JPPIPA 9(5) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

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

Development of Physics Interactive Multimedia Based on STEM Approach Class XI SMA

Rif'il Husniyah[1*], Ramli[1]

[1] Magister of Physics Education, Universitas Negeri Padang, Padang, Indonesia.

Received: March 28, 2023
Revised: May 26, 2023
Accepted: May 28, 202
Published: May 31, 2023

Corresponding Author:
Rif'il Husniyah
husniyahrifil26@gmail.com

DOI: 10.29303/jppipa.v9i5.3542

Abstract: This development aims to produce a product in the form of interactive multimedia based on the STEM approach for class XI SMA. The results of this study can be accessed via an Android smartphone making it easier for students to study wherever and whenever. The development model used is the ADDIE development model with the stages of analysis, design, development, implementation and evaluation. At the analysis stage, an analysis of learning activities is carried out, an analysis of the needs of students and an analysis of learning media. The development stage uses the articulate storyline 3 application. As for the stages of development results, for instrument validation it is 0.97 with valid criteria and product validation is 0.78 in the valid category. While the results of practicality by students amounted to 83.96 and the results of practicality by educators amounted to 85.63 with a very practical category. For the effectiveness stage, there was an increase in mastery of knowledge competencies from 6,06% (Pretest) to 69,69% (posttest) while the percentage of students' completeness in skill competencies was 80.00%. For the results of the gain score, an average of 0.64 is in the medium category. Therefore interactive multimedia based on the STEM approach in class XI SMA is appropriate for use in the learning process.

Keywords: ADDIE development model; Interactive multimedia; STEM approach

Introduction

21st century students must be able to master and be skilled in combining knowledge, attitudes, skills, and mastery of technology. With this integration, it can be a measure of the success of students in understanding problems (Maghfiroh et al., 2023). In addition, the use of information technology is one of the processes to increase learning effectiveness (Marta & Ramli, 2021). This can be realized if the learning process uses technology-based learning media.

The 21st century requires students to have 4C skills or skills, namely skills in critical, creative thinking, communication and creating innovation in learning. But in reality the expectations of 21st century learning are still far from what was expected. So that 21st century learning really needs innovation, especially in learning media. Because in fact, in the teaching and learning process, teachers have not utilized technology as a learning medium. This is known from the results of interviews that have been conducted with a physics teacher. Learning is still going on conventionally, due to limited age to learn new things and make learning media.

Learning media is a tool in the learning process (Ahmad Zaki, 2020). The use of learning media is one of the factors that influence the learning process (Tafonao, 2018). Learning media facilitate the delivery of material or learning objectives (Isdayanti et al., 2022). In addition , the existence of learning media can stimulate the minds, attention and abilities of students (Kahfi et al., 2021). Interactive multimedia learning media is a learning tool that contains material, methods, so that it can achieve the expected competencies

Interactive multimedia is one of the media to help computer based teaching and learning processes (Novianto et al., 2018). Multimedia is a combination of two or more media elements consisting of text, graphics, images, audio, video and animation (Wati & Asrizal,

How to Cite:
Husniyah, R., & Ramli, R. (2023). Development of Physics Interactive Multimedia Based on STEM Approach Class XI SMA. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 3899–3904. https://doi.org/10.29303/jppipa.v9i5.3542

2022). With the existence of interactive multimedia can increase the motivation of students. In addition, the use of interactive multimedia in learning will be more effective and more efficient and easier for students to understand (Rindiyani, 2020). Interactive multimedia is an electronic-based learning, so it can increase students' knowledge competence (Alenezi, 2020). The application used in the development of this interactive multimedia is articulate storyline 3. One of the advantages of using this application is that it can be formatted in the form of a personal web (Arief Darmawan, 2021). In addition, this application is presented with a specific purpose so that it is easy to use (Pratama, 2019).

In addition to the use of interactive multimedia in learning, one thing that is crucial to influencing the interest and motivation of students is the approach used in learning. The learning approach is an effort used by educators to achieve learning competence. An approach that is in line with the demands of the 21st century and the industrial revolution 4.0 is the STEM approach (Patmawati et al., 2019).

The STEM approach is a blend of science, engineering technology and mathematics (Asri & Fajri, 2023). The STEM approach is a discipline that is interrelated with one another (Wisnu Wibowo, 2018). Based on previous research, the STEM approach has a good impact on learning, including learning physics (Nazifah, 2022). So that the development of interactive multimedia based on the STEM approach is a solution that can be used to answer the challenges of 21st century education (Arifin et al., 2020). State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Method

This research is a teaching tool development research that produces interactive multimedia based on the STEM approach. Initial observations were made in three schools, namely SMAN 4 Padang, SMAN 15 Padang and SMA PGRI 2 Padang. Meanwhile, the application of interactive multimedia was carried out at SMA N 4 Padang. Class XI MIPA 3 research subjects with a total of 33 people. Instrument validation and product validation are carried out by three expert lecturers with a minimum qualification of postgraduate.

Development research was carried out using the ADDIE development model with the stages of analysis, design, development, implementation and evaluation. The following procedure for developing the ADDIE model can be seen in Figure 1.

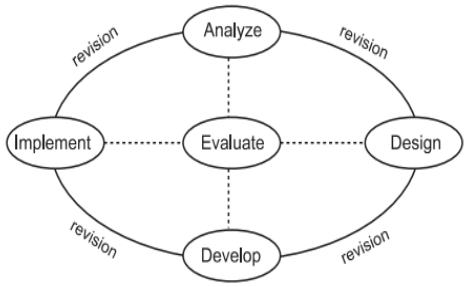

Figure 1. ADDIE development model chart

The needs analysis stage uses the following equation 1.

$$S_k = \frac{\sum X_i}{X_{maks}} x\ 100\% \quad (1)$$

Information: S_k = Score obtained, X_i = Score of each respondent, and $X_{\_max}$ = The maximum score.

Data analysis to assess the needs analysis for each indicator uses the following provisions in Table 1.

Table 1. Categories of Needs Analysis

Category	Mark
Very good	91-100
Good	81-90
Enough	71-80
Very less	≤ 60

For validity technique using Aiken's V formula as equation 2.

$$V = \frac{\sum s}{[n(c-1)]} \quad (2)$$

The results of the validity criteria consist of valid and invalid. This can be seen in the following table.

Table 2. Validity Criteria (Waluyo et al., 2020)

Interval Score	Validity Criteria
$x \geq 85$	Very Valid
$70 \leq x < 85$	Valid
$45 \leq x < 70$	Quite Valid
$x < 45$	Less Valid

Result and Discussion

The first stage in the ADDIE model development research is analysis. The analysis was carried out in three schools, namely SMA N 4 Padang, SMA N 15 Padang and SMA PGRI 2 Padang. The following are the stages of development based on the ADDIE model.

Analysis

The first analysis is an analysis of learning activities consisting of preliminary, core and closing activities. The results of learning activities can be seen in Figure 2.

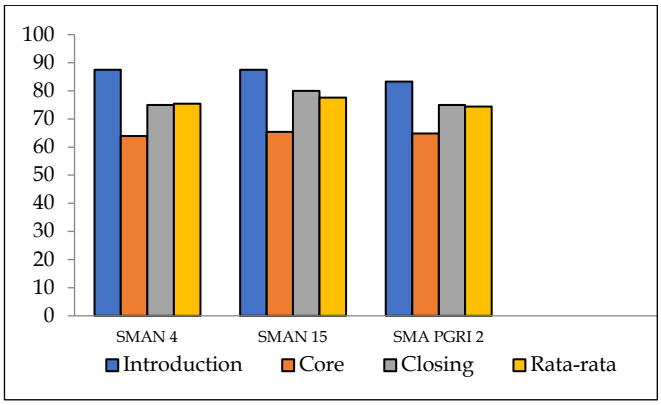

Figure 2. Analysis of Learning Activities

From Figure 2 it can be seen that the average learning activity for the three supervised SMAs is 75.83. Meanwhile, for the analysis of needs, SMAN 4 Padang has an average of 75.4 in the sufficient category, SMAN 15 Padang has an average of 76.80 in the sufficient category. Meanwhile SMA PGRI 2 with an average of 74.38 is sufficient. From these data it shows that the learning activities of the three observed SMAs are still in the sufficient category. The next analysis is an analysis of the needs of students consisting of indicators of attitudes (A), knowledge (K), skills (S), interests (I), motivation (M) and learning styles (LS). This can be seen in Figure 3.

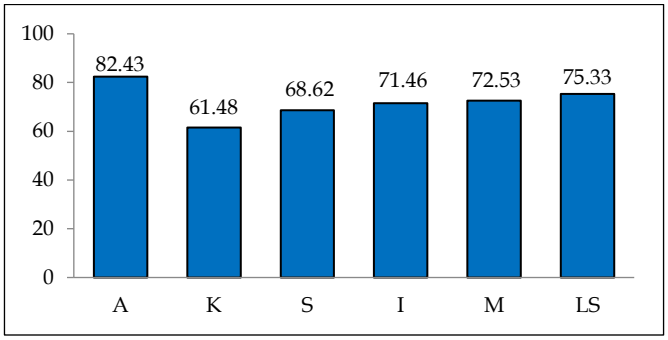

Figure 3. Analysis of student needs

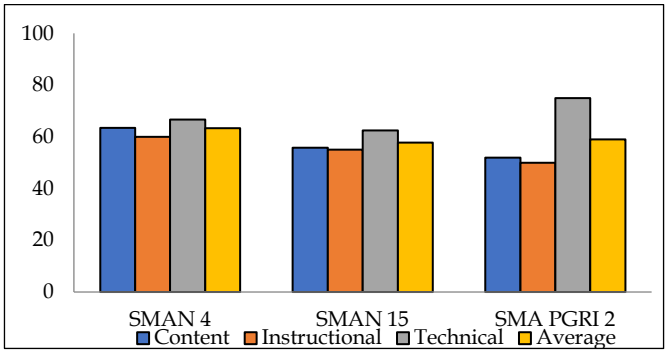

Figure 4. Analysis of learning media

Analysis of student needs was carried out in three observed schools. For attitude competence is in the good category. While interest, motivation and learning styles are in the sufficient category. As for knowledge and skill competencies, they are in the less category, namely 61.48 and 68.62. For the next analysis is the analysis of learning media. The identifiers used in learning media are content, instructional and technical. The results of the analysis of learning media can be seen in Figure 4.

Based on the data that can be seen in Figure 4, the analysis of learning media in the three schools has a very low percentage. So if it is categorized in the very less category. This is one of the reasons for developing interactive multimedia.

Design

The design stages in interactive multimedia are in the form of material arranged in the form of text, audio, video and multiple choice evaluation questions. At the design stage there is a main menu consisting of an introduction, materials, exercises, evaluations, references and exercises. The introductory menu contains basic competencies, indicators, and instructions for use.

Development

Interactive multimedia that is developed and produced uses the articulate story line 3 application. The development stages are the result of follow- up designs that have been planned. The results of the product from the development of interactive multimedia can be seen in the following figure.

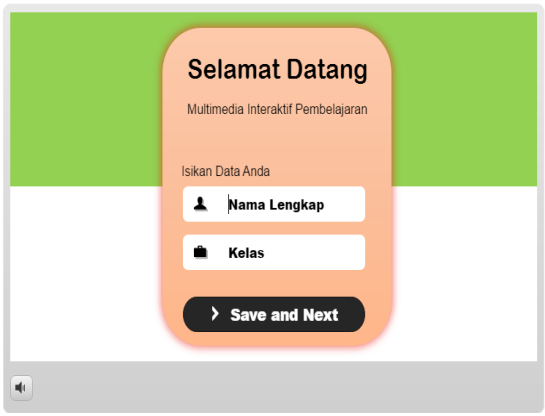

Figure 5. Login menu

Figure 6. Main menu of interactive multimedia

Figure 7. Instruction for using interactive multimedia

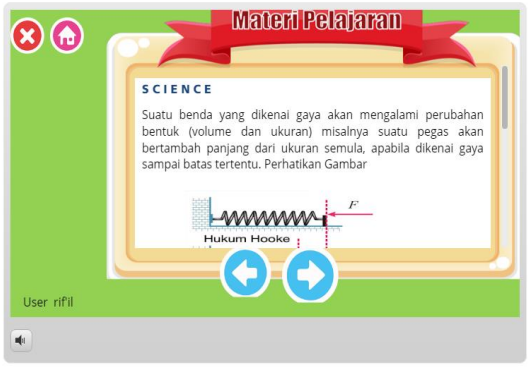

Figure 8. The contents of interactive multimedia

The validation results of interactive multimedia based on the STEM approach were carried out by three experts in this case, namely the lecturers were in valid criteria. The aspects that are assessed in the validation are material content, language, graphics, and media. Validation results can be seen in the following table.

Table 3. Interactive Multimedia Validation Results

Rated aspect	Expert validator	
	Aiken's V score	Criteria
Content Material	0.74	Valid
language	0.83	Valid
graphic	0.75	Valid
Media	0.81	Valid
Average	0.78	Valid

Table 4. Results of Practicality by Students

Indicator	Mark (%)	Category
Can be used	85.28	Very practical
Easy to use	81.61	Very Practical
Interesting	84.34	Very Practical
Efficient	84.61	Very Practical
Average	83.96	Very Practical

Based on Table 3, it can be seen that the average interactive multimedia validation result is 0.78 with valid criteria. Meanwhile, for each aspect, the content of the material is 0.78 with valid criteria. Language with valid criteria for aiken's score of 0.83 and graphics and media with valid criteria. This is in accordance with the research by Aprilia et al. (2021), Hayati et al. (2021) and Anita et al. (2021) that the development of interactive multimedia STEM approaches is in the valid category. The results of practicality by students can be seen in table 4.

Based on table 4 it can be seen that the practicality of interactive multimedia based on the STEM approach is very practical. For indicators that can be used, they are in the very practical category. Likewise, indicators that are easy to use, attractive, and efficient are in the very practical category. So that an average of 83.96 is obtain rated with the very practical category. The results of practicality by educators can be seen in table 5.

Table 5. Practicality Results by Educators

Indicator	Mark (%)	Category
Can be used	85.00	Very practical
Easy to use	84.34	Very Practical
Interesting	85.71	Very Practical
Efficient	87.50	Very Practical
Average	85.63	Very Practical

Based on table 5 it can be seen that the practical results of interactive multimedia by educators are in the very practical category. With the highest percentage, namely efficiency of 87.50, followed by attractive indicators, usable and easy to use. Meanwhile, the average percentage is 85.63% in the very practical category.

Implementation

The implementation of interactive multimedia based on the STEM approach was carried out in class XI MIPA 3 SMA N 4 Padang. The implementation phase is carried out to determine the effectiveness of the interactive multimedia. Effectiveness of two competencies, namely knowledge competence and skills competence. The following is data on student learning outcomes.

Table 6. Student Knowledge Competency Value

Comparison	Pretest	Posttest
Complete students	2.00	23.00
Incomplete students	31.00	10.00
Percentage of completeness (%)	6.06	69.69

Table 7. Student Skill Competency Scores

Component	Value Acquisition
Maximum Value	90.00
Minimum Value	75.00
Average	82.60
Pass Percentage (%)	80.00

Based on the data in the table it can be seen that there is an increase in knowledge competency in the class that is treated in the form of interactive multimedia based on the STEM approach. In the knowledge

competency there is an average increase of 42.42%. Likewise, the scores of students who completed the pretest were 9 people while in the posttest there were 23 people.

The average pretest score is 56.67 and the average posttest score is 82.87. So that the results of the pretest and posttest knowledge competency comparisons can be analyzed with a gain score. The results of the analysis with the gain score equation can be adjusted based on the Table 8.

Table 8. Gain Score Category

Score (<g>)	Category
(<g>)>0.7	High
0.7 ≥ (<g>)>0.3	Currently
(<g>)≤0.3	Low

The results of the analysis of the gain score obtained is 0.64 in the medium category. While in a percentage of 64, 28% are in the quite effective category. This shows that the use of interactive multimedia influences and increases the competence of knowledge and skills of students. This is in line with Pramadanti et al. (2021), Syuhendri et al. (2021), Pramuji et al. (2020), and Nurmala et al. (2021) that the use of learning media based on the STEM approach can improve student learning outcomes.

Evaluation

The last stage of product development that has been made is the revision of the final product from the trial stage that has been used by students and educators during the learning process. This revision was based on suggestions and input from class XI MIPA 3. Some of these improvements included: errors in writing in a few words, the location of the multiple choice options was inaccurate, and the number of questions in the final evaluation was not quite right.

Conclusion

Based on the research that has been done, it can be concluded that the development of interactive multimedia physics for class XI SMA based on the STEM approach is feasible to use. Judging from the results of product validation with an average of 0.78 with a valid category. For practicality results from students obtained an average of 83.96 and from teachers of 85.63 with a very practical category. Meanwhile, the effectiveness of interactive multimedia using gain score analysis obtained an average of 56.67 in the medium category. This shows that the resulting interactive multimedia is feasible to use in the learning process

Acknowledgments

Thanks to all parties who have supported the implementation of this research. I hope this research can be useful.

Author Contributions

Conceptualization: Rif'il Husniyah, data curation: Rif;il Husniyah, funding acquisition: Rif'il Husniyah, methodology: Rifil Husniyah, Ramli visualization: Rif'il Husniyah, writing–original draft: Rif'il Husniyah, writing–review & editing: Rif'il Husniyah, Ramli.

Funding

This research was privately funded by the author.

Conflicts of Interest

No Conflicts of interest.

References

Ahmad Zaki, D. Y. (2020). Penggunaan Media Pembelajaran untuk Meningkatkan Prestasi Belajar Siswa pada Pelajaran PKN SMA Swasta Darussa'adah Kec. Pangkalan Susu. *Al-Ikhtibar: Jurnal Ilmu Pendidikan*, *7*(2), 809–820. https://doi.org/10.32505/ikhtibar.v7i2.618

Alenezi, A. (2020). The role of e-learning materials in enhancing teaching and learning behaviors. *International Journal of Information and Education Technology*, *10*(1), 48–56. https://doi.org/10.18178/ijiet.2020.10.1.1338

Anita, Y., Thahir, A., Komarudin, K., Suherman, S., & Rahmawati, N. D. (2021). Buku Saku Digital Berbasis STEM: Pengembangan Media Pembelajaran terhadap Kemampuan Pemecahan Masalah. *Mosharafa: Jurnal Pendidikan Matematika*, *10*(3), 401–412. https://doi.org/10.31980/mosharafa.v10i3.1004

Aprilia, N., Azizahwati, & Azhar. (2021). Development of Physical Learning Media Using the Articulate Storyline 3 Application in Newton'S Law for Class X. *Jom Fkip-Ur*, *8*(1), 1–9. Retrieved from https://jom.unri.ac.id

Arief Darmawan, D. (2021). *Pedoman Penyelenggaran Pembelajaran Berbasis TIK Tahun 2021*. Retrieved from https://old-simpatik.belajar.kemdikbud.go.id/uploads/Pedoman_PembaTIK_dan_DRB_2021.pdf

Arifin, A. M., Pujiastuti, H., & Sudiana, R. (2020). Pengembangan media pembelajaran STEM dengan augmented reality untuk meningkatkan kemampuan spasial matematis siswa. *Jurnal Riset Pendidikan Matematika*, *7*(1), 59–73. https://doi.org/10.21831/jrpm.v7i1.32135

Asri, I. H., & Fajri, N. (2023). *Development of Project Based Learning with STEAM Approach Model Integrated Science Literacy in Improving Student Learning*

Outcomes. *9*(4), 1632–1640. https://doi.org/10.29303/jppipa.v9i4.2987

Hayati, S., Darman, R., & Antarnusa, D. G. (2021). *Seminar Nasional Fisika (SNF) 2021 Pengembangan multimedia interaktif berbasis articulate storyline pada materi gelombang bunyi*. 75–81. htt Retrieved from ps://p1webpembelajaran.000webhostapp.com/.

Isdayanti, Wicaksono, A. T., & Rahmawati, H. (2022). Pengaruh Penggunaan Worksheet Materi Asam Basa Berbasis Kearifan Lokal Terhadap Hasil Belajar Siswa. *Al Kawnu: Science and Local Wisdom Journal*, *01*(02), 74–81. https://doi.org/10.18592/alkawnu.v1i1.6402

Kahfi, M., Nurparida, N., & Srirahayu, E. (2021). Penerapan Multimedia Interaktif Untuk Meningkatkan Motivasi Belajar Dan Hasil Belajar Siswa Pada Pembelajaran IPA. *Jurnal Petik*, *7*(1), 63–70. https://doi.org/10.31980/jpetik.v7i1.986

Maghfiroh, S., Wilujeng, I., Jumadi, J., & Masyitha, D. (2023). Development of Physics E-Module Based on Discovery Learning to Improve Students' Scientific Literacy. *Jurnal Penelitian Pendidikan IPA*, *9*(2), 452–458. https://doi.org/10.29303/jppipa.v9i2.1733

Marta, Y. M. V., & Ramli, R. (2021). Analisis Kebutuhan Pengembangan Modul Pembelajaran Fisika SMA Berbasis Pendekatan STEM. *JIPFRI (Jurnal Inovasi Pendidikan Fisika Dan Riset Ilmiah)*, *5*(2), 95–101. https://doi.org/10.30599/jipfri.v5i2.918

Nazifah, N. & A. (2022). The Effect Of STEM Integrated Modules On Knowledge And Students' 21st Century Skill In Science And Physics Learning: A Meta Analysis. *IJPAST*, *21*(53), 1–38. https://doi.org/10.21608/sec.2006.146466

Novianto, Degeng, I. N. S., & Wedi, A. (2018). Pengembangan Multimedia Interaktif Mata Pelajaran IPA Pokok Bahasan Sistem Peredaran Darah Manusia Untuk Kelas VIII SMP Wahid. *Jurnal Kajian Teknologi Pendidikan (JKTP)*, *1*(3), 257–263. Retrieved from https://www.neliti.com/publications/334791/pengembangan-multimedia-interaktif-mata-pelajaran-ipa-pokok-bahasan-sistem-pered

Nurmala, S., Triwoelandari, R., & Fahri, M. (2021). Pengembangan media articulate storyline 3 pada pembelajaran IPA berbasis STEM untuk mengembangkan kreativitas siswa SD/MI. *Jurnal Basicedu*, *5*(6), 5024-5034. https://doi.org/10.31004/basicedu.v5i6.1546

Patmawati, K., Puspitasari, N., Mutmainah, S. N., & Prayitno, B. E. (2019). Profil Kemampuan Berfikir Kreatif Ditinjau Dari Kemampuan Akademik Mahasiswa. *Edu Sains Jurnal Pendidikan Sains & Matematika*, *7*(2), 11–18. https://doi.org/10.23971/eds.v7i2.1386

Pramadanti, M., Subiki, S., & Harijanto, A. (2021). Media Pembelajaran Fisika Menggunakan Smartphone Dengan Pendekatan Stem (Science, Technology, Engineering, and Mathematics). *ORBITA: Jurnal Kajian, Inovasi Dan Aplikasi Pendidikan Fisika*, *7*(2), 318. https://doi.org/10.31764/orbita.v7i2.5842

Pramuji, L., Permanasari, A., & Ardianto, D. (2020). Multimedia Interaktif Berbasis STEM Pada Konsep Perencanaan Berfikir Kritis Siswa. *Journal of Science Education and Practice*, *2*(1), 1–15. Retrieved from https://journal.unpak.ac.id/index.php

Pratama, R. A. (2019). Media Pembelajaran Berbasis Articulate Storyline 2 Pada Materi Menggambar Grafik Fungsi Di Smp Patra Dharma 2 Balikpapan. *Jurnal Dimensi*, *7*(1), 19–35. https://doi.org/10.33373/dms.v7i1.1631

Rindiyani. (2020). Artikel Review Media Pembelajaran Jarak Jauh (Pjj) Artikel Review Media Pembelajaran Jarak Jauh (Pjj). *Pendidikan Tambusai*, *5*(May), 8–11. Retrieved from https://www.researchgate.net

Syuhendri, S., Musdalifa, N., & Pasaribu, A. (2021). Pengaruh Penggunaan Multimedia Interaktif Berbasis Stem Terhadap Hasil Belajar Siswa. *Jurnal Inovasi Dan Pembelajaran Fisika*, *8*(1), 73–84. https://doi.org/10.36706/jipf.v8i1.14034

Tafonao, T. (2018). Peranan Media Pembelajaran Dalam Meningkatkan Minat Belajar Mahasiswa. *Jurnal Komunikasi Pendidikan*, *2*(2), 103. https://doi.org/10.32585/jkp.v2i2.113

Waluyo, E., Supiyati, S., & Halqi, M. (2020). Mengembangkan Perangkat Pembelajaran Kalkulus Integral Berbasis Model Pengajuan dan Pemecahan Masalah untuk Meningkatkan Kemampuan Berpikir Kreatif Mahasiswa. *Jurnal Elemen*, *6*(2), 357–366. https://doi.org/10.29408/jel.v6i2.2334

Wati, W. W., & Asrizal, -. (2022). Meta Analisis Pengaruh Multimedia Interaktif Terhadap Pemahaman Konsep dan Hasil Belaja Peserta Didik. *Jurnal Penelitian Pembelajaran Fisika*, *8*(2), 195. https://doi.org/10.24036/jppf.v8i2.119210

Wisnu Wibowo, I. G. A. (2018). Peningkatan Keterampilan Ilmiah Peserta Didik dalam Pembelajaran Fisika Melalui Penerapan Pendekatan STEM dan E-Learning. *Journal of Education Action Research*, *2*(4), 315. https://doi.org/10.23887/jear.v2i4.16321