Development of Augmented Reality as a Learning Media on Informatics Learning Hardware Material in SMP

Vani Aprianto*1, Munir², Rani Megasari³ ¹Universitas Pendidikan Indonesia, Indonesia ^{2,3}Pendidikan Ilmu Komputer, Universitas Pendidikan Indonesia E-mail: *¹vaniaprianto@upi.edu, ²munir@upi.edu, ³megasari@upi.edu

Abstract

This study was motivated by the researcher's concern about the difficulty of informatics subjects at the junior high school level. Moreover, when examined, hardware material is a challenge for teachers and students in carrying out learning in the classroom. In some places, student motivation and learning outcomes in understanding hardware material tend to be low. The purpose of this study is to develop Augmented Reality learning media on learning informatics hardware material in class VII junior high school. The research method used is Research and Development (R&D) which uses the Brog & Gall research model with 10 models, then simplified into 3 major steps which will be implemented in the development procedure process by adopting the results of Sukmadinata's R&D model simplification. Testing the feasibility of development, it was tested with the results of a media expert assessment of 81.25% very feasible criteria. While the material expert assessment with a score of 81.82% is very feasible. The results of the implementation of student respondents on a limited scale were 76.42% of the interesting category and a wide scale of 84.11% of the very interesting category. So it can be concluded through the results of expert validation, limited scale trials and wide scale trials, that augmented reality as learning media is feasible to use as a learning tool during the learning process. Keywords: Augmented Reality, Hardware, Learning Media

Submission: 4 August 2024	Accepted: 11 August 2024	Published: 31 January 2025
---------------------------	--------------------------	----------------------------

1. INTRODUCTION

Technological developments have penetrated the world of education, and to face global competition in the 21st century, tools and human resources/teachers that meet the standards are needed to create good and quality education. Teachers are the spearhead in carrying out the mission of education in the field and play a very crucial role in creating a quality and efficient education system. The 21st century is popular with bringing changes, namely the rapid development of Science and Technology (IPTEK) which resulted in a change in the learning paradigm characterised by changes in curriculum, media, and technology (Rahayu et al., 2022). Therefore, Indonesia needs to increase its sensitivity in designing a strategic educational framework to compete globally in the 21st century. The use of teaching media or learning media has benefits in increasing and directing children's attention so that it can motivate them to learn better.

The presence of Information and Communication Technology (ICT) in learning is a challenge for the world of education, especially learning technology today. Various computer devices and their connections can deliver participants to learn quickly and accurately if utilised correctly and appropriately. The role of ICT in education today requires a new breakthrough, both in terms of school management and in the learning process carried out by teachers. Technology is very useful if in the process of development as it is today, developments in the world of education can keep pace with technological developments. If education makes effective use of technological developments, it is possible that education in Indonesia will be much better. One example of how technological developments are applied to education is the learning process with the use of technological devices by teachers. ICT includes everything related to the process, use as a tool, manipulation, and management of information with the use of tools to process and transfer data from one device to another (Ardiana, 2023).

School efforts in improving the quality of education through the use of technology include providing ICT facilities, tools and devices. The results of technological advances in education can be seen in various digital learning media and of course have transformed the

Volume 19 Nomor 1 Januari 2025

traditional era into the digital era (Purnasari & Sadewo, 2020). So it can be understood that current technological advances provide space for teachers to be more innovative and creative in delivering learning to students. The introduction of technology to students has explicitly started at the junior high school level. This is illustrated through the Informatics subject in class VII, by learning Informatics there are many benefits obtained, such as making it easier for students to get to know the internet and use it to communicate with friends, family, and distant relatives. Informatics is a field of science regarding the study, design, and manufacture of computing systems, as well as the principles on which the design is based. It is hoped that students can understand the concepts and implementation of informatics better and more meaningfully.

Informatics is one of the subjects that is classified as difficult, especially when examined hardware material (Hardware) is a challenge for teachers and students in carrying out learning in the classroom, because the material is not enough with learning in the classroom and only explaining about understanding, functions, types and so on. However, it allows students to understand the concept of hardware better and not just memorise the theory, it is certainly necessary to see the real form of the physical components of the computer and how it works, even though the computer lab facilities at school are inadequate. So it must provide an ideal environment for students to observe hardware components directly. In many places, student outcomes motivation and learning in understanding hardware material tend to be low.

Based on interviews conducted by researchers with informatics subject teachers, it was found that hardware material is one of the materials that is classified as difficult. In fact, if examined, hardware is the basic material before discussing other more complex materials (such as computer network and internet material, software and other materials). Students' motivation and learning outcomes for the material in question are below the set completeness criteria. In addition to low learning outcomes, the subject teacher also said that students' learning motivation was also low, this can be seen from the learning process that not all students are enthusiastic and involved in solving the problem.

p-ISSN :1858-3911, *e-ISSN : 2614-5405* https://journal.fkom.uniku.ac.id/ilkom

2. RESECH METHODS

The research and development (R&D) method is a research method used to create a certain product, and test the effectiveness of the product. The products created will be adjusted to the needs of the problems in the field.

There are ten general steps of the Research and Development approach which is the main formula of R&D including: (1) gathering information and conducting preliminary research (research and information collecting); (2) planning; (3) developing preliminary form of product; (4) preliminary field testing; (5) revising the test based on the results of the preliminary trial (main product revision); (6) conducting the main field test; (7) making revisions after getting feedback from the main field test (operational product revision); (8) conducting the operational field test; (9) making the final product revision, and (10) submitting a research report (dissemination and implementation). Gall et al, 2007).

In the context of this research, the process of implementing learning media in the classroom based on the principles of Borg and Gall was not fully implemented considering the constraints faced by researchers such as the narrow research time, the number of schools and the number of school samples that have implemented the independent curriculum are still limited, so coordination with the schools where the research is quite constrained. The implementation of this research and development, there are some simplifications in determining the number of schools as limited and broad tests, as well as validity tests. The simplification of the R&D approach is also carried out into two stages including the preliminary study stage and the learning media development stage. The two major steps are expected to represent the major stages developed by Borg & Gall (2007) as depicted in the following chart:



Figure 1 R&D Research Procedure

Volume 19 Nomor 1 Januari 2025

In this research method, in order to produce a product, it uses needs analysis research and to test the feasibility of the product so that it can function for the wider community, research is needed to test the effectiveness of the product. Based on this understanding, researchers develop products in the form of augmented reality as a learning medium for hardware material in informatics learning in class VII SMP. The implementation this of research and development, there are some simplifications in determining the number of schools as a limited and broad test site. In this study, two data collection techniques were used, namely interviews and questionnaires. Interviews were conducted related to preliminary studies before the development of learning media. The questionnaire sheet used in the data collection process is a questionnaire for media experts, material experts and a questionnaire for student responses on a limited scale and broad scale test, to test the feasibility of the learning media that has been developed.

Interviews were conducted before the research and development process, the implementation of interviews was carried out with teachers of Informatics Class VII SMP, which sought information related to general problems that occur in schools, especially for students in class VII Informatics subjects.

The technique of analysing questionnaire data is quantitative data, evaluating the validator questionnaire data, namely media experts and material experts, as well as student questionnaires collected and processed. Survey data received by validators aims to test the feasibility of augmented reality as a learning media developed. The questionnaire sheet used was filled out by two media expert lecturers, two material expert lecturers.

On the instrument of media experts, material experts and student questionnaires with Augmented Reality as learning media using alternative answers, Strongly Agree (SS), Agree (S), Undecided (RR), Disagree (KS), and Disagree (TS). The instrument statement items with instrument scoring criteria are as follows.

Table 1 Scoring Criteria for Media Expert, Material Expert and Student Response Instruments

Scoring Pattern				
SS	S	RR	KS	TS
5	4	3	2	1

p-ISSN :1858-3911, *e-ISSN : 2614-5405* https://journal.fkom.uniku.ac.id/ilkom

Assessment of the interpretation of the feasibility of Augmented Reality as a learning medium is the result of the value generated by using the % index formula:

Index Formula % =
$$\frac{Total Score}{Y} \times 100$$

After knowing the results of the feasibility percentage calculation, it is then interpreted according to the following table.

Table 2 Interpretation Criteria for Media Expert and Material Expert Scores

Percentage	Interpretation
0% - 20%	Not feasible
21% - 40%	Less worthy
41% - 60%	Enough
61% - 80%	Feasible
81% - 100%	Very Decent

As for the criteria for interpreting student respondent scores, namely :

Table	3	Interpretation	Criteria	for	Student
Questi	onn	aire Scores			

Percentage	Interpretation
0% - 20%	Very uninteresting
21% - 40%	Less Interesting
41% - 60%	Fair
61% - 80%	Interesting
81% - 100%	Very Interesting

The validation results are used as input and to revise the learning media and learning materials developed. The product validation instrument questionnaire is used to determine the quality of the product developed. While success in learning is determined using survey data from students.

3. RESEARCH RESULTS

At this stage the author discusses the results of development research, namely regarding the presentation of data from the trial results, data analysis of the products that have been developed, namely the development of augmented reality as a learning medium for hardware material in informatics learning.

3.1 Preliminary Study

3.1.1 Literature Study

By studying previous literature, researchers can understand concepts, theories, and findings that are relevant to their research topics. The results found several problems such

Volume 19 Nomor 1 Januari 2025

as in learning media such as the lack of availability of adequate learning media, lack of teacher skills in using learning media effectively, and lack of utilisation of interesting and interactive learning media, these are factors that affect learning motivation and learning outcomes that are less than optimal. So that these efforts are made by researchers to develop learning which can increase motivation and learning outcomes. 3.1.2 Survey Study

Preliminary studies were carried out surveys in class VII SMP Negeri 1 Nusaherang, especially in Informatics, which is one of the subjects that is classified as difficult, especially if hardware material is examined, which is a challenge for teachers and students in carrying out learning in the classroom. In many places, student motivation and learning outcomes in understanding hardware material tend to be low. This problem was obtained from observations and interviews with subject teachers. From the results of the preliminary study, an overview of the learning conditions in the school was obtained.

- 3.2 Development Study
- 3.2.1 Product Design Plan

Based on the results of the preliminary study, the next step is to design and design learning media products. At this stage researchers also prepare instruments for product trials. In Figure 1, researchers provide an example of the initial product design. The process of making products is by using Vuforia, according to (Fernando, 2013) Vuforia is software for Augmented Reality developed by Qualcomm which uses a consistent source of computer vision that focuses on image recognition. Vuforia has many features and capabilities that can help developers to realise their thoughts without any technical limits. Besides this, it also uses Blender 3D to create 3D images, according to (Akbar, Syahrul, 2019) Blender is a 3D content creator program that is open source, which is free to be developed by its users and can be redistributed legally. And the most important thing is with the help of the Unity 3D application, according to (Sari et al., 2014) Unity 3D is an integrated tool for threedimensional objects in video games or for other interactive contexts such as architectural visualisation or real-time 3D animation. Not only using the application above, because to be able to work Augmented Reality is required to have a partner called Marker, in his research (Nazilah & Ramdhan, 2021) according to Mustaqim (2016) Marker is usually a black and white square illustration with thick black borders and a white

p-ISSN :1858-3911 , e-ISSN : 2614-5405 https://journal.fkom.uniku.ac.id/ilkom

background. The computer will recognise the position and orientation of the marker and create a 3D virtual world, namely the point (0,0,0) and 3 axes, namely X,Y, and Z. The following are the results of the products that have been developed, and need to be tested first before being used in the learning process.





В



Figure 2 Example of Initial Product Design Augmented Reality as a learning medium (Source: Researcher Documentation, 2024)

3.2.2 Augmented Reality Design as Learning Media

At the Expert Judgment stage in the form of validation of learning media by media experts and material experts with the aim of knowing and ensuring that the media designed has content that is in accordance with the material and learning objectives. After the learning media validation stage, the next stage is the stage to trial the learning media. Before the trial is carried out, this learning media has gone through the revision stage first based on input from media experts and material experts.

The results of the feasibility of augmented reality as a learning media obtained from the validation results of media experts and material experts using a Likert scale for quantitative data analysis techniques.

1) Media Expert Test Analysis

The assessment is carried out by filling in the expert assessment by giving an assessment

Volume 19 Nomor 1 Januari 2025

ranging from very feasible to very unfit, and providing suggestions for improvement.

At this stage of the analysis there are shortcomings that must be revised and suggestions for improvement from media experts, among others:

- a) Augmented Reality display for the CPU casing does not need to be displayed, because it is only in the form of a casing
- b) Images of hardware components Augmented Reality display should be clearer
- c) CPU buttons do not need to be displayed because there is already a Processor
- d) Hardware description so it's not just a video
- e) Add a little editorial explanation of the application

Suggestions for improvement from the media experts given have been done and fixed. The complete assessment results can be seen in the attachment page, the validation results from media experts can be seen in table 1 below:

Table 4 Media Feasibility Test Analysis Results

No	Assessment Aspects	Percentages	Catigories
1	Navigation	80.00%	Worthy
2	Convenience	81.67%	Very Worth It
3	Writing	80.00%	Worthy
4	Display	83.33%	Very Worth It
Average total percentage		81.25 %	Very Worth It

Judging from the table above, the navigation aspect obtained the assessment results with an average value of 80.00% there is a decent category, from the convenience aspect obtained the assessment results with an average value of 81.67% there is a very decent category, from the writing aspect obtained the assessment results with an average value of 80.00% there is a decent category and from the display aspect obtained the assessment results with an average value of 83.33% there is a very very decent category. From all aspects there is an average percentage of 81.25% with a very feasible category.

2) Material Expert Test Analysis

The assessment is carried out by filling in the expert assessment by giving an assessment ranging from very feasible to very unfeasible, and providing suggestions for improvement.

At this stage of the analysis there are shortcomings that must be revised and suggestions for improvement from the material expert with improvements in the content of the video explanation of hardware material

p-ISSN :1858-3911, *e-ISSN : 2614-5405* https://journal.fkom.uniku.ac.id/ilkom

suggested for explanation using a mixture of animation. Suggestions for improvement from material experts have been made and improved. The complete assessment results can be seen in the attachment page, the validation results from the material expert can be seen in table 2 below.

Tabel 5	Hasil A	nalisis I	Uii	Kelay	/akan	Materi
			~			

		<u> </u>	
No	Assessment Aspects	Percentages	Catigories
1	Content Eligibility	80.00%	Worthy
2	Use of	83.64%	Very Worth It
A	verage total	81.82%	Very Worth It
2 Av P	Language verage total percentage	83.64% 81.82%	Worth It Very Worth It

Judging from the table and diagram above, the aspect of content feasibility obtained the results of the assessment with an average value of 80.00% is very feasible category, from the aspect of language use obtained the results of the assessment with an average value of 83.64% is very feasible category. From all aspects there is an average percentage of 81.82% with a very feasible category.

3.2.1 Limited Scale Test

At this stage after validation by media experts and material experts and carried out after revising the product of expert test results both in terms of content, design and media, then the media was tested on a small group of 26 students in class VII A SMP Negeri 2 Kadugede on 31 May 2024. This small group trial was used to determine the feasibility of learning media developed and small group trial data obtained by giving a questionnaire instrument so that students were asked to fill out a questionnaire that had been provided to determine the weaknesses and student responses to the feasibility of augmented reality as a learning medium, the feasibility test was carried out using a Likert scale with a data range of 1 to 5. Student responses from each aspect obtained the following results:

Table 6 Processing Results of Limited Trial Student Respondents with Answers to Each Indicator

No	Indicator	Percentage	Category
1	Use	77.08%	Interesting
2	Attitude Direction	74.92%	Interesting
3	Convenience	76.46%	Interesting
4	Benefit	77.23%	Interesting
A	verage total percentage	76.42%	Interesting

Volume 19 Nomor 1 Januari 2025

From the results of the questionnaire analysis in Table 3, it can be seen that there are four indicators from the student response questionnaire in the limited trial with augmented reality as a learning media. The usage indicator obtained 77.08%, the attitude direction indicator obtained 74.92%, the convenience indicator obtained 76.46% and the benefit indicator obtained 77.23%. And the total average percentage of the four indicators is 76.42%, which means that the limited trial with Augmented Reality as a learning medium gets the Interesting category.

3.2.1 Broad Scale Test

In the next stage after a limited test is carried out then also carried out on a broad trial. namely the final stage trial of augmented reality products as learning media until it becomes media that is feasible to use. Field trials were conducted after material expert validation, media expert validation, and limited trials. This test was conducted in two classes of SMP Negeri 1 Kadugede, where the VII G class numbered 34 respondents carried out on 01 June 2024 and VII J numbered 32 respondents carried out on 03 June 2024. This broad group trial was used to determine the feasibility of the learning media developed and the broad group trial data was obtained by giving a questionnaire instrument so that students were asked to fill out the questionnaire that had been provided to determine the weaknesses and student responses to the feasibility of augmented reality as a learning medium, the feasibility test was carried out using a Likert scale with a data range of 1 to 5. Student responses from each aspect obtained the following results:

Table 7 Results of Processing of Student Respondents in Extensive Trials With Answers to Each Indicator

No	Indicator	Percentage	Category
1	Use	85 330/	Very
1	Use	85.5570	interesting
2	Attitude	82 3004	Very
2	Direction	82.30%	interesting
3	Convenience	8/1 70%	Very
5	Convenience	84.79%	interesting
4	Bonofit	84 00%	Very
4	Delletit	04.00%	interesting
Average total percentage		8/110/	Very
		04.11%	interesting

From the results of the questionnaire analysis in table 4, it can be seen that there are four indicators from the student response

Terakreditasi SINTA 5

p-ISSN :1858-3911, *e-ISSN : 2614-5405* https://journal.fkom.uniku.ac.id/ilkom

questionnaire on a wide trial with augmented reality as a learning media. The usage indicator obtained 85.33%, the attitude direction indicator obtained 82.30%, the convenience indicator obtained 84.79% and the benefit indicator obtained 84.00%. And the total average percentage of the four indicators is 84.11%, which means that the broad trial with Augmented Reality as a learning media obtained a Very Interesting category.

3.2.1 Final Product

In the final stage of product development, researchers make final revisions. The final product is then used in learning in the experimental class.



Figure 3 Example of Final Product Design Content Augmented Reality as a learning medium (Source: Researcher Documentation, 2024)

4. DISCUSSION

In the development results above that the learning media can be used in learning for Informatics subjects with Hardware / hardware material in class VII SMP because it has gone through a validation process from media experts and material experts. In addition, student responses to the use of this media in learning are very positive, thus this learning media makes an effective and efficient learning tool innovation so

Volume 19 Nomor 1 Januari 2025

that it can help teachers or students learn optimally and a new breakthrough where the rapid world of technology such as the use of Augmented Reality can be used in the field of education.

5. CONCLUSION

Based on the results of research that has been carried out with the R&D research method and using the principles of Borg and Gall, it can be concluded that augmented reality as a learning media with Hardware material has been developed and can be used. This, looking at the results of validation by media experts on the products developed including indicators of navigation. convenience, writing, display produces an average of 81.25% with a very feasible category. While the results of validation by material experts include indicators of content feasibility and language use resulting in an average of 81.82% with a very feasible category. Furthermore, it was also carried out on a limited scale test of 26 students by producing an average of 76.42% of each respondent in the interesting category, in the limited scale test it was felt that it was not optimal and then the researchers retested it on a wide scale test of 66 students by producing an average of 84.11% of each respondent in the very interesting category. So it can be concluded through the results of expert validation, small-scale trials and large-scale trials, that augmented reality as learning media can be used as a learning tool during the learning process. Thus, the input that researchers can convey based on the results of the study is augmented reality as a learning media can be used as a learning media innovation that can be developed on other subject matter.

6. SUGGESTION

Considering that the results of product development can provide benefits for learning, it is recommended for teachers to develop this product with a wider scope or in other materials, even in other subjects so that they can utilize technology as an effective material that can be used in the learning process. So it is necessary to carry out further development of Augmented Reality-based learning media to improve the quality of learning.

REFERENCES

 Akbar, Syahrul, M. N. M. (2019). Pengembangan Media Pembelajaran Berbasis Blender 3d Pada Mata

p-ISSN :1858-3911, *e-ISSN : 2614-5405* https://journal.fkom.uniku.ac.id/ilkom

Pelajaran Instalasi Motor Listrik di Sekolah Menengah Kejuruan (SMK). *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699.

- [2]. Ardiana, R. (2023). Implementasi Media Berbasis TIK untuk Pembelajaran Usia Dini. Anak Murhum: Jurnal Pendidikan Anak 103-111. Usia Dini, 4(1), https://doi.org/10.37985/murhum.v4i1. 117
- [3]. Arpan, M., & Sadikin, S. (2020). Media Pembelajaran Interaktif Perangkat Keras Komputer. *INVOTEK: Jurnal Inovasi Vokasional Dan Teknologi*, 20(2), 43–50. https://doi.org/10.24036/invotek.v20i2. 741
- [4]. D. Gall, M., P. Gall, J., & Walter R, B. (2007). *Educational Resech : An Introduction. The Eight Edition.* Pearson Education.
- [5]. Daryanes, F., Darmadi, D., Fikri, K., Sayuti, I., Rusandi, M. A., & Situmorang, D. D. B. (2023). The development of articulate storyline interactive learning media based on case methods to train student's problem-solving ability. *Heliyon*, 9(4), e15082. https://doi.org/10.1016/j.heliyon.2023.

e15082

- [6]. Fernando, M. (2013). Membuat Aplikasi Android Augmented Reality Menggunakan Vufuria SDK dan Unity. Buku AR Online.
- [7]. Firdanu, R., Achmadi, S., & Adi Wibowo, S. (2020). Pemanfaatan Augmented Reality sebagai Media Pembelajaran mengenai Peralatan Konstruksi dalam Dunia Pendidikan Berbasis Android. JATI (Jurnal Mahasiswa Teknik Informatika), 4(2), 276–282.

https://doi.org/10.36040/jati.v4i2.2657

[8]. Hadju, S. Y., Novian, D., Arafat, M. Y., & Dwinanto, A. (2024). Pengembangan Media Pembelajaran Berbasis Augmented Reality Pada Mata Pelajaran Informatika. *Inverted: Journal of Information Technology Education*, 4(2), 37–49.

Volume 19 Nomor 1 Januari 2025

https://doi.org/10.37905/inverted.v4i2. 21860

- [9]. Heryani, A., Pebriyanti, N., Rustini, T., & Wahyuningsih, Y. (2022). Peran Media Pembelajaran Berbasis Teknologi Dalam Meningkatkan Literasi Digital Pada Pembelajaran Ips Di Sd Kelas Tinggi. Jurnal Pendidikan, 31(1), 17. https://doi.org/10.32585/jp.v31i1.1977
- [10].Mulianti, S., Susanta, A., Hanifah, H., & Haji, S. (2023). Pengaruh Pendekatan Problem Based Learning (Pbl) Berbantuan Augmented Reality (Ar) Terhadap Kemampuan Pemecahan Masalah Matematika Di Smk Negeri 1 Lebong. Jurnal Lebesgue: Jurnal Ilmiah Pendidikan Matematika. Matematika Dan Statistika, 4(2), 930-939.

https://doi.org/10.46306/lb.v4i2.358

- [11].Nazilah, S., & Ramdhan, F. S. (2021). Augmented Reality Sebagai Media Pembelajaran Untuk Pengenalan Landmark Negara-Negara ASEAN Berbasis Android Dengan Menggunakan Metode Marker Based Tracking. *Ikra-Ith Informatika*, 5(2), 99–107.
- [12].Nelson, S., Darni, R., & Haris, F.
 (2022). Development Augmented Reality (AR) Learning Media for Pencak Silat Course at Faculty of Sports and Science Universitas Negeri Padang. *Educational Administration: Theory and Practice*, 28(1), 37–46. https://doi.org/10.17762/kuey.v28i01.3 22
- [13].Purnasari, P. D., & Sadewo, Y. D.
 (2020). Strategi Pembelajaran Pendidikan Dasar di Perbatasan Pada Era Digital. *Jurnal Basicedu*, 5(5), 3(2), 524–532. https://journal.uii.ac.id/ajie/article/vie

w/971

- [14].Rahayu, R., Iskandar, S., & Abidin, Y.
 (2022). Inovasi Pembelajaran Abad 21
 Dan Penerapannya Di Indonesia. Jurnal Basicedu, 6(2), 2099–2104.
- [15].Sari, O. P. N. K., Crisnapati, P. N., Kesiman, M. W. A., & Sunarya, I. M. G. (2014). Pengembangan aplikasi.

p-ISSN :1858-3911, *e-ISSN : 2614-5405* https://journal.fkom.uniku.ac.id/ilkom

Jurusan Pendidikan Teknik Informatika, 12(2), 123–132.

- [16].Setyawan, B., Rufii, Nf., & Fatirul, A.
 N. (2019). Augmented Reality Dalam Pembelajaran Ipa Bagi Siswa SD. *Kwangsan: Jurnal Teknologi Pendidikan*, 7(1), 78–90. https://doi.org/10.31800/jtp.kw.v7n1.p 78-90
- [17].Sobari, S. (2023). Penerapan Media Pembelajaran Interaktif Berbasis Flash Dalam Upaya Meningkatkan Hasil Belajar Materi Perangkat Keras Komputer Di Kelas 7a SMP Negeri 2 Jampangkulon. Utile: Jurnal Kependidikan, 9(2), 97–103. https://doi.org/10.37150/jut.v9i2.2169
- [18].Widianto, E. (2021). Pemanfaatan Media Pembelajaran Berbasis Teknologi Informasi. Journal of Education and Teaching, 2(2), 213. https://doi.org/10.24014/jete.v2i2.1170 7