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The Use of Learning Media "Fun Physics Learning" Based on Android to Improve Problem-Solving Skills of Students

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ABSTRACT

The research is motivated by the low problem-solving skills of students in learning physics. This study aims to determine whether there is no increase in the effectiveness of using Android-based learning media "Fun Physics Learning" on students' problem-solving skills. This type of research used a quasi-experimental design with a non-equivalent control group design. The population used was all students of class X SMAS Mandiri Balaraja, while the research sample used two classes, class X for the experimental class and the control class. The instrument used is a test in the form of an essay, which the validator and student response sheets have validated to the Physics Scatter application. Data analysis showed that there was a significant increase in the results of students' problem-solving skills, which were shown in the pretest and post-test of the experimental class, where there was a significant increase in the N-Gain acquisition of 0.61 in the medium category. Based on the hypothesis test using the t-independent sample test, obtained t_{-count} = 11.002 and t_{-table} = 2.045 at a significant level of 0.05 and got a positive student response. It was concluded that using Android-based Physics Spread learning media can improve students' problem-solving skills and is effectively used in learning.

Keywords: *Learning media, Learning applications, Android, Problem solving, Physics.*

INTRODUCTION

The development of Science and Technology is increasingly rapid, especially in the world of education. The development of learning media is increasingly easy to obtain and increasingly sophisticated (Latifah et al. 2017). The learning media that is still frequently used is print media, such as modules, textbooks, *handouts*, magazines, and so on. In contrast, audio, electronic, and visual media are rarely appropriately used (Kristanto 2013). Print media only allows students to learn independently from a demonstration of knowledge to gain concise, clear, and procedural knowledge, resulting in a lack of student ability to solve problems (Habibi, Zainuddin, and Misbah 2017). To encourage students in this regard, students need to have a high level of curiosity by searching for and exploring information and being confident in asking questions (Artinta and Fauziah 2021). So, in the learning process, teachers are advised to influence students to be able to think and carry out activities that provide *feedback,* find out their initial abilities, and share students' strong motivation. (Siboro et al. 2021). In creating activities such as the process of providing material,

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communication, and interaction between teachers and students, learning media can be used (Diah et al., 2018).

Students are expected to have problem-solving abilities in physics (Hudha, Aji, and Rismawati 2017). Problem-solving ability is a person's ability to obtain a problem-acquisition process, thereby obtaining many solutions that can be used to solve existing problems (Siboro et al., 2021). A student must have problem-solving skills in looking for an idea or a solution (Rahmawati, Sutrio, and Makhrus 2020). According to (Negoro & Wijaya, 2010), there are five indicators of problem-solving ability consisting of recognizing the elements that are known, required, and the adequacy of the elements needed, stating and structuring problems, applying strategies to solve various problems, and explaining the results. Encouraging students in this regard, students need to have a high level of curiosity by searching for and exploring information as well as being confident in asking questions (Artinta and Fauziah 2021). Learning media can create activities such as providing material, communication, and interaction between teachers and students (Diah et al., 2018).

Learning media is a tool used to provide information about lessons to attract students' attention (Dasmo et al., 2017). Technological developments can use learning media to obtain information and knowledge (Siboro et al. 2021). *Mobile learning* can be defined as a learning medium that uses technological developments, namely *Android*, which is managed so that learning can be carried out anywhere and anytime by students because almost all students already have *Android.* (Mahuda, Meilisa, and Nasrullah 2021) . The advantage of *Android* is that it makes the operating system most popular with the public, namely that it has an *open-source nature* capable of creating applications by providing convenience to developers (Dian Anggraeni & Kustijono, 2013). So, learning media that utilizes it is needed *smartphones*-based *Android* in the learning process physics.

The results of an interview with a physics teacher at a high school in Banten stated that learning media in physics learning was still not optimal because the physics teacher only used simple tools around the school to carry out simple practicums to support physics learning. That is in line with (Putri, Gusteti, and Azmi 2022), who stated that there are still teachers who do it, learning only teacher-centered and yet use interactive learning media. The use of print media is still the main one because when using audio and visual media, the school only has one projector, so there are limitations in displaying this media. Many students already have *Android-based smartphones* but have yet to use them optimally, so learning media are needed that can utilize these *smartphones*. This is supported by research conducted by (Anggraeni, Wahyono, and Darsikin 2021), which states that only 42% of Indonesia, while Malaysia has reached 79%, have used *smartphones* for activities in the world of education.

Mobile learning can be used to create better learning outcomes because it can increase learning independence and support the learning process (Rubianto 2020). The learning process using *Android-based* learning media can help students achieve learning success and improve their problem-solving abilities (Mahuda et al. 2021). Android-based applications that contain audio, video, images, and animation with text can increase students' attention, interest, understanding, and experience of a material (Chang et al. 2017). In developing interactive learning media using *Adobe Captivate,* further research is needed so that the media can be accessed via smartphones, not only on computers (Putri, Risdianto, and Rohadi 2019). Based on the supporting research and learning conditions mentioned, the objectives This researcher wants to know the use of an *Android-based* application in improving problem-solving *skills* at time effectiveness its use.

METHODS

This research uses a quantitative approach to test a hypothesis that has been determined using a specific sample or population, analyzing data in the form of statistics using research instruments as a data collection tool. (Sugiyono 2018). Experiments are carried out under controlled conditions to understand the impact of the independent variable or treatment on the dependent variable or quantitative results, which is an experimental method (Sugiyono 2018), so this research uses an experimental method. The experimental research design used in this research is quasi-experimental because this research will be carried out in high school, so it is not possible to randomly select some of the students for the experiment. The quasi-experimental design that will be used is *a nonequivalent control group design*. This design is the same as *the pretest-posttest control group design* but is different from the selection of experimental groups or random groups that are not random. The design of this research can be seen in Table 1.

Table 1. Research Design

Class	Pre-Test	Treatment _	Post-Test
Experiment _	O_1	X	O_3
Controls	O_2		O_4

Information :
O_1 = Pretest for experimental class.
O_2 = Pretest for control class.
O_3 = Post-test for the experimental class.
O_4 = Post-test for the control class.
X = Treatment in the form of learning using SEBAR learning media.

The research will be conducted at SMAS Mandiri Balaraja, on Jalan Raya Kresek, Balaraja, Tangerang Banten Regency. The population in the study were all class X students at SMAS Mandiri Balaraja. The sample is part of a population with characteristics and must genuinely represent a population (Sugiyono 2018). Determining the sample to be used in a study uses various sampling techniques, namely *Convenience sampling* combined with *matching techniques*. In *convenience sampling*, researchers select participants based on the availability of elements and the ease of obtaining these participants (Sugiyono 2018). The *matching* technique is that two equal groups are formed by equating the experimental class with the control class. The samples in this study were two classes at class X MIA level, namely X MIA 1 and X MIA 2.

The research procedure was carried out in four stages. First, give a pre-test to classes X MIA 1 and X MIA 2 before being given treatment. The second step is in class. The third step is to carry out a post-test to determine the level of knowledge competency that students have achieved. The final step is to carry out an analysis of the data obtained during the research using appropriate statistical analysis to see the increase in student competence and the effectiveness of the learning media applied.

Instrument study is the means used for collecting data by researchers. Study quantitative can use instrument-shaped interviews, tests, questionnaires, etc observation (Sugiyono 2018). The instruments used for this research were: (1) Fun Physics learning media, (2) a Test of students' problem-solving skills where, in this research, the material given was simple harmonic motion on a pendulum, (3) Student response questionnaire regarding the use of the fun learning media Physics. All instruments used have been validated by experts first. The data collection technique is a written test in the form of 2 essay questions, which have been adjusted to the student's problem-solving skill indicators. The test is given at the beginning of learning and at the end of learning. The student response

questionnaire to the Fun Physics learning media was used to determine students' assessments of the Fun application used during learning using the Technological Acceptance Model (TAM).

The data analysis tests used are the independent sample t-test and the N-Gain test. This test was carried out after carrying out prerequisite tests for data analysis, namely the normality and homogeneity tests. Independent sample t-test to determine the differences in problem-solving skills of students in the control class and experimental class. N-Gain test to see the difference in the increase in problem-solving of students in the control class and the experimental class. As well as analysis of data from student response questionnaires to determine student responses regarding using the Spread Physics learning media.

RESULTS AND DISCUSSION

Results

Display of Android-based Physics Distribution Application Learning Media

The Spread Physics application was created using one of the Android application maker websites, Andromo, to create the background design, and others using Canva. Physics spreads are based on *problem-based learning* stages that support *problem-solving skill* indicators. According to (Primadani, Tukiran, and Jatmiko 2017), the combination of media and appropriate learning models can have a positive influence on students' problem-solving abilities and mastery of concepts. The Physics Spread has four main menus, namely the introductory Physics Spread, the Physics Material Spread, the Physics Practical Spread, and the Physics Evaluation Spread which can be seen in Figure 1.

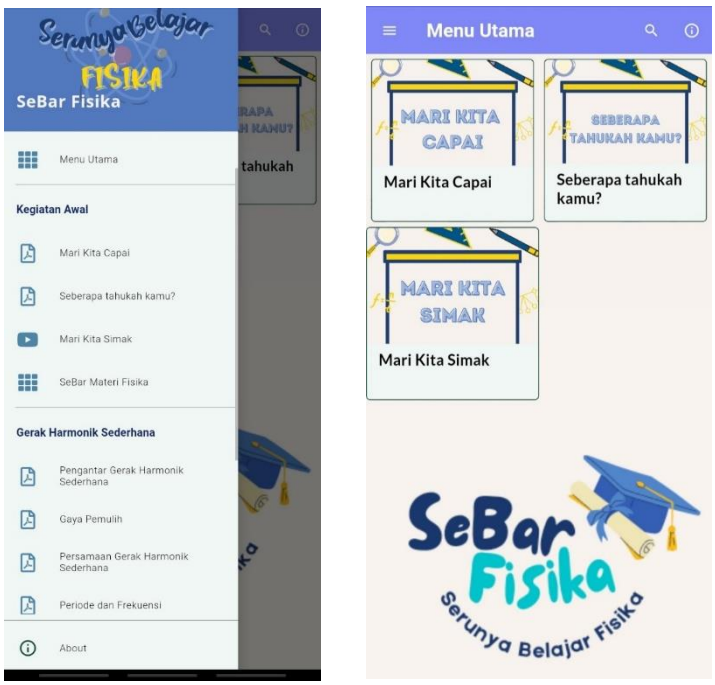

Figure 1. Display of the Android-based Spread Physics Application

The "Introduction to Physics Spread" menu contains learning indicators that must be achieved, *pretest questions,* and videos containing problems that will be discussed in the lesson. Rahmana (2021) states that using videos in problem-based learning can help students do their assignments well. Apart from that (Sari and Sugiyarto 2015) stated that students can be interested in discussing options for solving problems both in groups and individually

when given problems that are packaged interestingly. The "Distribute Physics Material" menu contains material about simple harmonic motion in pendulums, which supports the learning process using the *based learning model*. This aligns with (Nugraheni 2017), where mastery of material can measure learning difficulties. So, it is hoped that the "Distribute Physics Material" menu will overcome learning difficulties. The "Distribute Physics Practicum" menu contains *online* practicums connected to PhET so that students can do practicums at any time. The "Distribute Physics Evaluation" menu contains *posttest questions* that students can complete at the end of the lesson. The Spread Physics application must use Internet data because there are *online videos and practicums*.

Descriptive Statistical Analysis

This research was conducted in May 2022/2023 academic year at SMAs Mandiri Balaraja. This research was conducted with four meetings in the experimental and control classes. The first meeting held *a pretest. The* second and third meetings carried out learning; the fourth held *a posttest*. The results of the research carried out obtained experimental and control class data in the form of *pretest* and *posttest* data with descriptive analysis of students' *problem-solving skills* obtained in this research using the help of IBM *version* 22 *software, which can be seen in:*

Table 2. Statistics Description Data Pretest dan Posttest

Statistics	Minimum	Maximum	Mean
Pretest Experiment	20.0	37.5	27.333
Posttest The experiment	62.5	85.0	71.833
Prettest Control	35.0	57.5	47.500
Pottest Control	52.5	65.0	60.938

Based on Table 2, the differences between the *pre-test* and *post-test scores* from the experimental class and control class were obtained. The results of the descriptive analysis showed that the average student test score before applying the Spread Physics learning media in the experimental class and the conventional learning model in the control class had an average student score of 27.33 and 47.5. This shows that the initial *problem-solving skills of students in both the control and experimental classes could be improved.* However, after implementing the Physics Spread learning media in the experimental class and the conventional learning model in the control class, the students' average scores increased to 71.83 and 60.98. This shows that *the problem-solving skills* of experimental class students after being given treatment, are at a medium level, while those in the control class are at a low level. Based on this analysis, using the Spread Physics learning media can improve students' *problem-solving skills*, as evidenced by the *posttest scores* for the experimental class being higher than the control class.

Analysis of Student Response Results

The results of student responses were obtained by distributing questionnaires to students to know the responses of students in the experimental class to SPREAD Physics learning media. The questionnaire contains 15 questions on a scale of 1-7. The results of the student response questionnaire can be seen at:

Table 3. Description of Student Response Questionnaire Data to Media SPREAD Physics Learning

S statistics	Minimum %	%Maximum	% A verage
Student Response	61	89.5	75.9

In Table 3, the response questionnaire obtained from class, The minimum student assessment score for the Spread Physics application is 61% in the neutral category. In comparison, the maximum is 89.5% in the agreed category. Average gain 75.9% with agreed qualifications. Student responses are said to be effective if the student's response is in the agree or strongly agree category (Zainudin and Pambudi 2019). Based on responses from students, it was concluded that using the *Android-based Spread Physics learning media* was effective in learning.

Inferential Statistical Analysis

Stage Next, researchers want to see the increase in experienced students in class experiments and control students' problem-solving skills. The improvement experienced by students in the experimental and control classes on students' *problem-solving skills* can be seen by calculating *N-Gain*. The *N-Gain* calculation was carried out using IBM SPSS version 22 *software*. The results of the data calculation can be seen in:

Tabel 4. Average N-Gain Score results

Class	N-Gain Score	Category
Experiment	0.61	Medium
Control	0.22	Low

Based on Table 2, the N-Gain score results in the experimental class are included in the medium category with an N-Gain score of 0.61. Meanwhile, the control class is in the low category, with an N-Gain score of 0.22. These results show that there has been an increase in students' problem-solving skills in both the experimental and control classes. Both classes experienced an increase, but it was higher in the experimental class compared to the control class. So, the increase in problem-solving skills of students who were treated with the Fun Physics learning application was higher than the increase in problem-solving skills of students who were not treated with the Fun Physics learning application.

The normality test is carried out to find out whether the data obtained comes from a normally distributed population or not. The homogeneity test is carried out to determine whether the samples taken are homogeneous data. Hypothesis testing is used to determine the truth of a previously determined hypothesis. All these tests using IBM SPSS version 22 *software can be seen at:*

Table 5. Normality, Homogeneity and Hypothesis Test Results

Class	Normality t test _		Homogeneity Test		T-Test	
	Pretest	*Posttest*	*Pretest*	*Posttest*	*Tcount*	*Ttable*
Experiment	0.0218	0.123	0.146	0.046	11.002	2.045
Control	0.83	0.083				
Information	Distributed normal		Homogeneous	Inhomogeneous	There are significant differences	

Based on Table 5, the normality and homogeneity tests use two pieces of data, namely *pretest* and *post-test.* The results of normality testing in the experimental class and control class obtained a significance value > 0.05. That is, in the experimental and control classes, during *the pretest* and *post-test,* the data was normally distributed. There are differences in the results of homogeneity testing in *the pretest* and *post-test*, where *the*

pretest obtained a significance of 0.146 > 0.05, and it can be stated that the data is homogeneous. In *the post-test,* it obtained a significance of 0.046 < 0.05, and it can be stated that the data is not homogeneous. Because the homogeneity test is not an absolute requirement for deciding which statistical test to use, if the data is normally distributed and not homogeneous, then the statistical test for independent data uses the t-test (Independent Sample t-test) with the assumption that the two variances are not homogeneous (Equel *Variance* Not *Assumed* (Priyatno 2013). The results of hypothesis testing using the *independent sample t-test* showed that $t_{table} = 1.699$ and $t_{count} = 11.002$ and obtained a result (sig.) of 0.000. So, it is following the test criteria when t count > t table and (sig.) < α 0.05, then H_0 is rejected and H_a is accepted, so it can be concluded that there is a significant difference between the Physics Spread learning media on students' *problem-solving skills*.

Discussion

Based on the results of the descriptive analysis, the average student test score was obtained before the Spread Physics learning media was applied in the experimental class, and the conventional learning model in the control class had an average student score of 27.33 and 47.5. This shows that the initial *problem-solving skills of students in both the control and experimental classes could be improved.* However, after implementing the Physics Spread learning media in the experimental class and the conventional learning model in the control class, the students' average scores increased to 71.83 and 60.98.

This shows that *the problem-solving skills* of experimental class students after treatment were at a medium level, while those in the control class were at a low level. Based on this analysis, using the Spread Physics learning media can improve students' *problem-solving skills*, as evidenced by the *post-test scores* for the experimental class being higher than the control class. In the next stage, researchers want to see the improvements experienced by students in the experimental and control classes regarding students' *problem-solving skills*. *The N-Gain score* obtained in the experimental class was 0.61, and the control class was 0.23. When learning to use this application, before the lesson takes place, students watch a video that raises problems regarding simple harmonic motion in pendulums, thereby motivating students to continue learning because the problems raised will be resolved when the lesson is finished. The application menu supports students in solving these problems. At the beginning of the lesson, a video is given which contains problems in learning packaged with exciting animations. In line with (An-nawaf, Karimah, and Adna 2021), they stated that using animated videos could make it easier for students to understand something conveyed in the video. Conduct an online practicum *and* present the results of the practicum. This is what was done by (Anggraeni et al. 2021), who stated that the use of *virtual lab learning media* can influence student learning outcomes. Utilizing the Spread Physics application also helps students to be curious about solving problems that have been provided with the menus in the application. This is by research (Albab, Wanabuliandari, and Sumaji 2021), which states that the influence of students using applications in the learning process can make students brave in trying and trying to solve problems sequentially. Thus, the use of the Spread Physics application can improve *the problem-solving skills* of students in the experimental class.

The research results stated a significant difference in *problem-solving skills* between students who were treated with the Physics Spread media and students who were not taught with this media. Based on this, there is a significant difference in students' *problem-solving skills* between the experimental class and the control class. It has also been explained previously that there are differences between the two classes seen from the average value of *problem-solving skills* obtained by students. This is in line with research conducted by

(Arlen et al. 2020), which shows significant differences between the experimental groups that were given treatment using the Android-based *Appypie learning media* and *PowerPoint learning media*. The results of the student response questionnaire regarding learning using the Spread Physics application obtained an average percentage of 75.9% with qualifications agree. Student responses are said to be effective if the student's response is in the agree or strongly agree category (Zainudin and Pambudi 2019). Based on responses from students, it was concluded that using the *Android-based* Spread Physics learning media was effective in learning. This is in line with research conducted by (Zainudin and Pambudi 2019), where the Edmodo application on the Android platform was said to be effective when obtaining research results that showed a significant increase in positive student response to the application. (Prasetiyo, Widaningrum, and Astuti 2020) Stated that *Android-based* applications make it easy to access them. Based on the research that has been carried out, it can be concluded that the use of *Android-based Spread Physics learning media* is effective.

Android-based Spread Physics learning media still has limitations when applied to students; firstly, this application can only be accessed on *Android-based smartphones*, whereas what is found in the field is that some students use *iOS-based smartphones*. This is in line with (Armiati and La'ia 2020) stating that the use of devices can influence students' problem-solving abilities. These two applications can only be accessed by students who have an *Android-based smartphone* and are connected to the internet because, in this application, there are videos and practicums that must be accessed using the internet. This is in line with (Nurfa, Aripin, and Susanti 2022) stating that there are difficulties in accessing media when the internet signal is less supportive, requiring students to *re-load*. So, further development of this application is needed.

CONCLUSION

Android-based Spread Physics learning media (The Excitement of Learning Physics) showed a higher increase in *problem-solving skills* in students who learned using the Spread Physics learning media compared to those who did not use the application. Judging from the *pretest* and *posttest results* obtained by each class, significant differences were obtained. The use of the *Android-based* Scatter Physics learning media to improve *students' problem-solving skills* was declared effective, as seen from the student's responses to the applications used. The choice of learning media can influence students' *problem-solving skills; there* is an interaction between learning media and learning models. This interaction can make learning activities occur in two directions between students and teachers. The results of this research are intended to encourage teachers to improve the teaching that has been carried out by paying attention to the learning media and learning models used to improve students' *problem-solving skills.*

REFERENCES

Albab, Royyana Ulyl, Savitri Wanabuliandari, and Sumaji. (2021). Pengaruh Model Problem Based Learning Berbantuan Aplikasi Gagung Duran Terhadap Kemampuan Pemecahan Masalah Siswa. *Program Studi Pendidikan Matermatika,* 10(3), 1767–75.

An-nawaf, Fathimatuz Zahra, Sayyidatul Karimah, and Syita Fatih Adna. (2021). Penerapan Pembelajaran Google Classroom Berbantuan Video Animasi Terhadap Kemampuan Pemecahan Masalah Matematis Siswa SMP Negeri 5 Pekalongan. *Journal of Instructional Mathematics,* 2(1), 36–43.

Anggraeni, Weni, Unggul Wahyono, and Darsikin. (2021). Pengaruh Penggunaan Media Pembelajaran Virtual Lab Berbasis Android Terhadap Hasil Belajar Fisika Siswa Kelas

Viii Smpn 3 Palu. *Media Eksakta* 16(1), 16–21.

Arlen, Serly Resna, Irnin Agustina Dwi Astuti, Fatahillah Fatahillah, and Popi Purwanti. (2020). Pengaruh Media Pembelajaran Fisika Menggunakan Aplikasi Appypie Terhadap Hasil Belajar Fisika Siswa Di SMK. *Schrodinger Jurnal Ilmiah Mahasiswa Pendidikan Fisika,* 1(1), 44–49.

Armiati, and Hestu Tansil La'ia. (2020). Dampak Perangkat Pembelajaran Matematika Berbasis Kompetensi Profesi Terhadap Kemampuan Pemecahan Masalah Siswa Bidang Keahlian Teknologi Informasi Dan Komunikasi. *JEP (Jurnal Eksakta Pendidikan),* 4(1), 57–65.

Artinta, Sindy Vega, and Hanin Niswatul Fauziah. (2021). Faktor Yang Mempengaruhi Rasa Ingin Tahu Dan Kemampuan Memecahkan Masalah Siswa Pada Mata Pelajaran IPA SMP. *Jurnal Tadris IPA Indonesia,* 1(2), 210–18.

Chang, Chi-cheng, Chaoyun Liang, Pao-nan Chou, and Guan-you Lin. (2017). Computers in Human Behavior Is Game-Based Learning Better in Fl Ow Experience and Various Types of Cognitive Load than Non-Game-Based Learning ? Perspective from Multimedia and Media Richness. *Computers in Human Behavior,* 71, 218–27.

Diah, Inung, Sekreningsih Nita, Dosen Teknik Informatika, Fakultas Teknik, and Universitas PGRI Madiun. (2018). Media Pembelajaran Berbasis Multimedia Interaktif Untuk Meningkatkan Pemahaman Konsep Mahasiswa. 1(2), 68–75.

Habibi, Muhamad, Zainuddin Zainuddin, and Misbah Misbah. (2017). Pengembangan Perangkat Pembelajaran IPA Fisika Berorientasi Kemampuan Pemecahan Masalah Menggunakan Model Pengajaran Langsung Pada Pokok Bahasan Tekanan Di SMP Negeri 11 Banjarmasin. *Berkala Ilmiah Pendidikan Fisika,* 5(1), 1.

Hudha, Muhammad Nur, Sudi Aji, and Astri Rismawati. (2017). Pengembangan Modul Pembelajaran Fisika Berbasis Problem Based Learning Untuk Meningkatkan Kemampuan Pemecahan Masalah Fisika. *SEJ (Science Education Journal),* 1(1), 36–51.

Kristanto, Andi. (2013). Pengembangan Media Komputer Pembelajaran Multimedia Mata Pelajaran Fisik Pokok Bahasan Sistem Tata Surya Bagi Siswa Kelas 2 Semester I Di SMAN 22 Surabaya. *Teknologi Pendidikan,* 10(2).

Latifah, Nurul, Rian Vebrianto, Tarbiyah Dan, Keguruan Program, Studi Pendidikan, Universitas Islam, Negeri Sultan, and Syarif Kasim. (2017). Pengembangan Media Pembelajaran Berbasis Multimedia Blog Untuk Mata Pelajaran Sains. 18–19.

Mahuda, Isnaini, Ranny Meilisa, and Anton Nasrullah. (2021). Pengembangan Media Pembelajaran Matematika Berbasis Android Berbantuan Smart Apps Creator Dalam Meningkatkan Kemampuan Pemecahan Masalah. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika,* 10(3), 1745.

Nugraheni, Diah. (2017). Analisis Kesulitan Belajar Mahasiswa Pada Mata Kuliah Mekanika. *Jurnal Pendidikan Sains Dan Matematika,* 5(1), 23–32.

Nurfa, Nisa Nisriana, Aripin, and Ernita Susanti. (2022). Pengembangan Media Pembelajaran Learning Management System Berbasis Moodle Sebagai Daya Dukung Pembelajaran Fisika. *JEP (Jurnal Eksakta Pendidikan),* 6(2), 143–51.

Prasetiyo, Hardi, Ida Widaningrum, and Indah Puji Astuti. (2020). Game Edukasi Math & Trash Berbasis Android Dengan Menggunakan Scirra Construct 2 Dan Adobe Phonegap. *Jurnal Rekayasa Sistem Dan Teknologi Informasi,* 4(1), 37–49.

Primadani, Rohmah, Tukiran Tukiran, and Budi Jatmiko. (2017). Pengembangan Perangkat Pembelajaran Fisika Model Structured Inquiry Untuk Meningkatkan Keterampilan Pemecahan Masalah Siswa Pada Materi Fluida Statis. *JPPS (Jurnal Penelitian Pendidikan Sains),* 6(1), 1235.

Priyatno, Duwi. (2013). *Mandiri Belajar Analisis Data Dengan SPSS*. 1st ed. Yogyakarta: Media Komputindo.

Putri, Elva Kurnia, Meria Ultra Gusteti, and Khairul Azmi. (2022). Pengembangan Media Pembelajaran Berbasis PBL Terintegrasi Karakter Percaya Diri Untuk Meningkatkan Pemecahan Masalah Matematika SMA. *Jurnal Eksakta Pendidikan (JEP),* 6(2), 170–177.

Putri, Ramadhanty Mashama, Eko Risdianto, and Nyoman Rohadi. (2019). Pengembangan Media Pembelajaran Interaktif Dengan Menggunakan Adobe Captivate Pada Materi Gerak. *Jurnal Kumparan Fisika,* 2(2), 113–20.

Rahmana, Fiki, Prodi Pendidikan Fisika, and Universitas Mataram. (2021). Pengembangan Perangkat Pembelajaran Fisika Berbasis Masalah Berbantuan Video Pada Materi Elastisitas Untuk Meningkatkan Kemampuan Pemecahan Masalah. *Jurnal Ilmiah Profesi Pendidikan,* 6(4), 588–93.

Rahmawati, Mulya, Sutrio Sutrio, and Muhammad Makhrus. (2020). Pengembangan Perangkat Pembelajaran Model Reasoning and Problem Solving Dalam Meningkatkan Kemampuan Pemecahan Masalah Fisika Peserta Didik. *Jurnal Pijar Mipa,* 15(5), 445–451.

Rubianto, Ahmad. (2020). Pengembangan Modul Berbasis Aplikasi Android Untuk Mata Kuliah Ilmu Bahan Teknik Pada Prodi D3 Teknik Mesin Universitas Negeri Malang. *Jurnal Teknik Mesin Dan Pembelajaran* 2(2), 124.

Sari, Dwi Septiana, and Kristian Handoyo Sugiyarto. (2015). Pengembangan Multimedia Berbasis Masalah Untuk Meningkatkan Motivasi Belajar dan Kemampuan Berpikir Kritis Siswa. *Jurnal Inovasi Pendidikan IPA,* 1(2), 153.

Siboro, Asiroha, Jelita Panjaitan, Julianus Gulo, and Hari Napolna Siboro. (2021). Pengaruh Model Pbl Berbantuan Phet Terhadap Kemampuan Pemecahan Masalah Fisika Pada Materi Pokok Elastisitas Dan Hukum Hooke Siswa Kelas XI Semester I SMA Muhammadiyah 18 Sunggal T.P. 2019/2020. *Jurnal Penelitian Fisikawan,* 4(2), 1–7.

Sugiyono. 2018. *Metode Penelitian Kuantitatif Kualitatif Dan R&D*. 2nd ed. edited by Sutopo. Yogyakarta: Alfabeta.

Zainudin, Zainudin, and Buyung Pambudi. (2019). Efektifitas Penerapan Perangkat Pembelajaran Fisika Dasar Berbasis Keterampilan Berpikir Kritis Menggunakan Aplikasi Edmodo Berplatform Android. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram,* 7(1), 17.