suwito (Suharsimi Arikunto, 1993: 45) limits learning media as follows: learning media is a means of learning that is used as a means to achieve goals. Azhar Arsyad (2002: 4) states that learning media include tools that are physically used to convey the content of teaching materials. R. Angkowo and A. Kosasih (2007: 10) state that media is anything that can be used to channel messages, stimulate thoughts, feelings, attention and willingness of students so that they can be encouraged to engage in the learning process. Based on the above opinions, it can be concluded that learning media is a tool used to build communication and interaction between teachers and students and the teaching and learning process.

Giving learners direct experience is not easy. This is because not all direct experience can be learned by students. Therefore, learning media that are abstract can become real. In general, the media has several benefits (Haryono, 2014: 49), including:

(1) Overcoming the limitations of the experience possessed by students, because the experience of each student is different and depends on the factors that determine the richness of the child's experience; (2) Obtaining a clear picture of objects that are difficult to observe directly, because: objects are too large, objects are too small, objects move too slowly, objects move too fast, objects are too complex, objects that sound too soft, objects that are too far away, dangerous objects; (3) Allows direct interaction between students and teachers and the environment; (4) Produces uniformity of observation; (5) Instill basic concepts that are correct, concrete, and realistic; (6) Generate new desires and interests; (7) Generate motivation and stimulate children to learn; (8) Provide a comprehensive experience from concrete to abstract; (9) Make it easy for students to compare, observe and describe an object.

Based on the thoughts of the figures above regarding learning media, so that researchers can conclude that learning media is an intermediary in the form of humans, materials or events that can provide messages that can stimulate students to learn so that they can bring about changes in both knowledge, skills and attitudes. Through learning media, teaching and learning activities will be more interesting so that students are motivated to learn. Learning media also allows good communication between teachers and students, so that it can make students more comfortable in expressing their opinions.

QR Code is a two-dimensional matrix image that has the ability to store data in it. QR Code is an evolution of the bar code (barcode). Barcode is a real object marking symbol made of a pattern of black and white bars to be easily recognized by a computer while according to (Sholeh & Muharom, 2016) 'Qiuck Response Code often called QR Code or QR code is a kind of two-dimensional symbol developed by Denso Wave which is a subsidiary of Toyota a Japanese company in 1994. The purpose of this QR Code is to convey information quickly and also get a response quickly. Initially the QR Code was used for tracking vehicle parts for manufacturing. But now, it has been used for commercial use which is shown in the use of cell phones. QR Code is the development of barcodes or bar codes that are only able to store more information, both horizontally and vertically (Rubianti & Sahara, 2019).

The increasingly widespread use of smartphones and the Qr code internet network is also utilized in the world of education because it is simpler and more fun in its application in learning. As is the case with subject matter stored on line / drive storage that can be seen only by scanning the link that is presented in the form of a Qr code.

The utilization of Qr code-based interactive learning media above, it is hoped that students will be more motivated to take part in learning and make it easier for students to understand human respiratory organs. Maintaining an interactive video then scanning the qr code to explore human respiratory organs material in class V. It's just that the use of this media is less efficient if it is not supported by an adequate internet network. This research was conducted on fifth grade students at SDN 4 Blingoh with 14 students as the experimental class and SDN 3 Blingoh, Donorojo District, Jepara Regency with 16 students as the control class.

METHOD

In this study using methods including quasi experiments with the design of the nonrandomized control group, pretest-posttest. According to Ady et al (Anggraeni, 2017: 88) states that the nonrandomized control group, pretest-posttest is one of the most widely used designs in quasi-experimental research methods in education. Researchers determined the experimental group (Y1) and control group (Y1), in order to conduct a pretest with the intention of knowing the homogeneity and normality of the two groups. Conduct experimental treatment (X) which in this study is Qr code-based interactive

learning media only with the experimental group (Y1), and then conduct a posttest to measure the difference between the two groups.

According to Sukardi (2013: 186) the Nonrandomized Control Group Pretest-Posttest Design is as follows:

Table 1. Quasi-Experiment Design

Group	Pretest	Independent variable	Posttest
Experiment	Y1	X1	Y2
Control	Y1	O	Y2

Description
Y1   = Initial test in the experimental group
Y2   = Final test in the experimental group
Y1   = Initial test in the control group
Y2   = Final test in the control group
X1   =   Treatment,   interactive   learning   media   based   on   QR   code
O   = Treatment, without media

The stages that will be carried out in this research include (1) Preparation stage (preparing lesson plans, instruments and determining research subjects, (2) Implementation stage (before learning in both control and experimental classes, students are given a pretest first, then after learning activities students are given posttest questions), (3) Data analysis stage (qualitative and quantitative data collection which includes pretest and posttest results along with student observations), (4) conclusion making (based on the hypothesis that has been formulated). Sampling in this study was purposive sampling. This sampling technique is used in studies that prioritize research objectives rather than the nature of the population in determining the research sample, so that the data obtained is more representative. The subjects of this study came from grade V SDN 3 Blingoh with a total of 16 students as the experimental class and SDN 4 Blingoh students with a total of 14 students as the control class. The reason the researchers conducted research in the two schools was because the school had never conducted learning using interactive learning media based on Qr code in science subjects.

To determine the success in using interactive learning media based on QR code in improving science learning outcomes on human respiratory organ material is to conduct pre and post tests in experimental classes and control classes. So that after the implementation of the post test in both classes, a comparison of learning outcomes between the control class and the experimental class can be obtained. The test given is in the form of multiple choice questions with a total of 10 (ten) items. The research data were processed in two ways, namely descriptive methods and statistical methods. Research data in the form of observation sheets, questionnaire results, and interview results are processed by descriptive methods. While the pretest and posttest test results were processed by statistical methods. Statistical method analysis was carried out by normality test, homogeneity test, hypothesis test, and gain test with the help of IBM SPSS Statistic 25.

RESULT AND DISCUSSION

During learning activities, researchers made observations of the implementation of ongoing learning activities. There was a difference in the quality of learning activities

between learning using Qr code-based interactive learning media and conventional learning. The following is a comparison of the observation results.

No	Indicator	Experiment Class	Control Class
1	Submission of material according to KD	√	√
2	Learning activities in accordance with the lesson plan	√	√
3	Using a learning model	√	-
4	Already using media	√	-
5	Students are active in learning	√	-
6	Giving example problems with props	√	-

Based on the observations above, science learning activities on the material of human respiratory organs using interactive learning media based on QR code are more interesting for students in participating in learning, this can be seen from the activeness of students in solving the problems faced with their respective groups.

In addition, this study analyzed the Pretest and Posttest scores and N-gain of science learning outcomes of human respiratory organs material in class V. The research was conducted in the control class and the experimental class. The pretest score shows the value before treatment and the posttest score shows the value after treatment using interactive learning media based on QR code in the experimental class. The initial data analysis of this study is a prerequisite analysis, namely normality and homogeneity analysis.

The normality test is used to determine whether the data to be analyzed is normally distributed or not. The normality test uses the Shapiro-Wilk test because in this small class test there are less than 5 respondents. Decision making based on the significance value has a greater value.

Tabel 2. Normality Test of the Pre Test

	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Initial Test Score	SDN 3 Blingoh	.185	16	.178	.938	16	.354
	SDN 4 Blingoh	.172	14	.171	.928	14	.179

Based on the normality test table for the initial test, the sig value of SDN 3 Blingoh is 0.354 sig for SDN 4 Blingoh is 0.1790 with a significance level of 0.050, so the sig value in the initial test is> from the significance level (0.050), meaning that it can be concluded that the data of all initial tests have a normal distribution, so that the experimental class data and control class tests can be used for research subjects.

Table 3 Normality Test of the Final Test

	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Final Test Score	SDN 3 Blingoh	.202	16	.101	.921	16	.198
	SDN 4 Blingoh	.225	14	.016	.903	14	.064

Based on the final test normality test table, the sig value for SDN 3 Blingoh is 0.198, the sig for SDN 4 Blingoh is 0.064, with a significance level of 0.050, so that the calculated sig value in the final test is> from the significance level (0.05), meaning that it can be concluded that all final test data has a normal distribution, so that the experimental class and control class data can be used as research subjects.

The homogeneity test is a test carried out after the normality test. Homogeneity test is a test conducted to determine that two or more groups of sample data come from populations that have the same variance (homogeneous). Homogeneity test can be done by levene test, fisher or barlelett test, (Sudjana, 2005: 250). This test is a prerequisite before

conducting other tests, such as the T test and Anova. The test is conducted to determine that the data groups do come from the same group.

The decision-making guidelines on the homogeneity test are:

a. If the significance value (sig) Based on Mean> 0.05, then the data variant is Homogeneous

b. If the significance value (sig) Based on Mean <0.05, then the data variance is not homogeneous.

Below are the results of the homogeneity test of the initial test scores and the final test scores of the science learning outcomes of human respiratory organ material in grade V elementary schools.

Table 4 Homogeneity Test of Initial Test

		Levene Statistic	df1	df2	Sig.
Initial Test Score	Based on Mean	.008	1	31	.930
	Based on Median	.001	1	31	.975
	Based on Median and with adjusted df	.001	1	28.124	.975
	Based on trimmed mean	.016	1	31	.901

Based on the homogeneity test table above, the significance value (sig) Based on Mean is 0.930> 0.005, so it can be concluded that the initial test in the experimental class and control class is the same or homogeneous.

Table 5 Homogeneity of the Final Test

Final Test Score	Based on Mean	.058	1	31	.812
	Based on Median	.106	1	31	.747
	Based on Median and with adjusted df	.106	1	30.844	.747
	Based on trimmed mean	.029	1	31	.866

Based on the homogeneity test table above, the significance value (sig) Based on Mean is 0.812> 0.05, so it can be concluded that the final test scores in the experimental class and control class are the same or homogeneous. In this study, researchers conducted a t-test with the help of the SPSS software program version 25.0 to help find conclusions. In the calculation of the paired t test, the following hypothesis is compiled.

Ho = The use of interactive learning media based on Qr code cannot improve the results of science learning outcomes of human respiratory organs material for grade V students.

Ha = The use of interactive learning media based on Qr code can improve the learning outcomes of mathematics fraction material for grade V students.

The conclusion of the hypothesis is accepted if the significance < α, namely α = 0.05, 03 whether there is a difference in learning outcomes in the control group and the experimental group is indicated by the Sig. (2 tailed). If Sig. (2 tailed) > q = 0.005 then Ho is accepted. Conversely, if Sig. (2 tailed) < q = 0.005 then Ho is rejected. The t test results for the hypoths used are as follows.

Table 6 t-test results

	class	N	Mean	Std. Deviation	Std. Error Mean
Final Test Score	SDN 3 Blingoh	16	78.67	15.055	3.887
	SDN 4 Blingoh	14	66.11	14.200	3.347

Based on the table above, it is known that the average final test score for SDN 3 Blingoh was 78.67 and SDN 4 Blingoh was 66.11. Descriptive statistics show that there is a difference in the average student final test scores between the control class and the experimental class. So, to continue proving whether the difference is significant or not, it is necessary to interpret the second table, namely the independent sample test. The results of the independent sample test in the table below. Based on the table above, it is known that the significance level is 0.05 and the sig. (2-tailed) value is 002, so 0.020 <0.05. The calculated t value is 2.461 The t table value with df = 31 is 2.03951, so the calculated t value> t table (2.461> 2.03951). The decision is Ho rejected and Ha accepted because sig. (2-tailed) <0.05. And t count > t table. The conclusion is that there is a significant increase in the experimental class with interactive learning media based on QR code in improving the results. In conclusion, there is a significant increase in the experimental class with interactive learning media based on QR code in improving science learning outcomes in the material of human respiratory organs in class V elementary school.

Table 7 t test results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Final Test Score	Equal variances assumed	.058	.812	2.461	31	.020	12.556	5.102	2.151	22.960
	Equal variances not assumed			2.448	29.224	.021	12.556	5.130	2.068	23.043

Independent Samples Test

The N Gain test was conducted with the help of SPSS. The results of the N Gain test in each class are as follows:

Table 8 N Gain Test of Experimental and Control Classes

No.	Value	Experiment Class SDN 3 Blingoh	Control Class SDN 4 Blingoh
1	Mean	55.8571	19.8179
2	Minimum	16.67	0.00
3	Maximum	100.00	50.00
4	**N-Gain**	0.56	0.198
5	Criteria	Medium	Low
6	N-Gain %	56	20
7	Interpretation	Effective Enough	Ineffective

Based on these data, the results of the calculation of the N Gain of the experimental class obtained an average N Gain of 0.558571. This means that the % is 55.8571. which is interpreted that learning using interactive learning media based on QR code is effective enough to be used to improve science learning outcomes on human respiratory organs in grade V elementary schools.

Then in the control class obtained an average N-Gain of 19.8179 and obtained an N-Gain value of 0.198179, meaning that the control class experienced an increase in learning outcomes with a low category because the gain value <0.3. The N-Gain % value of 19.9179 is interpreted that conventional learning is not effective for improving science learning outcomes on human respiratory organs. Based on the results of the analysis above, it can be concluded that the use of interactive learning media based on QR code in science lessons on human respiratory organs in class V is quite effective in improving student learning outcomes. effectiveness is shown by the increase in pretest and posttest scores in the experimental class. In addition, the quality of the increase is also indicated by the high gain value.

The findings that researchers get based on the results of data analysis are presented, namely: First, fifth grade students have difficulty understanding the material of human respiratory organs. Through learning that only focuses on the teacher then only the teacher as the deliverer of the material, learning is less effective which results in students who should need more treatment in carrying out learning finally being neglected due to time constraints. So that when learning is carried out using interactive learning media based on QR code, learning will be more effective and efficient. This is because through this media can foster an attitude of take and give in understanding the material and solving the problems faced by each student. Through the use of interactive learning media based on Qr code will make it easier for students to understand and master the material of human respiratory organs. Second, learning using interactive learning media based on Qr code is very suitable for use in grade V. because grade V students who are generally 11 years old are capable and accustomed to utilizing smartphones in learning because they are used to participating in online learning during the corvid-19 pandemic.

CONCLUSION

From the results of existing observations, differences in the conditions of learning activities were found. The success of learning activities can be seen from the results of observations made by researchers during ongoing learning. In the experimental class, an active class condition was found due to students' interest in the Qr code- based interactive learning media used. While in the control class students tend to be passive because it is only done by the lecture method. In addition, the difference can also be seen from the posttest results after the use of interactive learning media based on Qr code in the experimental class is different from the control class. The average score on fraction material with different denominators in the experimental class is higher than in the control class using conventional methods. Empirically, Qr code-based interactive learning media is quite effective in improving science learning outcomes in human respiratory organ material with an N-Gain value of 55.8571.

REFERENCE

Aditya, P. T. (2018). Development of web-based mathematics learning media on circle material for grade VIII students. *Journal of Mathematics, Statistics and Computing*, 15(1), 64-74.

Arikunto, Suharsimi. (1993). *Research Procedure: A Practical Approach*. Jakarta: PT Rineka Cipta.

Arsyad, Azhar. 2019. Learning Media. Depok: Rajagrafindo Persada.

Hanafy, Muh. Sain. (2014). The Concept of Learning and Learning. *Lentera Education*, 17(1). 66-79. http://journal.uinalauddin.ac.id/index.php/lentera_pendidikan/article/viewFile/516/491. (Accessed on December 28, 2022).

Haryono, N. D. (2015). Development of Interactive Multimedia as a Learning Media for Social Science Cooperative Materials for Fourth Grade Students of SD Negeri Tegalpanggung Yogyakarta. (*Thesis*). Elementary School Teacher Education Study Program, Faculty of Education, State University of Yogyakarta, Yogyakarta.

Irma.2020. The Importance of Media and Learning Models in the Teaching Process.(Online).(https://metrojambi.com/read/2017/10/27/26042/pen tingnya-media-and-model- learning-in-the-teaching-process/ accessed on August 26, 2020.

Rubianti, Y., & Sahara, E. (2019). QR Code Generator Application Design to Optimize Learning Media. *Journal of Information and Communication Technology (JTIK)*, 10(2), 127-134.

Rusman, 2019. Learning Models: Developing Teacher Professionalism, RajaGrafindo Persada, Jakarta

Sholeh, M., & Muharom, E. (2016). Quick Response Code (QR Code). *Journal of Electrical and Computer Engineering* (JTEK), 5(2), 52-59.

Slameto. (2003). *Learning and factors that influence it*. Jakarta: Rineka Cipta.

Sugiyono. 2018. *Management Research Methods*. Bandung: Alfabeta.

Sukardi. 2013. *Educational Research Methods*. Jakarta: Bumi Aksara.

Sudjana, Nana. 2014. *Assessment of Teaching and Learning Process Results*. Bandung: PT Remaja Rosdakarya.

Susilana, Rudi, Cepi Riyana (2017).*Learning Media*. Bandung: CV.Wacana Prima.

Tian, J., & Siegler, R. S. (2017). *Fractions learning in children with mathematics difficulties. Journal of Learning Disabilities,* 50(6), 614-620.Disabilities, 50(6), 614-620.

Wagner, Tony. (2021). Learning by Heart: An Unconventional Education. The New Press.

Wisudawati, N.M., & Sulistyowati, E. (2015). The Effect of Problem-Based Learning Model on Problem Solving Ability and Student Learning Motivation on Heat Material. Journal of Physics and Technology Education, 1(2), 22-30.

Wulandari, S., Hima, L. R., & Nurfahrudianto, A. (2020). Development of Bandicam Screen Recorder (BSR) Media on Derivative Application Materials (Doctoral dissertation, Universitas Nusantara PGRI Kediri.