Improving Student Learning Outcomes Through Physics Learning Media Using Macromedia Flash

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A B S T R A K

Dalam proses pembelajaran fisika, guru masih belum mampu mengembangkan media pembelajaran berbasis ICT menggunakan software macromedia flash yang efektif dan efisien. Perlu dilakukan analisis artikel dari hasil-hasil penelitian terdahulu untuk memahami media yang tepat untuk pembelajaran fisika. Penelitian ini dilakukan dengan tujuan untuk mengetahui jenis penelitian apa saja yang telah dilakukan dalam pengembangan media pembelajaran fisika mengunakan sofware macromedia flash dan untuk menganalisis effect size pengaruh media pembelajaran fisika mengunakan software macromedia flash ditinjau dari hasil belajar peserta didik berdasarkan tingkatan pendidikan, jenis media yang dikembangkan dan materi pembelajaran. Jenis penelitian yang digunakan adalah penelitian meta-analisis. Subjek penelitian ini yaitu 21 artikel tentang pengembangan media pembelajaran fisika mengunakan software macromedia flash ditinjau dari hasil belajar peserta didik yang telah diujicobakan di kelas terbitan tahun 2011-2020. Analisis data yang digunakan dalam penelitian ini adalah analisis kuantitatif dengan menghitung effect size menggunakan parameter statistik. Hasil penelitian yaitu efektivitas terbaik media pembelajaran fisika mengunakan software macromedia flash ditinjau dari hasil belajar peserta didik berdasarkan tingkatan pendidikan adalah pada Perguruan Tinggi. Efektivitas terbaik media ditinjau dari hasil belajar peserta didik berdasarkan jenis media yang dikembangkan adalah multimedia. Efektivitas terbaik media pembelajaran fisika ditinjau dari hasil belajar peserta didik berdasarkan materi pembelajaran adalah pada materi gerak. Dapat disimpulkan bahwa media pembelajaran yang menggunakan software macromedia flash merupakan media yang dapat membanti siswa dalam belajar.

A B S T R A C T

In the process of learning physics, teachers can still not develop ICT-based learning media using Macromedia flash software that is effective and efficient. It is necessary to analyze articles from the results of previous studies to understand the right media for learning physics. This research was conducted to know what types of research have been carried out in the development of physics learning media using Macromedia flash software and to analyze the effect size of the influence of physics learning media using Macromedia flash software in terms of student learning outcomes based on education level, type of media developed and learning materials. The type of research used is a meta-analysis study. The subjects of this research are 21 articles on the development of physics learning media using Macromedia flash software in terms of student learning outcomes that have been tested in class published in 2011-2020. The data used in this study is a quantitative analysis by calculating the effect size using statistical parameters. The result of the research is that the best effectiveness of physics learning media using Macromedia flash software in terms of student learning outcomes based on education level is in Higher Education. The best effectiveness of the media in terms of student learning outcomes based on the type of media developed is multimedia. The best effectiveness of physics learning media in student learning outcomes based on learning materials is on motion material. It can be concluded that Multimedia that uses Macromedia flash software is a medium that can help students in learning.

1. INTRODUCTION

The era of the industrial revolution 4.0 is synonymous with the rapid development of information and communication technology (ICT) (Chin & Wang, 2021; Lange et al., 2020; Rajagukguk & Simanjuntak, 2015). The development of ICT provides many conveniences and becomes a new way for humans to carry out activities (Heemskerk et al., 2012; Nursamsu & Kusnafizal, 2017). For example, in sending money, just by pressing a few

digits of the value of the money to be sent and a few digits of the destination account number, the money moves from one account to another. Advances in ICT have now provided a lot of convenience and comfort for human life, especially in education (Anwariningsih & Ernawati, 2013; Lawrence & Tar, 2018). One of the roles of ICT for education is the availability of facilities that can be used to carry out unidirectional or interactive learning. The use of ICT in education is proliferating. Therefore it requires updates to keep up with these developments (Arrosagaray et al., 2019; Baya'a et al., 2019). In updating following the development of ICT in the education process, teachers play an essential role because teachers are the main actors in education. Teachers must have the skills to utilize ICT in learning activities by developing interactive learning media (Arrosagaray et al., 2019; Baya'a et al., 2019; Kim et al., 2020).

Preliminary studies have been carried out in this study by analyzing several articles related to the development of physics learning media. Based on the initial study, it is found that the reality is different between ideal conditions and conditions in the field. The first actual condition is that students' learning achievement in physics subjects is still low compared to other subjects (Ariani, 2020; Gunawan et al., 2017; Saprudin et al., 2020). The second actual condition in the physics learning process is that most students seem less interested, less enthusiastic, and passive (Putri, I & Sibuca, A, 2014; Rozi & Kristari, 2020). The third actual condition is that not many teachers use ICT media. Even the lecture method is still quite popular in the learning process (Astuti et al., 2017; Damanik & Tanjung, 2013; Siti Hadizah et al., 2021). The identification results obtained that one of the causes of the above problems is that the learning media used by teachers in the physics learning process is not appropriate so that learning has not been able to generate student learning motivation optimally. Teachers can still not develop effective and efficient learning media (Manurung & Panggabean, 2020; Surata et al., 2020). Teachers have not optimally used ICT learning media, so many students are less interested and do not understand what the teacher has conveyed. As a result, student learning outcomes have not been maximized. Teachers still use limited interactive media in the learning process, resulting in low student learning outcomes (Dasril & Usmeldi, 2020; Fauyan, 2019).

Based on the causes of the problems above, the solution offered is exciting and interactive learning media in learning physics. Considering that physics is a relatively abstract concept, it is necessary to use ICT media based on Macromedia flash software to facilitate students' absorption of physics material (Viajayani et al., 2013). ICT media can overcome abstract physics learning problems by displaying images in animations and videos (Suseno, 2015). ICT learning media can also make abstract concepts concrete with static visualization and dynamic visualization (Syefrinando, 2016). ICT media is beneficial in facilitating the delivery of abstract messages in the form of an attractive and interactive website. One of the subjects known for its abstract concepts in physics. Physics laws and concepts are abstract, so they become obstacles for teachers in delivering material to students (Astuti et al., 2017; Mufit et al., 2020). Not all physics concepts can be experimented with in the laboratory because they are abstract (Viajayani et al., 2013). Therefore, teachers must develop and use appropriate ICT media so that physics learning in the classroom becomes exciting and provides an accurate and deep understanding.

Building an ICT learning media requires software to increase students' motivation and enthusiasm to learn and understand the physical symptoms of abstract concepts (Changwong et al., 2018; Haryadi & Pujiastuti, 2020). Making learning media with software applications is expected to increase students' interest and motivation to learn, further affecting student learning outcomes (Kurniawati et al, 2016). Engaging learning media such as flash software can generate interest in learning to improve student learning outcomes (Sakti et al., 2012; Salim et al., 2011). One of the software that can be used to develop ICT-based physics learning media is Macromedia flash software. Macromedia flash software is one of the software that can create digital and interactive learning media. Macromedia Flash is one of the application programs used to design animations widely used today. One of the research results related to Macromedia flash software is applying physics learning media using Macromedia Flash to create interactive multimedia that can improve student learning outcomes (Fakhri & Bektiarso, 2018; Gómez et al., 2011).

Macromedia Flash is multimedia that can create videos, animations, images, and sounds quickly and effectively (Fakhri & Bektiarso, 2018). Media development using Macromedia flash software in physics learning makes abstract material concrete, making objects in applications more interactive to attract the attention and interest of students in the learning process. The advantages of using Macromedia flash media include animation, and the resulting images are very consistent and flexible. Image quality is maintained; program emergence time is relatively fast; the resulting interactive program; easy to create animations; can be integrated with several other programs; the final result can be stored in various forms, and can be used to make short films, and presentations (Haeruddin, 2017).

Previous research stated that interactive multimedia is effectively used to facilitate students ' learning (Knoop-van Campen et al., 2020; Prasetyo et al., 2020). Other studies also state that multimedia will increase students' enthusiasm for learning (Indah Septiani et al., 2020; Khan & Masood, 2015). Other findings also state that learning media in multimedia will improve student learning outcomes (Daniels & Gierl, 2017; Mayer,

2012). Previous research studies discussing physics learning media using Macromedia flash software have been widely tested in the classroom and published in ISSN national and sinta accredited journals. Therefore, it is necessary to summarize, compare and analyze the results of these studies. So that they can understand the suitable media in learning physics and better suggestions for future research, based on this, researchers are interested in conducting research using the meta-analysis method with the title "Meta-analysis of physics learning media usinMacromediaia flash software." The purpose of this study was to analyze physics learning media using Macromedia flash software in terms of student learning outcomes based on the type of research method used, level of education, type of media, and material used as content in the media under study.

2. METHOD

This study uses a meta-analysis method that examines several research results in similar problems regarding physics learning media using Macromedia flash software in terms of student learning outcomes. Meta-analysis is quantitative because it uses numerical calculations and statistics for practical purposes, namely to compile and extract information from so much data that is not possible with other methods (Fajrin, 2018). The data collection technique for this research is to collect research articles that discuss physics learning media using Macromedia flash software for the last ten years that have been tested in class and published in national journals with ISSN—summarizing research article data in the form of research variables, research objectives, type of research, education level, material and statistical data that can be used. The research sample was taken using a purposive sampling technique, a non-random technique to obtain data or information by the research theme. The sample consists of 21 articles on physics learning media using Macromedia flash software published in 2011-2020. Articles come from various sources such as national journals with ISSN, sinta accredited national journals, national journals with ISBN, and IOP Publishing, International Conference of Technology and Education. The articles used must have several criteria to be analyzed, namely having variables that can be used to calculate the effect size. The variables are articles with the average post-test and pretest values, standard deviation, the average of the experimental and control groups, the average post-test of the experimental and control groups, and the average pretest, the standard deviation of the experimental and control groups. T test results, number of experimental and control groups, and correlation values. The use of each variable based on the data contained in the article is adjusted to the effect size formula. The distribution of 21 research subject articles can be seen in Table 1.

Table 1. Distribution of Article Sample

No	Research	Types of Research	Types of Media	Materials
1	Damanik & Tanjung (2013)	Quasi Eksperimen	Animation media	Suhu dan Kalor
2	Salim et al., (2011)	Penelitian Tindakan Kelas	Multimedia	Gaya
3	Ratna & Dewi (2017)	Quasi Eksperimen	Multimedia	Besaran dan satuan
4	Sakti et al., (2012)	Quasi Eksperimen	Multimedia	Fluida Statis
5	Siagian, Y & Siagian (2017)	Quasi Eksperimen	Animation media	Momentum dan impuls
6	(Marnita & Ernawati, 2017)	Quasi Eksperimen	Multimedia	Gerak
7	Turnip & Panggabean, J (2017)	Quasi Eksperimen	Animation media	Momentum dan impuls
8	Tampubolon et al. (2020)	Quasi Eksperimen	Animation media	Fluida Statis
9	Anggereni & Khairurradzikin (2016)	Quasi Eksperimen	Animation media	Hukum Newton
10	Ika, Y (2018)	Quasi Eksperimen	Animation media	Listrik Dinamis
11	Nopianti et al. (2019)	Quasi Eksperimen	Animation media	Cahaya
12	Sare, Y & Budhi (2018)	Quasi Eksperimen	Animation media	Gerak
13	Siregar et al. (2019)	Quasi Eksperimen	Animation media	Fluida Statis
14	Abbas, M, L (2019)	Quasi Eksperimen	Animation media	Tekanan
15	Fartina et al. (2019)	Research and Develompent	Animation media	Gerak Lurus
16	Fakhri & Bektiarso (2018)	True Eksperimen	Animation media	Momentum Impuls dan Tumbukan
17	(Saputra & Sari, 2018)	Pre-eksperimental design	Animation media	Tekanan
18	Elfina, Maria, & Flash	Pre-eksperimental	Learning Media	Tekanan Zat Cair

No	Research	Types of Research	Types of Media	Materials
	(2017)	design		
19	Sastria et al. (2013)	Pre-eksperimental design	Learning Media	Pengukuran
20	Thahir et al. (2019)	Quasi Eksperimen	Animation media	Suhu dan Panas
21	Usmeldi (2012)	Quasi Eksperimen	Learning Media	Medan Magnet

The steps of data analysis are; (1) identify the type of research and the research variables that have been found, are included in the appropriate variable column, (2) identify the mean and standard deviation of the experimental group data/before treatment and control group/after treatment for each subject/sub-study that trials have been carried out, (3) identify t-tests for each subject/sub research that have been tested, (4) calculate effect size (ES) using statistical parameters, (5) analyze effect size (ES) from the results of collecting research articles, and (6) conclude the results of data analysis. After the effect size is calculated based on the appropriate formula, then the effect size is categorized by the effect size criteria according to Diancer in Table 2.

Table 2. Criteria for Effect Size (ES)

No	ES	Category
1	ES ≤ 0,15	Very low
2	0,15< ES ≤ 0,40	low
3	0,40< ES ≤ 0,75	Currently
4	0,75< ES ≤ 1,10	High
5	ES >1,10	Very high

(Olejnik & Algina, 2003)

3. RESULT AND DISCUSSION

The first result of this research is the type of research that has been done by previous researchers in the development of physics learning media using Macromedia flash software. Based on data analysis, it was found that 71% of articles on physics learning media used Macromedia flash software using a quasi-experimental method. The research that has been entered as a journal article is quasi-experimental research that tests the effectiveness of physics learning media using Macromedia flash software in terms of student learning outcomes. In addition, 14% of the research is a pre-experimental design research that tests the effectiveness of physics learning media. The rest are actual experiments, R & D as much as 5%, and PTK as much as 5%.

Research on physics learning media using Macromedia flash software uses more quasi-experimental methods because this method can analyze the effectiveness of physics learning media using Macromedia flash software in terms of student learning outcomes (Gunawam et al., 2015). In addition, this method can assess the effect of an action on behavior or test whether there is an effect of the action. The action in the experiment is called treatment which means giving conditions that will be assessed for their effect pengaruhnya (Gunawam et al., 2015; Umam & Yudi, 2016). This treatment is given in the form of learning media using Macromedia flash software. This is in line with previous research, which determined how much influence the problem-based learning model assisted by Macromedia flash had on student learning outcomes on the subject matter of static fluids in the X-MIA class of MAN Binjai (Sulani et al., 2020). The research he conducted using a quasi-experimental method showed that student learning outcomes were classified as very good, with an average of 81.87. The results of this study provide input to the next researcher to research physics learning media with a quasi-experimental method with better testing. The results of these two studies are the effect size (ES) of physics learning media using Macromedia flash software in terms of student learning outcomes based on the level of education presented in table 3.

Table Three shows that research on physics learning media using Macromedia flash software in terms of student learning outcomes is mainly carried out at the SMA/MA level, namely 57%, followed by research at the SMP/MTs level as much as 24%, followed by research at the SMK level as much as 9.5%, and research at the university level as much as 9.5%. The results of the analysis of the effect size of physics learning media using Macromedia flash software in terms of physics learning outcomes based on education level found that the effect size was very high in universities with an average value of 2.79. The effect size is high at the junior high school level, with an average value of 0.89. The effect size is moderate at the SMA and SMK levels, with an average value of 0.74 and 0.45, respectively. This shows that physics learning media using Macromedia flash software is effective in improving student learning outcomes at the level of junior high school and equivalent, high school equivalent, vocational school, and university.

Table 3. Distribution of Education Levels

No.	Education Level	Frekuensi	Frequency Relative Frequency(%)	ES	Category
1	SMP/MTs	5	24	0.89	high
2	SMA/MAN	12	57	0.74	Currently
3	SMK	2	9.5	0.45	Currently
4	PerguruanTinggi (PT)	2	9.5	2.79	Very high

Physics learning media using Macromedia flash software in universities can improve students' understanding of concepts. This is in line with previous research on physics learning using Macromedia flash-MX animation media and images to improve students' understanding of concepts (Yuliani, 2017). The results of his research show that there is an increase in understanding of concepts in quantum physics learning by using Macromedia Flash - MX animation media. This is because physics learning media using Macromedia flash software in universities can stimulate students' thoughts, feelings, interests, and attention in such a way that the learning process can be more optimal and students can learn independently (Gunawan et al., 2015; Usmeldi, 2012). Physics learning media using Macromedia flash software can visualize abstract material into concrete so that it can help students understand physics learning material in universities (Viajayani, et all, 2013; Yuliani, 2017).

Based on the description above, the results of this study indicate that physics learning media using Macromedia flash software at the higher education level (PT) is effectively used. Research on physics learning media using Macromedia flash software at the education level of SMA, SMK, and SMP/MTs, needs to do a more in-depth needs analysis so that the media used is genuinely compelling. The results of these three studies are the effect size (ES) of physics learning media using Macromedia flash software in terms of student learning outcomes based on the type of media developed, which is presented in table 4.

Table 4. Distribution of Media Types

No	Media Type	Frequency	Relative Frequency (%)	ES	Category
1	Animation Media	14	67	0,77	High
2	Multimedia	4	19	1,98	Very high
3	Learning Media	3	14	0,69	Currently

Based on table 4, the average effect size of the media types from the articles analyzed consists of the medium, high, and very high categories. The type of learning media is in the medium category with an average effect size of 0.69, the type of animation media is in the high category with an average effect size of 0.77, while the type of multimedia media is in the very high category with an average effect size of 1.98. . This proves that physics learning media using Macromedia flash software in terms of physics learning outcomes has a significant effect. This is because physics learning media using Macromedia flash software can increase student activity during learning. As was done by researchers in their research to determine how much influence the discovery learning model assisted by Macromedia flash animation media on the activities of students on pressure material at SMP N 1 Suhaid, obtained an effect size of 1.19 in the very high category. His research shows that the activities of students during learning are classified as very good with a percentage of 95% - 100% (Saputra, 2018). This is because using Macromedia flash animation media can improve the quality of learning, both students' learning motivation, student learning outcomes, or teaching activities in the classroom (Margareta & Wahyuno, 2014; Handhika J, 2012; Siagian, Y, & Siagian, H, 2017). It can also increase the curiosity of students and stimulate students to react physically and emotionally.

The type of multimedia using Macromedia flash software has a very high influence on student learning outcomes, with an average effect size of 1.98. This is because using multimedia using Macromedia flash software can remediate students' misconceptions. Previous research also used spreadsheet-assisted Macromedia flash, one of the computer-assisted instruction learning media, to perform simulations in learning. This study obtained an effect size of 1.2 in the very high category (Elfina, Maria, & Hamdani, 2017). Using Macromedia flash in Elfina's research can help students see abstract concepts that look like actual processes. Students can manipulate data, collect, analyze data, and draw conclusions through the simulation because Macromedia flash can visualize abstract concepts. The advantage of Macromedia Flash is that it can create animations, presentations, and simulations from one form to another, which is then moved by following a predetermined path (Fitria et al., 2016; Siagian & Simatupang, 2017). Simulation results that are contrary to students' initial ideas, if carried out repeatedly, will eventually result in a change in the concept of students (Paul, 2013). The results of

these four studies are the effect size (ES) of physics learning media using macromedia flash software in terms of student learning outcomes based on the learning materials presented in table 5.

Table 5. Material Distribution

No	Material	Frequency	Relative Frequency (%)	ES	Category
1	Suhu dan kalor	2	9.52	0,74	Currently
2	Gaya	1	4.76	0,35	Low
3	Besaran dan satuan	1	4.76	0,99	high
4	Momentum dan impuls	3	14.3	0,51	Currently
5	Fluida statis	3	14.3	0,90	high
6	Hukum newton	1	4.76	1,3	Sangat Tinggi
7	Listrik dinamis	1	4.76	0,50	Currently
8	Gerak	2	9.52	3,82	Sangat Tinggi
9	Gerak lurus	1	4.76	0,13	Very Low
10	Tekanan	2	9.52	0,90	high
11	Tekanan zat cair	1	4.76	1,20	Very high
12	Pengukuran	1	4.76	0,74	Currently
13	Cahaya	1	4.76	0.20	Low
14	Medan Magnet	1	4.76	0.13	Very Low

The analyzed media types were 14 topics of learning material, as shown in Table 7 above. Based on the data obtained, the average effect size value is in the very low to very high category. The physics materials that fall into the very low category are straight motion and magnetic fields; low category, style, and light material. Furthermore, that are included in the medium category are temperature and heat, momentum and impulse, dynamic electricity, and measurement. Then the materials whose effect size is in the high category are quantities and units, static fluid, and pressure. Effect size in the very high category is Newton's law of motion and the pressure of liquids. The highest effect size is shown in multimedia with motion material, which is 3.82.

This type of multimedia media makes it easy for students to learn individually or in groups, makes it easy for teachers to deliver material, increases students' motivation and learning outcomes (Sunarti & Anggraini, 2013; Faizah, et all, 2020). Multimedia can reduce the saturation of students because the learning process is carried out by most students interactively (Abendroth & Richter, 2021; Choi et al., 2019). Based on the description above, it can be concluded that multimedia is the most effective learning media. Multimedia can then be developed in multimedia to increase students' motivation and critical thinking skills (Rante, et all, 2013; Marnita & Ermawati, 2017). Research on physics learning media using Macromedia flash software on the types of learning media and animation media needs to do a more in-depth analysis of needs so that the media used is genuinely effective.

Physics learning media using Macromedia flash software with motion material is developed in the form of learning media that makes it easier for students to master concepts and assist educators in communicating with students and even able to package material to be more explicit, complete, and interesting for students (Saputra & Sari, 2018, Martina & Ernawati, 2017). The process of learning physics focuses on concepts and the relationship between abstract concepts. The characteristics of some abstract concepts in physics cause difficulties in visualizing and conveying concepts to students (Gunawan et al., 2015; Tampubolon, et all, 2020). This difficulty is then overcome by using physics learning media (Lia, 2015). So that learning media become teaching aids that can motivate students to be creative and construct their knowledge and concrete abstract concepts (Handhika, 2012; Rante et al., 2013).

4. CONCLUSION

The best effectiveness of physics learning media using Macromedia flash software in terms of student learning outcomes based on education level is in Higher Education. The best effectiveness of physics learning media using Macromedia flash software in terms of student learning outcomes based on the type of media developed is multimedia. The best effectiveness of physics learning media using Macromedia flash software in terms of student learning outcomes based on learning material is motion material. It can be concluded that learning media using Macromedia flash software is a medium that can help students in learning.

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