



## Students' Conceptual Understanding in Science Subjects Using the Macromedia Flash 8 Application with The Instructional Games Model

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### Abstrak

Penelitian ini dilatarbelakangi sayakurangnya pemanfaatan media pembelajaran yang mampu memfasilitasi peserta didik dalam proses pembelajaran, sehingga peserta didik merasa kurang motivasi peserta didik dalam membaca. Tujuan dari penelitian ini yaitu mengembangkan multimedia pembelajaran Berbantuan Aplikasi Macromedia Flash 8 Model Permainan Instruksional yang valid, praktis dan efektif untuk meningkatkan pemahaman konsep siswa pada materi IPA. Subjek penelitian ini terdiri dari pakar media, pakar materi, pakar bahasa, guru dan peserta didik kelas V SDN. Penelitian ini merupakan penelitian pengembangan. Model pada penelitian ini yaitu ADDIE. Berdasarkan hasil penelitian multimedia pembelajaran yang dikembangkan masuk pada kategori valid baik dari segi desain, materi dan bahasa. Dari hasil uji praktikalitas yang dilakukan terhadap peserta didik dan guru, pembelajaran multimedia yang dikembangkan dikategorikan sangat praktis. Selanjutnya, berdasarkan hasil uji pretes dan tes pasca menunjukkan terjadinya peningkatan hasil belajar peserta didik dengan menggunakan multimedia pembelajaran yang dikembangkan. Dengan demikian, multimedia pembelajaran berkembang telah dinyatakan valid, praktis, dan efektif untuk meningkatkan pemahaman konsep siswa pada mata pelajaran IPA. Hal ini dikarenakan multimedia yang dikembangkan memiliki desain yang menarik dan mudah dioperasikan serta materi pembelajaran disajikan dengan video, gambar serta animasi-animasi yang menarik minat siswa untuk belajar. penggunaan aplikasi Macromedia Flash 8 yang interaktif dalam bentuk permainan instruksional dapat meningkatkan keterlibatan siswa dalam proses pembelajaran. Sifat visual dan dinamis dari aplikasi ini memungkinkan siswa untuk memahami konsep-konsep abstrak dalam IPA, seperti fisika, biologi, atau kimia, dengan lebih mudah. Kedua, model instructional games memfasilitasi pembelajaran yang lebih menyenangkan dan bermakna, yang pada akhirnya dapat meningkatkan motivasi belajar siswa.

**Kata Kunci:** Multimedia, Permainan Instruksional, Pemahaman Konsep.

### Abstract

This research is motivated by a lack of use of learning media that is able to facilitate students in the learning process, so that students feel less motivated in reading. The aim of this research is to develop application-assisted learning multimedia Macromedia Flash 8 Model Instructional Games Which is valid, practical and effective for improving students' understanding of concepts in science material. The subjects of this research consisted of media experts, material experts, language experts, teachers and students of class V SDN. This research is development research. The model in this research is ADDIE. Based on the results of multimedia research the learning developed is in the valid category both in terms of design, material and language. From the results of practicality tests carried out on students and teachers, multimedia learning that was developed is categorized as very practical. Next, based on the test results pretest and post test shows an increase in learning outcomes students by using the developed learning multimedia. Thus, multimedia learning developed has been declared valid, practical, and effective for improving students' understanding of concepts in science subjects. This is because the multimedia developed has an attractive design and is easy to operate and the learning material is presented well interesting videos, pictures and animations that increase students' interest in learning. Using the interactive Macromedia Flash 8 application in the form of instructional games can increase student involvement in the learning process. The visual and dynamic nature of this application allows students to understand abstract concepts in science, such as physics, biology, or chemistry, more easily. Second, the instructional games model facilitates more enjoyable and meaningful learning, which in the end can increase students' learning motivation.

**Keywords:** Multimedia, Instructional Games, Concept Understanding.

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## 1. INTRODUCTION

The rapid development of Industrial Revolution 4.0 has had a significant impact on many aspects of life, especially education. This revolution has brought major changes to human life, pushing the education system to improve the quality of learning (Mukti & Nurcahyo, 2017; Rozie & Siswoyo, 2020; Simangunsong & ., 2015). This includes advancing science education through the integration of digital technology. Science education is very important in improving the overall quality of education. In the context of the Industrial Revolution 4.0, digital technology can function as a powerful tool for teaching science, offering many benefits for student learning by acting as a learning medium and information delivery system (Fitria, 2017; Harahap, 2019; Sunarno, 2019). Especially in the field of education where in this condition human labor has been replaced by machines. Currently students can search for assignment materials on the internet via YouTube And Google, so we have to be able to make things more interesting for students and we also have to provide learning about information and communication technology and its impact on our students from an early age to reduce the negative impact on students (Batubara et al., 2017; Siboro et al., 2020).. Explaining the role of teachers in welcoming the Industrial Revolution 4.0, they must be able to develop students' critical abilities. Teachers must be able to foster students' creativity and innovation (Firmadani, 2020; Wahyono, 2019).

Based on observations made on class V teachers at SD Negeri 03 Padang Ganting on February 6 2021, several main problems were identified. First, the ongoing pandemic makes it impossible to hold 100% face-to-face classes. Second, most teachers rely on traditional teaching methods that use books and blackboards, causing a lack of student involvement and motivation, thus having a negative impact on learning outcomes. Third, students' low motivation to read due to the monotonous nature of the learning material also does not foster a scientific mindset. Fourth, there is a scarcity of use of interactive multimedia in schools. Fifth, the teaching approach includes presenting a concept, providing examples, and then providing exercises. Given the limitations of face-to-face interaction due to the pandemic, there is an urgent need for media that facilitates distance learning effectively. This is where the role of interactive multimedia is, where researchers hope that interactive multimedia will be assisted by Macromedia Flash 8 Model Instructional Games The app could be more helpful by transferring it to your phone or another app like YouTube.

Incorporating interactive multimedia into educational activities can significantly engage students, thereby shifting the focus from a teacher-centered approach. This method, especially if enhanced with sound, images, video and animated movements, will encourage students to participate more actively in their learning. Interactive multimedia, with its charming animations, transforms the learning experience into a more dynamic one. As an important element in education, this technology supports the learning process by functioning as an interesting educational tool for students. Reasons for choosing Macromedia Flash 8 namely teachers make school learning media more interesting because there are animated video images. Presents usage Macromedia Flash as software for creating interactive learning media is based on several advantages it has (Hamidah & Nazurty, 2020; Iflakhah, 2017). Flash not only combines multimedia elements with Action Script, Flash also has the ability to create script. Macromedia Flash has advantages over others, namely Macromedia Flash users can and are free to create animations with free movement depending on the desired animated scene, Macromedia Flash generates a small file, can be converted into a file like html, jpg, png, exe, moving. The results of previous research show that the use of interactive multimedia is based on Macromedia flash 8 and learning motivation has an influence on increasing student learning achievement in science subjects. These results indicate that overall in the field test, multimedia in learning the digestive system is quite suitable for use in learning research (Anwar et al., 2017; Firmadani, 2020). In addition, the research results

show that there are variations in student motivation when using Macromedia-based learning in the cooperative learning model. Furthermore, the media expert's assessment assessed the tool as very valid and the material expert also assessed it as very valid. Practical assessment based on student response questionnaires at the trial stage shows that the tool is considered very practical (Anwar et al., 2017; Fitria & Idriyeni, 2020; Kusmiarti & Hamzah, 2018).

In contrast to previous research, this research focuses on examining the impact of using interactive multimedia based on Macromedia Flash 8 in science education. The novelty of this research lies in the synergy between interactive technology, game-based learning, and a focus on increasing students' conceptual understanding in the field of science, which can practically and theoretically have a significant impact on the development of learning models in the digital era. This aims to measure learning motivation and learning outcomes. Researchers anticipate that developing engaging and useful interactive multimedia will improve the learning process. The goal is that such multimedia tools will encourage students to engage with the material, clarify complex topics, and make learning more accessible.

## 2. METHODS

This research uses research and development (R&D) methods. In general, this research aims to see the feasibility of using interactive multimedia created using Macromedia Flash was developed to address the environment of our friends in the discipline. The tools used in this research are questionnaires and test guidelines. The research and development approach is known as Research and development (R&D). R&D is an approach to research, producing educational products to solve educational problems and improve teaching effectiveness. R&D development research is a research method used to produce new product designs, test the effectiveness of existing products, and develop and create new products (Fitria, 2017; Kusmiarti & Hamzah, 2018). In the development and research of Interactive Multimedia assisted by Macromedia Flash 8 Learning Game Model, researchers used a descriptive development model with the ADDIE development model. The model includes five stages of development, ADDIE Model Schematic presented in Figure 1.

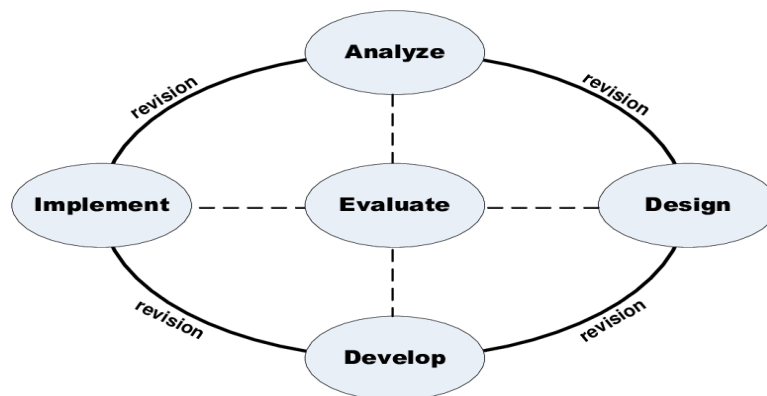


Figure 1. ADDIE Model Schematic Source (Hamidah & Nazurty, 2020; Harahap, 2019; Kusmiarti & Hamzah, 2018)

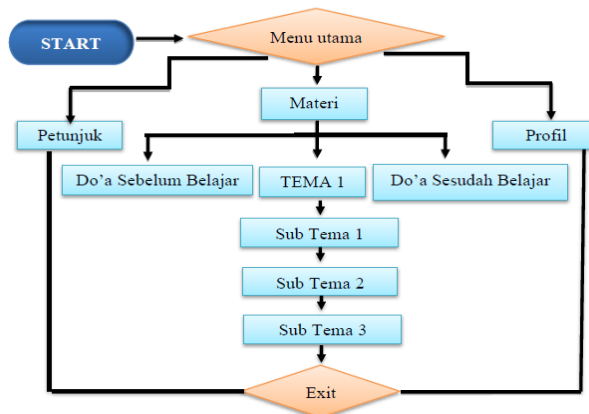
The subject of interactive multimedia test research was assisted by Macromedia Flash 8 Learning Game Model application of environmental material. Our friends are class V students of SDN 03, 02, 05, and 13 Padang Ganting Batusangkar, Tanah Datar Regency. Analysis of Media Validation Results, The verification results of all aspects of the assessment are presented in table form to assess the validity of the media. The procedure for determining

the level of validity involves two main steps: first, identifying the highest possible score on the verification form, and second, calculating the validity score assigned by the evaluator. Analysis of Media Practicality Results, The practicality results of all aspects of the assessment are presented in the media practicality assessment table. The process for determining the level of practicality involves several steps. Effectiveness Data Analysis, To analyze the effectiveness of interactive multimedia assisted by Macromedia Flash 8 Learning Game Model In its application, researchers examined the results of learning outcomes tests. Assessment is focused on students' understanding of concepts which is calculated based on the classical completeness achieved by students.

### 3. RESULTS AND DISCUSSION

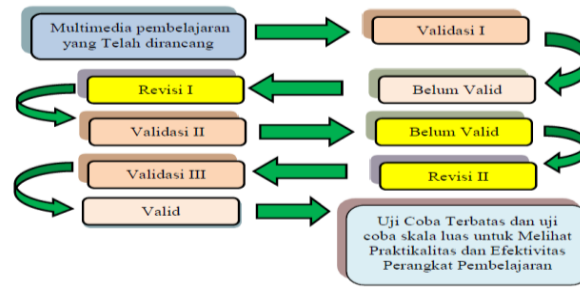
#### Result

To produce interactive multimedia assisted by Macromedia Flash 8 Instructional Games model, flow chart And storyboard first made. The flowchart is useful for showing the flow of the program that will be created at that time storyboard contains the information that will be displayed on the screen. The results of the design stage are making flowcharts. Flowchart help show the development of the program to be made and each part has a certain relationship. A flow chart interactive multimedia assisted by Macromedia Flash 8 Instructional Games presented in [Figure 2](#).



**Figure 2.** Interactive Multimedia Flowchart Assisted by the Macromedia Flash 8 Application, Learning Game Model

During this development stage, interactive multimedia products undergo verification. Experts conduct validity tests to evaluate multimedia, provide feedback which is then used for modifications. Flow of the interactive multimedia development process assisted by the Macromedia Flash 8 Instructional Games model presented in [Figure 3](#). Media experts carry out validation by focusing on the appropriateness of the media, its design and layout, and its ease of use. These experts assess interactive multimedia to ensure it meets these criteria. The Score Display of Media Expert Validation Results. Based on validation carried out by media experts, an average score of 80% was obtained. Scores in the range of 75% to 84% are considered valid. The following is an outline of the revisions made. The results of revisions from media expert suggestions and comments are presented in [Figure 4](#). Validation carried out by material experts is presented in the form of interactive multimedia. In material validation, there are two things that are validated. Based on the results of the RPP validation carried out by material experts, an average score of 85% was obtained. Therefore, the RPP created is declared very valid.



**Figure 3.** Flow of the Interactive Multimedia Development Process Assisted by the Macromedia Flash 8 Instructional Games Model



**Figure 4.** Revision Results of Media Expert Suggestions and Comments

The results of the validation of the material presented in interactive multimedia assisted by the Macromedia Flash 8 Instructional Games model obtained an average value of 88% with a very valid category and can be tested after minor revisions. Language validity data was obtained from elementary school teacher education experts and also postgraduate program lecturers. The language validation results are presented in [Table 1](#).

**Table 1.** Linguist Expert Validation Results

No	Validator	Number of Assessment Results
1	A linguist validator	23
	Average Validity Percentage Figure	77%
	Category	Legitimate

The interactive multimedia created uses good and correct language rules, the language used is easy to understand and the writing is easy to read and interesting so that the interactive multimedia developed can be tested in the field. At the practicality test stage for teachers, the process carried out was to ask teachers to fill out a practicality questionnaire regarding the learning multimedia being developed. The results of the teacher practitioner test are presented in [Table 2](#).

**Table 2.** Teacher Practicality Test Results

No	Total Score	Practical Results	Category
1.	64	98	Very Practical
2.	63	97	
3.	59	91	
4.	57	88	
<b>Total Amount</b>	<b>243</b>	<b>374</b>	
<b>Average Practicality</b>	<b>60.75</b>	<b>94</b>	<b>Very practical</b>

To find out the level of practicality of interactive multimedia development assisted by Macromedia Flash 8 Instructional Games application model developed, a practicality test was carried out on students by asking students to fill out a practicality questionnaire on the multimedia being developed. The results of the student practitioner test are presented in Table 3.

**Table 3. Student Practicality Test Results**

Number of participants	Total Score	Practical Results	Category
14	1.226	88	
10	916	92	
12	1.142	95	<b>Very Practical</b>
21	1.925	92	
Total	5.209	367	
<b>Rate-rate</b>	<b>1.302</b>	<b>92</b>	<b>Very Practical</b>

The average results show an increase in students' conceptual understanding. It can be seen that in the pre-test the average result was 48 in the low category, when the post-test was carried out there was an increase with an average of 87 in the very high category, the average N-gain result from the 4 schools was 0.76 with a High category. N-profit results are within that range  $G \geq 0.7$  is declared High.

### Discussions

Based on the design aspect, interactive multimedia is assisted by *Macromedia Flash 8 Instructional Games* the model is valid. This relates to a good multimedia display, easy-to-read font type and size, layout, as well as supporting images, animations, games and videos in accordance with the material being studied (Purnamasari, 2019; Sylvia Lara Syaflin, 2022). This is in accordance with the opinion which states that learning multimedia which is presented attractively and supported by clear and attractive navigation buttons is declared suitable and effective for use by students. Based on the feasibility aspect of the content or assisted interactive multimedia material *Macromedia Flash 8 Instructional Games* the model is very valid. This means that this learning multimedia has fulfilled the KI, KD, instructions and learning objectives that are appropriate to the student's level of ability, and can increase student understanding (Krisma & Setyadi, 2022; Simarmata, 2018). This is in accordance with what states that one of the aspects that must be considered in determining the type of learning is that the media used is encouraging or informative (Hamidah & Nazurty, 2020; Harahap, 2019; Iflakhah, 2017). Based on linguistic aspects, interactive multimedia is assisted by *Macromedia Flash 8 Instructional Games* the model is valid. The validity of learning media is characterized by sentence structures that comply with good and correct Indonesian language rules, clear data and directions, and the ease with which students understand the language used. This is in accordance with the affirmation. Good teaching materials should be prepared by teachers according to students' needs and characteristics (Manongga et al., 2009; Sepriyanti et al., 2024).

The practicality of this multimedia is seen in terms of convenience and effectiveness of learning time. This shows that this multimedia is simple and does not require extraordinary abilities to use it (Sunarno, 2019; Wahyono, 2019; Wahyugi & Fatmariza, 2020). This multimedia is also equipped with usage guidelines so that teachers and students know the methods that must be taken in learning. This is in accordance with the assessment. A learning media is said to be practical if the learning media can be used effectively by educators and

students in the learning system (Kusmiarti & Hamzah, 2018; Mardhatillah & Trisdania, 2021). That the use of interactive multimedia is aided by *Macromedia Flash 8 Instructional Games*. The application model developed has an effect on improving students' concepts. This can be seen from the results carried out through *initial test* And *post test* (Hafizah, 2020; Ilmiah et al., 2013; Sudihartinih et al., 2021). From *initial test results*, Student learning outcomes received a poor rating, then there was an increase afterwards *post test of* Student learning outcomes received very high predicate. This is because The learning multimedia developed presents problems related to subject matter that must be mastered concretely and thoroughly (Plomp & Nieveen, 2018; Qistina et al., 2019; Sunarno, 2019).

Research on this has several important implications. First, the use of the interactive Macromedia Flash 8 application in the form of instructional games can increase student involvement in the learning process. The visual and dynamic nature of this application allows students to understand abstract concepts in science, such as physics, biology, or chemistry, more easily. Second, the instructional games model facilitates more enjoyable and meaningful learning, which in the end can increase students' learning motivation. Thus, the integration of this technology has the potential to help students build a deeper understanding of the material being taught. In addition, the implementation of game-based learning allows teachers to measure the development of students' understanding through interactions and completing tasks in the game. Another implication is the need for training for teachers in using this technology effectively, so that they can design and implement learning strategies that suit students' needs and abilities.

This study has several limitations that need to be noted. First, limitations in terms of technology, where not all schools or students have access to adequate computer equipment or supporting technology to operate the Macromedia Flash 8 application. This can limit the widespread implementation of learning, especially in areas that have limited technological infrastructure. Second, game-based learning models may not be suitable for all types of students. Students with a more kinesthetic or auditory learning style may not get the most benefit from this approach. Additionally, although instructional games can increase motivation, some students may view them as entertainment rather than serious learning tools, thereby reducing focus on deeper understanding of concepts. Based on these limitations, several recommendations can be proposed. First, efforts are needed to increase access to technology in schools, for example through equipment subsidy programs or training for teachers in using technology effectively. Second, so that the instructional games model can be more inclusive, its development needs to consider variations in student learning styles, by adding elements that involve more physical and auditory interaction. Third, there needs to be better control over the use of games as a learning tool, for example by integrating game-based assessments that are structured and oriented towards understanding concepts, not just entertainment. Another recommendation is to provide intensive training for teachers to integrate this technology into learning so that its use is more effective and targeted.

#### 4. CONCLUSION

The conclusion of this research is that interactive multimedia supported by the Macromedia Flash 8 application using the Instructional Games model for science education is valid and suitable for use in the classroom. The results of the teacher and student practicality questionnaire show that this multimedia tool meets the criteria of being very practical. In addition, its implementation has proven effective in improving students' conceptual understanding, thanks to engaging videos, images and animations that captivate and motivate students to learn.

## 5. REFERENCES

- Anwar, H., Damris, & Yelianti, U. (2017). *Development Of Biology Multimedia On Human Digestive System Material Based On Macromedia Flash For Class Viii Junior High School Students* (Vol. 6, Issue 1, Pp. 43–49). <https://doi.org/10.21154/insecta.v5i1.8852>.
- Batubara, M. H., Mesran, Sihite, A. H., & Saputra, I. (2017). Aplikasi Pembelajaran Teknik Mesin Otomotif Kendaraan Ringan Dengan Metode Computer Assisted Instruction ( Studi Kasus : Smk Swasta Karya Pendidik ). *Informasi Dan Teknologi Ilmiah (Inti)*, 12material(2), 266–270. <https://doi.org/10.21154/insecta.v5i1.8848>.
- Firmadani, F. (2020). Technology-Based Learning Media As A Learning Innovation In The Era Of The Industrial Revolution 4.0. *Proceedings Of The National Education Conference*, 2(1), 93–97. <https://doi.org/10.21154/insecta.v5i1.8851>.
- Fitria, Y. (2017). The Effectiveness Of Achieving Student Learning Competencies In Science Learning In Elementary Schools. *Journal Of Innovation In Elementary School Education And Learning*, 1(2), 96. <https://doi.org/10.21154/insecta.v5i1.8856>.
- Fitria, Y., & Idriyeni, I. (2020). Development Of Problem-Based Teaching Materials For The Fifth Graders Of Primary School. *Ta'dib*, 20(2), 99. <https://doi.org/10.31958/Jt.V20i2.747>. <https://doi.org/10.21154/insecta.v5i1.8941>.
- Hafizah, S. (2020). Penggunaan Dan Pengembangan Video Dalam Pembelajaran Fisika. *Jurnal Pendidikan Fisika*, 8(2), 225. <https://doi.org/10.24127/Jpf.V8i2.2656>.
- Hamidah, A., & Nazurty. (2020). *Development Of Science-Based Learning Multimedia Using Adobe Flash Professional Cs6 For Elementary Students* (Vol. 6, Issue I, Pp. 118–135). <https://doi.org/10.21154/insecta.v5i1.8856>.
- Harahap, N. J. (2019). Students And The Industrial Revolution 4.0. *Ecobisma (Journal Of Economics, Business And Management)*, 6(1), 70–78. <https://doi.org/10.21154/insecta.v5i1.8404>.
- Iflakhah. (2017). The Effect Of Using Interactive Multimedia Based On Macromedia Flash 8 And Research Motivation On Ips Research Presentation (Research On Class Vii Students Of Mts Negeri Bangil Kab. Pasuruan, 11(2), 200–212. <https://doi.org/10.21154/insecta.v5i1.8689>.
- Ilmiah, A., Pembelajaran, P. M., Laju, M., Dengan, R., & Nabila, I. (2013). *Movie Berbasis Macromedia Flash 8*. 2(2), 98. <https://doi.org/10.21154/insecta.v5i1.8689>.
- Krisma, W. W., & Setyadi, D. (2022). Pengembangan Media Pembelajaran Matematika Berbasis Macromedia Flash Materi Luas Dan Keliling Untuk Meningkatkan Motivasi Belajar Siswa Development Of Macromedia Flash-Based Mathematics Learning Media For Area And Circumference Material To Increase Studen. *Scholaria: Jurnal Pendidikan Dan Kebudayaan*, 10(1), 73–84. <https://doi.org/10.21154/insecta.v5i1.8518>.
- Kusmiarti, R., & Hamzah, S. (2018). Literacy In Indonesian Language Learning In The Industrial Age 4.0. *National Seminar On Language And Literature Education*, 1(1), 211–222. <https://doi.org/10.21154/insecta.v5i1.8270>.
- Manongga, D., Tambotoh, J. J. C., & Bawu, J. N. (2009). Perancangan Modul Pembelajaran Berbasis Interactive Multimedia Learning. *Jurnal Teknologi Informasi-Aiti*, 6(1), 1–100. <https://doi.org/10.21154/insecta.v5i1.8616>.
- Mardhatillah, & Trisdania, E. (2021). Development Of Macromedia Flash Based Learning Media To Improve Ability. *Bina Gogik: Scientific Journal Of Elementary School Teacher Education*, 5(1), 91–102. DOI: <https://doi.org/10.3991/ijim.v14i19.16795>.
- Mukti, I. N. C., & Nurcahyo, H. (2017). Pengembangan Media Pembelajaran Biologi Berbantuan Komputer Untuk Meningkatkan Hasil Belajar Peserta Didik. *Jurnal Inovasi Pendidikan Ipa*, 3(2), 137. <https://doi.org/10.21831/Jipi.V3i2.7644>.



- Plomp, & Nieveen. (2018). Educational Design Research. *Enchede. Institute For Curriculum Development*, 6(6), 49. <http://ejournal.upi.edu/index.php/jpgsd/index>.
- Purnamasari, N. L. (2019). Metode Addie Pada Pengembangan Media Interaktif Adobe Flash Pada Mata Pelajaran Tik. *Jurnal Pendidikan Dan Pembelajaran Anak Sekolah Dasar*, 5(1), 23–30. <https://Jurnal.Stkipppgritulungagung.Ac.Id/Index.Php/Pena-Sd/Article/View/1530>.
- Qistina, M., Alpusari, M., Noviana, E., & Hermita, N. (2019). Development Of Interactive Multimedia For Science Subjects Ivc Class Sd Negeri 034 Taraibangun Kampar Regency. *Primary: Journal Of Elementary School Teacher Education*, 8(2), 148. <https://Doi.Org/10.33578/Jpkip.V8i2.7649>.
- Rozie, F., & Siswoyo, A. A. (2020). Pegebanan Media Pembelajaran Ipa Interaktif Tata Surya Di Sdn Banyuajuh. *Jurnal Ilmiah Rekayasa*, 8(2), 129–136. | Journal homepage : <https://jurnal.iainponorogo.ac.id/index.php/insecta>.
- Sepriyanti, I., Husna, H., & Yanti, I. R. (2024). Pengembangan Media Macromedia Flash Berbasis Model Kontekstual Pada Pembelajaran Fisika Di Sma Negeri 1 Bukit Sundi. *Diffraction*, 5(2), 80–90. <https://Doi.Org/10.37058/Diffraction.V5i2.8614>.
- Siboro, A., Sianturi, T. A., Ndruru, S., & Sitompul, D. (2020). Pengembangan Media Pembelajaran Interaktif Pada Mata Pembelajaran Fisika Siswa Kelas Ix Mtsn 3 Medan. *Jurnal Penelitian Fisikawan*, 3, 34. <http://www.stmik-budidarma.ac.id/>.
- Simangunsong, T., & . M. (2015). Pengembangan Media Pembelajaran Berbasis Multimedia Pada Mata Pelajaran Ipa Di Smp. *Jurnal Teknologi Informasi & Komunikasi Dalam Pendidikan*, 2(1), 50–58. <https://Doi.Org/10.24114/Jtikp.V2i1.3288>.
- Simarmata, J. (2018). *Aplikasi Pembelajaran Mata Pelajaran Fisika Tingkat Sekolah*. 2(2), 87. <http://dx.doi.org/10.37058/diffraction>.
- Sudihartinih, E., Novita, G., & Rachmatin, D. (2021). Desain Media Pembelajaran Matematika Topik Luas Daerah Segitiga Menggunakan Aplikasi Scratch. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, 5(2), 1390–1398. <https://Www.J-Cup.Org/Index.Php/Cendekia/Article/View/643>.
- Sunarno, W. (2019). The Role Of Science Educators And Scientists In Welcoming The Industrial Revolution 4.0. *E-Journal Unipma*, 1(2), 1–8. <http://dx.doi.org/10.37058/diffraction>.
- Sylvia Lara Syaflin. (2022). Pengembangan Multimedia Interaktif Berbasis Macromedia Flash Pada Materi Ipa Sekolah Dasar. *Jurnal Cakrawala Pendas*, 8(4), 1516–1525. <https://Doi.Org/10.31949/Jcp.V8i4.3003>.
- Wahyono, H. (2019). Utilization Of Information Technology In The Assessment Of Learning Outcomes In The Millennial Generation In The Era Of The Industrial Revolution 4. 0. *Proceeding Of Biology Education*, 3(1), 192–201. DOI : [10.37058/diffraction.v6i1.6380](https://doi.org/10.37058/diffraction.v6i1.6380).
- Wahyugi, R., & Fatmariza. (2020). *Development Of Interactive Multimedia Using Macromedia Flash 8 Software As An Effort To Increase Learning Motivation Of Elementary School Students* (Vol. 3, Issue 3, Pp. 785–793). DOI : [10.37058/diffraction.v6i1.8582](https://doi.org/10.37058/diffraction.v6i1.8582).