JPPIPA 9(11) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of Interactive Multimedia based on Case Method Assisted by Articulate Storyline 3 in General Physics

Ida Wahyuni[1*], Yeni Megalina[2], Ratna Tanjung[1], Khairul Amdani[2], Rajo Hasim Lubis[1]

[1] Physics Education Department, University of Medan, Medan, Indonesia.
[2] Physics Department, University of Medan, Medan, Indonesia.

Received: September 5, 2023
Revised: October 16, 2023
Accepted: November 25, 2023
Published: November 30, 2023

Corresponding Author:
Name Ida Wahyuni
idawahyuni@unimed.ac.id

DOI: 10.29303/jppipa.v9i11.5685

Abstract: Based on a survey of students in the PSPF D 2022 class, educators have 100% used smartphones, but some still use them to access things unrelated to learning. The general Physics course allocates three credits with two material credits and one practicum credit. The material can be conveyed thoroughly to students using learning media on Android smartphones, so learning media will be developed based on the Android smartphone operating system, namely Android-based interactive multimedia-based case method assisted by articulate storyline 3 in General Physics. This interactive multimedia will include several media consisting of RPS, material explaining everyday life, images, graphics, example problems, questions, learning videos, and student worksheets. This study aims to develop interactive multimedia that is feasible, practical, and effective and also to determine student responses. The research was conducted at the Physics Department of State University of Medan. This type of research uses the 4D models. The results of study show the percentage of assessment scores for interactive multimedia from material experts is 97% and media experts is 79.2%, the results of a practicality questionnaire 80%, and student responses according to the category 3.58 very effective, 3.61 very practical, 3.43 very safe, 3.38 very satisfied.

Keywords: Articulate storyline 3; Case method; Interactive multimedia; Physics

Introduction

In 2023, the odd semester, the OBE (Outcome-Based Education) curriculum was used at State University of Medan. This curriculum focuses on learning achievement, meaning that it is not only centered on material but also on learning outcomes. The outcome is knowledge and skills that really must be measurable. This curriculum adheres to the sustainability of innovative, effective, and interactive learning processes. Innovative learning provides opportunities for students to build knowledge themselves or independently. According to Supardi (2013), effective learning is directed at changing student behavior towards a positive and better direction following students' potential differences to achieve learning goals. Interactive learning is a learning process of interaction between teachers, students, and the environment. It is hoped that the interaction process will allow students' abilities to develop mentally and intellectually (Rohmalina, 2016). implementing innovative, effective, and interactive learning requires a learning model, learning method, strategy, approach, and media. The Physics course for the class of 2023 already uses the OBE curriculum. Based on a questionnaire distributed to 2021 students who have studied Mechanics material in general Physics courses. Learning media can clarify the presentation of messages and information, cause learning motivation, and overcome the limitations of the senses, space and time (Sukiman, 2012). At this time, the development of technology is growing very rapidly. Sutikno (2013) reveals that the development of information and communication technology (ICT) has influenced the world of education, especially in learning. Smartphone-based educational devices have arrived and shown great potential to help educators build information and knowledge sharing for learning through mobile devices (Pustikayasa, 2019). Sutomo

How to Cite:
Wahyuni, I., Megalina, Y., Tanjung, R., Amdani, K., & Lubis, R. H. (2023). Development of Interactive Multimedia based on Case Method Assisted by Articulate Storyline 3 in General Physics. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 9652–9659. https://doi.org/10.29303/jppipa.v9i11.5685

(2017) stated that cellular phone utilization has a positive impact. Utilizing usability in mobile phones that help the learning cycle will work on the nature of learning interaction.

The use of smartphones in education is known as mobile learning (m-Learning) technology. The utilization of m-Learning, as stated by González et al. (2015), can positively contribute to participants accessing learning materials or as learning media. According to (smanto et al. (2017) smartphones can implement various forms of multimedia just like computers, but the advantage is that smartphones have high mobility and can be operated more effectively. One operating system that is widely used on smartphones is Android. Android is a Linux-based operating system used on various mobile devices. Android has the primary goal of advancing mobile device innovation so that users can explore the advantages of Android compared to other mobile platforms. Until now, Android continues to develop, both in terms of systems and applications (Purwanti, 2013).

Based on observations in the class D 2022, the problem that occurs when learning general physics is that there are still students who use smartphones to access things that are not related to learning, such as opening social media, chatting with friends on WhatsApp, opening online shops and also playing games. Therefore, using smartphones as learning media can attract interest, facilitate learning, and overcome space and time limits. The general physics course allocates three credits, with two material credits and one practicum credit. Sometimes, there needs to be more time to provide extensive material, such as observing natural phenomena directly, by using learning media on smartphones, the material can be conveyed thoroughly to students. Then, students can discuss the material with self-study anytime and anywhere. Based on the above problems, it is necessary to develop learning media based on the Android smartphone operating system, namely Android-based interactive multimedia assisted by articulate storyline 3 in General Physics. Interactive multimedia that will be made has interactive learning features in general Physics courses, which contain semester learning plans (RPS), learning materials, images, graphics, videos, virtual simulations equipped with student worksheets, and learning evaluations such as a collection of concepts understanding questions.

Interactive media allows for a reciprocal flow of information that allows users to participate and modify the content of the information at that time (real-time) (Morissan, 2010). Interactive multimedia, proposed by (Surjono, 2017), is a learning program consisting of a combination of several media, namely text, images, graphics, audio, video, animation and simulations that are integrated with the help of computer technology or the like and can actively provide feedback (interact) between programs and users in supporting the learning process.

The interactive multimedia created is based on the case method. The case method is a strategy that can develop skills to develop learning (Rosidah et al., 2107). Case Method is a discussion-based participatory learning method to solve cases or problems. Applying this method will help students hone and improve critical thinking skills to solve problems, communication skills, collaboration, and creativity. In each material, students are given the case in everyday life. Then, students discuss with their groupmates. Case Method is a discussion-based participatory learning method to solve cases or problems. According to Graham et al. (1980), the purpose of using this method is to lend reality to indirect experiences, focus on concrete problems, develop decision-making skills, and help ensure that students see with various points of view. Similarly to team-based projects, this strategy is also student-centered to train them to develop skills needed in the 21st century: communication, collaboration, critical thinking, and creativity. The case method is a student-centered learning strategy that can provide them with critical thinking, communication, and interpersonal skills. (Widiastuti et al., 2022) research showed that of the number of students who attended the change management lecture class, 36% of the number of students who had attended lectures through the implementation of the case method showed a positive influence on the case method learning method and helped develop the ability to think to solve problems, intellectual skills and become independent learners.

Articulate Storyline 3 is an application for producing interactive multimedia that can be published (Khusnah et al., 2020). In addition, according to Husna et al. (2022), Articulate Storyline 3 is software for creating interactive presentations similar to Microsoft PowerPoint but with more sophisticated capabilities that are easy to use, such as timeline, movie, picture, character, animation and so on. The output of this application can be a website (HTML 5), video, Learning Management System (LMS), program (exe), and other online and offline applications. This application also includes several templates for creating interactive media, especially for creating exercises and exams.

Previous research by Prasetya et al. (2017) showed that at the expert review stage, the total average percentage value of expert validators was 97.02% with a very valid category, at the one-to-one evaluation stage, the average percentage was 90.81%, and at the small group stage the average percentage was 86.93% so that a total average percentage of 88.87% was obtained with an

efficient category. Based on the description above, the author will conduct a study entitled " Development of Interactive Multimedia based on Case Method Assisted by Articulate Storyline 3 in General Physics ".

Method

This research will be conducted at the Department of Physics State University of Medan. The subjects of this research are FMIPA students majoring in Physics in 2021, class B and class C, this research uses Research and Development (R & D), which was developed by Thiagarajan et al. (1974). The research design uses the 4D research stages Thiagarajan, et al (1974) developed, namely define, design, development and disseminate. Instruments or data collection tools in this study are using questionnaires, observation and documentation. Data analysis techniques are carried out using analysis techniques. After all data has been obtained and collected, the data needs to be analyzed. Qualitative and quantitative data analysis techniques are used by researchers in this development. Qualitative data was obtained from the interview survey results before researching Dik C 2020 Physics Department at the State University of Medan, criticism, and suggestions for the products developed. Quantitative data consists of assessment scores by material experts, media experts, and students for interactive multimedia.

$$P = \frac{x}{x_1} x100\% \quad (1)$$

Description:
P = Percentage of each criterion
X = score for each criterion.
Xi = maximum score for each criterion

For the Percentage of feasibility

Table 1. Feasibility Percentage Scale

Percentage of Achievement	Scale	Interpretation Value
76% ≤ score ≤ 100%	4	Very Feasible
51% ≤ score ≤ 75%	3	Feasible
26% ≤ score ≤ 50%	2	Pretty Feasible
0% ≤ score ≤ 25% 1	1	Less Feasible

Practicality data analysis

The practicality of the product can be seen in the table below:

Table 2. Product Practicality Interpretation Criteria

Interpretation Criteria	Percentage
Very Practical	81%<X<100%
Practical	61%<X<80%
Pretty Practical	41%<X<60%
Not Practical	21%<X<40%
Very Not Practical	0% <X<20%

After obtaining the results through the score calculation above, the results are grouped based on the quality criteria in use based in Table 3 below:

Table 3. Quality Criteria in Use

Score	Average Score	Classification			
4	3.26 – 4.00	Very Effective	Very Productive	Very Safe	Very Satisfied
3	2.51 – 3.25	Effective	Productive	Safe	Satisfied
2	1.76 – 2.50	Less Effective	Less Productive	Less Safe	Less Satisfied
1	1.01 – 1.75	Not Effective	Not Productive	Not Safe	Not Satisfied

Result and Discussion

Research Results

This research produces products that are interactive Multimedia based case method assisted on General Physics. The percentage of assessment scores for learning design from material experts is 97%, and the percentage of assessment scores from media experts is 79.22%, with the category very feasible to use, practice, student responses according to the category 3.58 very effective, 3.61 very practical, 3.43 very safe, 3.38 very satisfied.

Define Stage

This stage is an initial activity by conducting a needs analysis and literature study to determine the product to be developed. This stage aims to establish and determine the instructional requirements before the research. Through the analysis conducted, it is expected to determine the objectives and constraints in the field. This stage includes five activities, including:

Front-end Analysis. In this activity, an analysis was carried out regarding the fundamental problems encountered in the learning process by conducting interviews with lecturers teaching General physics courses. After the interview activities were completed, the researchers distributed a front-end analysis questionnaire to class of 2021 students who had taken General Physics courses. Based on the data obtained from the questionnaire results, many students suggested using multimedia because multimedia helps visualize abstract physics concepts. Students need multimedia in the general physics learning process.

Front-end Analysis. In this activity, a questionnaire was distributed to students to obtain information related to student attitudes, language use in the learning process and student skills in accessing and using technology.

Task Analysis. In this activity, a questionnaire was distributed to students to obtain information related to the set of assignments given by the teacher, the technical work of the assignment, the criteria and the framework given by the teacher.

Concept Analysis. In this activity, an analysis of the concepts to be taught is carried out, compiling indicators to be achieved and the steps to be taken. In this activity, an interview is conducted with one of the physics lecturers regarding material that could be clearer for students to understand. Researchers determine the concepts that will be presented based on the syllabus.

Specifying Instructional Objectives. In this activity, concept and task analysis results are summarized into objectives expressed through learning activities. The activity is to determine the objectives or learning outcomes from the analysis to avoid being at odds with the objectives of developing learning multimedia adapted from the syllabus.

Design Stage

This stage is an activity of designing the product to be developed. This stage includes three activities, including:

Media Selection. This activity selects the right media to present the learning content. Media selection is based on problem identification and adjustment of needs and conditions in the field. Researchers chose General Physics to be presented in the multimedia to be developed.

Format Selection. Interactive learning multimedia is created using the Articulate Storyline 3 application. Interactive learning multimedia created in the Articulate Storyline 3 application is stored in HTML 5. This Articulate Storyline 3 application has many advantages, such as being easy to use, easy to learn by beginners, supporting interactive learning, and the content presented can combine many types of media. After that, the interactive learning multimedia in HTML 5 format is converted into an Android application using the Website 2 APK Builder application to use the resulting multimedia offline. The material in this interactive learning multimedia refers to several references such as University Physics and other physics books.

Initial Design. In this activity, researchers carried out the initial design of multimedia products to be developed. This research succeeded in developing interactive multimedia with the size of the resulting application 32 MB. The following is a multimedia design in the form of a flowchart and storyboard of android-based interactive learning multimedia on Newton's Law material:

The results of the android-based interactive learning multimedia on Newton's Law physics material are in Figure.

Figure 1. Initial view

The initial display is the first page when the interactive multimedia is opened. On the display, there is the Unimed logo, welcome reading, name input command, school of origin input command and the "enter" navigation button to the main menu.

Figure 2. Main menu

Welcome reading, name input command, school of origin input command and the "enter" navigation button to the main menu.

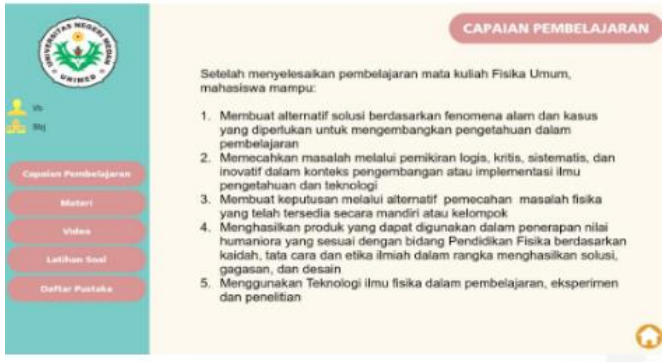

Figure 3. Learning outcomes

In this view, there are learning outcomes. In addition, there is a navigation button back to the main menu, a navigation button back to the previous page and a navigation button to the next page.

Figure 4. Material

On the material menu, there is material 1 to material 7. The material in this multimedia is material that has been adapted to the syllabus. In addition, there is a navigation button back to the main menu.

Figure 5. Experiment video

In the video menu, a barcode is provided. Students are expected to scan the barcode.

Figure 6. Questions

Develop Stage

The third stage in the ADDIE development model is development. Product manufacturing is carried out at the development stage, namely multimedia learning for Modern Physics courses. After the product has been finished, feasibility is carried out by material experts and media experts. The product is Modern Physics Hybrid Learning This stage is an activity to test the feasibility of the product so that the product gets suggestions for improvement and becomes a product with the desired objectives. This stage includes two main steps, as follows:

*Experts Assessment***.** Expert assessment is a validation technique by experts to obtain suggestions for improving the material, multimedia design and questions that have been developed. Suggestions are obtained by conducting validation by experts, which become material for revising multimedia products. Results of Assessment by Material Experts.

The material expert validator in this interactive multimedia development is Dr. Erni Halawa, M.Si. Assessment by material experts aims to see the suitability of the material with learning objectives, the suitability of the language used and the concept of material in the developed learning multimedia. The results obtained from the assessment by material experts are:

Table 4. Material Expert on Learning Multimedia

Aspects	Frequency					Score	Item	Max Score	Percentage
	1	2	3	4	5				
Functionality	0	0	0	0	10	50	10	50	100
Reliability	0	0	0	1	5	29	6	30	96.7
Usability	0	0	0	0	5	25	5	25	100
Efficiency	0	0	0	1	1	9	2	10	90
					Total	113	23	115	97%

Assessment Results by Media Experts. The media expert validator in this multimedia development is Dr. Ridwan Sani, M.Si. Assessment by media experts aims to see the accuracy of image selection, font size,

characters and videos used, usability and efficiency as learning media. The results obtained from the assessment by media experts are in the Table 5.

The results of the student response questionnaire to Interactive multimedia-based case method assisted by an Articulate shown in Table 7.

Table 5. Feasibility Test by Media Experts on Interactive Learning Multimedia

Aspects	Frequency					Score	Item	Max Score	Percentage
	1	2	3	4	5				
Functionality	0	0	0	10	1	45	11	55	82
Reliability	0	0	0	3	0	12	3	15	80
Usability	0	0	0	6	0	24	6	30	80
Efficiency	0	0	0	2	0	8	2	10	80
Maintainability	0	0	1	2	0	11	3	15	73.33
Probability	0	0	0	1	0	4	1	5	80
					Total	104	25	130	79.22%

Table 6. Feasibility Test by Media Experts on Interactive Learning Multimedia

Aspects	Frequency					Score	Item	Max Score	Percentage
	1	2	3	4	5				
Presentation	0	0	2	65	17	315	84	420	75
Content	0	1	15	122	51	775	189	945	82
Language	0	0	2	49	12	262	63	315	83.2
					Total	1352	336	1680	80%

Table 7. Results of Student Responses to Multimedia

Aspects	Frequency				Score	Item	Score Max	Category Percentage
	1	2	3	4				
Effectiveness	-	18	81	95	695	194	776	3.58
Productivity	-	2	41	74	423	117	468	3.61
Safety	1	5	31	41	268	78	312	3.43
Satisfaction	2	20	121	129	921	272	1088	3.38

Disseminate Stage

This stage is an activity to disseminate interactive learning multimedia products that have been developed to be used to be utilized by individuals or groups. The distribution of Android-based interactive learning multimedia products is carried out by submitting multimedia products to lecturers who carry General Physics courses.

Discussion

This interactive multimedia is based on the case method. Currently, the State University of Medan uses the case method because it can improve student skills. Andayani's research, Case method is one of the methods used by the MBKM program and can provide opportunities to improve student skills (Andayani et al., 2022). In each General Physics material, namely Mechanics, Electricity, Optics, Fluids, Vibrations and Waves, Thermodynamics and Modern Physics, a case and problem are presented. The steps of the case learning method are as follows: a) selection of cases by the lecturer, then students find out the causes of the case or problem under study, b) students discuss with their groupmates to collect data and information such as observation, interviews and documentation analysis, c) after obtaining data, students process and analyze again to determine the truth of the data, d) then students write a report or conclusion from the results of the case study, e) present the results of the report to the lecturer and other groups.

So, based on the results of this case method-based interactive multimedia research, it makes students learn independently, this is to the research of (Asep et al., 2023), learning activities through the case method require optimizing student activeness through independent learning, self-development through case-based learning. This interactive multimedia also makes students interested and enthusiastic about learning general physics. This is the same as the research of Hodijah et al. (2022) and Widiastuti et al. (2022), this case study has the effect of increasing student enthusiasm during lectures and more interest in learning because students themselves are already thinking and looking for answers to the cases to be discussed.

Based on the feasibility test results by material experts, the results obtained in the functionality aspect are 100%, in the reliability aspect are 96%, in the usability aspect are 88%, and in the efficiency aspect are 100%. Overall, the average obtained by researchers in the feasibility test by material experts is 90%. From this

acquisition, the material used in the development of interactive multimedia is very feasible to use so that it can be continued for the development trial stage. However, the material expert gave suggestions:

1. The initial menu (login) must be fixed because users can log in without filling in their data by sliding the menu slide to the left. If the user's data is not needed, it should be removed, but if it is needed, it needs to be addressed.
2. Each material has a choice of practice questions, but the questions given are the same from all materials. We recommend that the practice questions menu contains questions related to the selected material in each material. For example, when choosing the exercise questions menu in Modern Physics material, what appears are questions about Modern Physics.
3. Writing the unit of a variable must be consistent. For example, the unit of acceleration is m/s^2, not m/s^2.

Based on the results of the feasibility test by media experts the results obtained in the functionality aspect are 82%, in the reliability aspect of 80%, in the usability aspect of 80%, in the efficiency aspect of 80%, in the maintenance aspect of 73.33% and the probability aspect of 80%. The overall average obtained by researchers in the feasibility test by media experts is 79.22%. From this acquisition, it can be concluded that the media used in the development of interactive multimedia is very feasible to use so that it can be continued for the development trial stage. The results obtained in the presentation aspect were 75%, in the content aspect were 82%, and in the language aspect were 83.2%. Overall, the average obtained is 80%. From this acquisition, the media used in developing interactive multimedia is very practical so that it can be continued for the distribution stage. The advantages of interactive learning multimedia based on case method assisted by articulate storyline are as follows: case method-based interactive learning multimedia has a relatively small size of 32 MB, can be used anytime and anywhere and can support students' independent learning abilities; and interactive learning multimedia based on case methods that have been downloaded will be stored on the cellphone and can be used offline. The disadvantages of interactive learning multimedia based on case methods are as follows: interactive learning multimedia based on Android can only be run on mobile phones with an Android operating system. This multimedia cannot be used for iOS operating systems, windows phones, etc.

Conclusion

Interactive learning multimedia based on case method assisted by articulate storyline 3 getting an assessment by material experts are 97% with the criteria of "very feasible", the assessment by media experts is 79,22% with the criteria of "very feasible". The results of the student practicality questionnaire are very practical. Student response to interactive learning multimedia based on case method assisted by articulate storyline 3, which has been tested on students of the Faculty of Mathematics and Natural Sciences majoring in class A statistics, in the effective aspect of 3.58 with a very effective category, in the aspect of productivity of 3.61 with a very productive category, in the aspect of security of 3.43 with a very safe category and 3.38 very satisfied category.

Acknowledgments

Thank you to the students of classes PSPF D 2022, who have helped to obtain research data.

Author Contributions

Ida Wahyuni, Yeni Megalina, Ratna Tanjung, Khairul Amdani: writing-original draft preparation, result, discussion, methodology, analysis, conclusion; Rajo Hasim Lubis: proofreading, review, and editing.

Funding

This research is funded by the campus research program (LPPM Universitas Negeri Medan).

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Andayani, E., Mustikowati, R. I., Wahyu, S., Setiyowati, & Firdaus, R. M. (2022). Case method: Mengoptimalkan critical thinking, creativity communication skills dan collaboratively mahasiswa sesuai MKKM di era abad 21. *Jurnal Penelitian Dan Pendidikan IPS (JPPI)*, *16*(1). https://doi.org/10.21067/jppi.v16i1.6973

Asep, A., Helmi, D., Ansiska, P., & Sohilait, D. (2023). Aktivitas Pembelajaran Berbasis Metode Case Method Dalam Pembelajaran Geografi Mata Kuliah Antropologi. *Jurnal Ilmiah Profesi Pendidikan*, *8*(1b). https://doi.org/10.29303/jipp.v8i1b.1216

González, M., González, M., Martín, M. E., Llamas, C., Martínez, Ó., Vegas, J., Herguedas, M., & Hernández, C. (2015). Teaching and learning physics with smartphones. *Journal of Cases on Information Technology*, *17*(1). https://doi.org/10.4018/JCIT.2015010103

Hodijah, S., Hastuti, D., & Zevaya, F. (2022). Implementasi model case method dalam meningkatkan inovasi pembelajaran mahasiswa dan kemampuan berpikir kritis pada mata kuliah

teknik perdagangan Internasional. *Jurnal Paradigma Ekonomika*, *17*(2). https://doi.org/10.22437/jpe.v17i2.20895

Husna, A., & Fajar, D. M. (2022). Development of Interactive Learning Media Based on Articulate Storyline 3 on Newton's Law Material with a Contextual Approach at the Junior High School Level. *IJIS Edu : Indonesian Journal of Integrated Science Education*, *4*(1). https://doi.org/10.29300/ijisedu.v4i1.5857

Ismanto, E., Novalia, M., & Herlandy, P. B. (2017). Pemanfaatan Smartphone Android Sebagai Media Pembelajaran Bagi Guru Sma Negeri 2 Kota Pekanbaru. *Jurnal Pengabdian UntukMu NegeRI*, *1*(1). https://doi.org/10.37859/jpumri.v1i1.33

Khusnah, N., Sulasteri, S., Suharti, S., & Nur, F. (2020). Pengembangan media pembelajaran jimat menggunakan articulate storyline. *Jurnal Analisa*, *6*(2). https://doi.org/10.15575/ja.v6i2.9603

Morissan. (2010). Periklanan: Komunikasi Pemasaran Terpadu Edisi Pertama (Terjemahan). In *Penerbit: Kencana Prenada Media Group*.

Prasetya, I. G. A. S., Wirawan, I. M. A., & Sindu, I. G. P. (2017). Pengembangan E-Modul Pada Mata Pelajaran Pemodelan Perangkat Lunak Kelas Xi Dengan Model Problem Based Learning Di Smk Negeri 2 Tabanan. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *14*(1). https://doi.org/10.23887/jptk.v14i1.9885

Purwanti, I. (2013, March). Perancangan aplikasi pembelajaran huruf hijaiyah berplatform android untuk madrasah baca tulis al quran al-fattah desa widodaren kabupaten ngawi. In *Seruni-Seminar Riset Unggulan Nasional Inoformatika dan Komputer* (Vol. 2, No. 1). http://dx.doi.org/10.0809/seruni.v2i1.734

Pustikayasa, I. M. (2019). Grup Whatsapp Sebagai Media Pembelajaran. *Widya Genitri: Jurnal Ilmiah Pendidikan, Agama Dan Kebudayaan Hindu*, *10*(2). https://doi.org/10.36417/widyagenitri.v10i2.281

Rohmalina, W. (2016). *Psikologi Belajar*. PT RajaGrafindo Persada.

Rosidah, T., Astuti, P. A., & Wulandari, A. (2107). Eksplorasi Keterampilan Generik Sains Siswa Pada Mata Pelajaran Kimia di SMA Negeri 9 Semarang. *Jurnal Pendidikan Sains (JPS)*, *5*(2), 130–137. https://doi.org/10.26714/jps.5.2.2017.130-137

Sukiman. (2012). *Pengembangan Media Pembelajaran*. Pustaka Insan Madani.

Supardi. (2013). *Sekolah Efektif Konsep Dasar dan Praktiknya*. PT RajaGrafindo Persada.

Surjono, H. (2017). *Multimedia Pembelajaran Interaktif: Konsep dan Pengembangan*. UNY Press.

Sutikno, S. (2013). *Belajar dan Pembelajaran*. Holistica.

Sutomo, P. (2017). Penggunaan Smartphone Terhadap Proses Dan Efektivitas Belajar Mahasiswa Pendidikan Akuntansi Fkip. *Jurnal Sains Dan Seni ITS*, *6*(1). Retrieved from https://eprints.ums.ac.id/54766/

Widiastuti, F., Amin, S., & Hasbullah, H. (2022). Efektivitas Metode Pembelajaran Case Method dalam Upaya Peningkatan Partisipasi dan Hasil Belajar Mahasiswa pada Mata Kuliah Manajemen Perubahan. *Edumaspul: Jurnal Pendidikan*, *6*(1). https://doi.org/10.33487/edumaspul.v6i1.3034