

LEARNING MEDIA DEVELOPMENT AR HELPED ASSEMBLR EDU TYPE MERGE CUBE IN GRADE V SCIENCE MATERIAL

PENGEMBANGAN MEDIA PEMBELAJARAN AR BERMANFAAT UNTUK MERAKIT MATERI MATERI IPA TIPE GABUNG KUBUS PADA MATERI IPA KELAS V

Luluk Maysaroh¹, Ahmad Teguh P², Anna Mariyani³

^{1, 2, 3} PGSD, STKIP Muhammadiyah Blora, Blora, Jawa Tengah, Indonesia

E-mail: lulukmaysarohh@gmail.com¹, ahmedteguh82@gmail.com²

annamariyani89@gmail.com³

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Abstrak

Penelitian ini dilatarbelakangi oleh minimnya penggunaan media pembelajaran yang menarik dan menyenangkan, serta belum adanya media pembelajaran AR di SDN 1 Gempolrejo. Penelitian ini bertujuan untuk mengembangkan media pembelajaran berbasis Augmented Reality (AR) menggunakan platform Assemblr Edu berupa Merge Cube, dan menguji kelayakan produk yang dihasilkan. Media yang dikembangkan merupakan materi visual 3D yang dapat diakses melalui QR Code. Subjek penelitian adalah siswa kelas V SDN 1 Gempolrejo yang berjumlah 24 orang. Teknik pengumpulan data meliputi wawancara, angket, dan dokumentasi; Data dianalisis secara kualitatif dan kuantitatif dari 3 validator media, yaitu ahli desain, ahli materi, dan ahli bahasa, serta hasil uji coba siswa kelompok kecil, uji coba kelompok besar, dan dari guru kelas V. Hasil validasi menunjukkan bahwa media sangat layak digunakan, dengan penilaian dari ahli desain sebesar 97%, ahli materi 80%, dan ahli bahasa 94%. Respons siswa menunjukkan minat yang tinggi (91%) dan guru menilai media sangat menarik (94%). Dengan demikian, media ini dinyatakan valid, menarik, dan layak digunakan sebagai referensi pembelajaran sains, khususnya materi bencana alam.

Abstract

This research is motivated by the minimal use of interesting and fun learning media, as well as the absence of AR learning media at SDN 1 Gempolrejo. This study aims to develop Augmented Reality (AR)-based learning media using the Assemblr Edu platform in the form of Merge Cube, and test the feasibility of the resulting product. The media developed is a 3D visual material that can be accessed via QR Code. The research subjects were 24 fifth-grade students of SDN 1 Gempolrejo. Data collection techniques included interviews, questionnaires, and documentation; Data were analyzed qualitatively and quantitatively from 3 media validators, namely design experts, material experts, and language experts, as well as the results of small group student trials, large group trials, and from fifth-grade teachers. The validation results showed that the media was very suitable for use, with an assessment from design experts of 97%, material experts 80%, and language experts 94%. Student responses showed high interest (91%) and teachers rated the media as very interesting (94%). Thus, this media was declared valid, interesting, and suitable for use as a reference for science learning, especially natural disaster material.

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INTRODUCTION

The digital era has changed the way teachers teach and students learn (Ultra Gustati, 2024). Teachers play a central role in developing various teaching methods and achieving learning objectives (RimahDani, Shaleh, & Nurlaeli, 2023). Mahfuz (2021) argues that teachers must be able

to provide a variety of learning resources throughout the process, as well as determine the methods and media to be used to ensure effective and successful teaching and learning activities. Furthermore, Susilo (2020), also argues that educators are encouraged to implement various innovations in the learning process so that teaching and learning activities can take place more effectively, efficiently, and productively, thereby improving the quality of learning. Teachers, as facilitators, are expected to be able to teach learning to achieve learning objectives. As facilitators, teachers should provide facilities that support students' ease in carrying out learning activities (Fauzi & Mustika, 2022). One such support is the teaching materials or media used in the learning process (Wardani, Kusumaningsih, & Kusniati, 2024)

Media is a bridge or means of communication for conveying messages (Suryana & Hijriani, 2021). According to Fadilah etc (Fadilah, Nurzakiah, Kanya, Hidayat, & Setiawan, 2023), learning media is a tool that can be utilized to support the learning process so that it runs more effectively and optimally. Learning media should be made interesting and interactive to support students in understanding the learning (Nadzif, Irhasyurna, & Sauqina, 2022). Students need assistance in the form of concrete objects as media to facilitate understanding of the material presented by the teacher (Mauliddiyah, 2021). Natural and Social Sciences (IPAS) is one of the various subjects that students consider quite difficult. This difficulty is caused by the many abstract concepts and formulas (Citradevi, 2023). In her research, Lilisari (in Sidik & Gerhana, 2023) argues that Natural and Social Sciences (IPAS) is knowledge with abstract concepts and is sometimes difficult for students to directly visualize. In elementary school science lessons, many topics require concrete learning media, one of which is natural disasters. Chapter VIII of "Bumiku Sayang, Bumiku Malang" contains material on natural disasters, which discusses the definition, causes, and impacts of natural disasters. Common natural disasters in Indonesia include earthquakes, volcanic eruptions, hurricanes, floods, and tsunamis. This often leads to misconceptions that can hinder students' understanding of the material.

Based on interviews with fifth-grade homeroom teachers, it was discovered that SDN 1 Gempolrejo has never used and integrated diverse technology in its natural disaster science (IPAS) learning. Science learning is still limited to monotonous print media. Teachers have not utilized diverse technology-based media, resulting in students often feeling bored, having low motivation, and finding abstract concepts difficult to grasp. However, according to Piaget's theory, elementary school students are at the concrete operational stage and therefore require tangible visual media to better understand the material. This situation demonstrates the need for innovative, interactive learning media capable of visualizing abstract concepts. One solution is the use of learning media based on *Augmented Reality (AR)*. Technology *Augmented Reality (AR)* integrate two or three-dimensional digital objects into the real world in real-time (Sari, Batubara, Hazidar, & Basri, 2022). *Augmented Reality (AR)* proven to be able to increase student interest through immersive 3D visualization (Rahmatika, Manurung, & Ramadhani, 2023). One of the platforms that supports *AR* is *Assemblr Edu*, which provides interactive material in the form of 3D objects and can be easily accessed (Khaira, Hermita, & Alim, 2025).

Development of learning media *Augmented Reality (AR)* supported by the platform *Assemblr Edu* has been proven effective in the context of learning in today's digital era. Researchers integrate technology *Augmented Reality* based *Assemblr Edu* in form *Merge Cube*, a cube-shaped medium that displays illustrations of three-dimensional objects on each side. Previous research was limited and focused on the development of *Augmented Reality* use *Assemblr Edu*, but this research introduces innovation by applying this technology to a medium known as *Merge Cube*. *Merge Cube* is a cube-

shaped media that has six sides, each equipped with illustrations and *QR Qode* which is used to connect *device or smartphone* with 3d objects *Augmented Reality*. This research offers innovation in the development of assisted learning media. *Assemblr Edu* in form *Merge Cube* namely a cube-shaped media that displays 3D illustrations on each side. With the help of *QR Qode*, Students can display 3D illustrations on each side. With the help of *QR Qode*, students can display objects *AR* relevant to natural disaster material. This media is expected to be able to address and provide a solution to the learning needs at SDN 1 Gempolrejo by providing an engaging, interactive learning experience and increasing student motivation and understanding of the science material.

METHOD

Types of Research and Development Models

This research used a research and development (R&D) method with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. According to Sugiyono, the Research and Development (R&D) method is a research approach aimed at creating a specific product and evaluating its effectiveness (Okpatrioka, 2023).

Place and Time of Research

This research was conducted at SDN 1 Gempolrejo, located in Gempolrejo village, Tunjungan district, Blora Regency, Central Java. The study period was eight months, from December 2024 to July 2025.

Research Subjects

The subjects of the feasibility test were design experts, material experts, and language experts. The field trial was conducted on all 24 fifth-grade students of SDN 1 Gempolrejo in the 2024/2025 academic year, along with their teachers.

Data Collection Techniques

Data collection techniques are methods that can be used by researchers in determining the necessary data. In this study, the data collection techniques used are as follows:

1. **Interview** : is a communication interaction activity involving two or more parties (Yuhana & Aminy, 2019). The interview was conducted with the aim of obtaining information related to problems in class V of SDN 1 Gempolrejo, thus becoming the reason for the researcher to develop the media.
2. **Questionnaire**: The questionnaire was used during research, validation, and trials. Validation was shown to validators, namely design experts, material experts, language experts, grade V teachers of SDN 1 Gempolrejo, and grade V students. By using a questionnaire to determine the feasibility of the product that has been developed.
3. **Documentation**: Documentation also includes efforts to record and classify information related to written forms, photos, and images (Hasan, 2022).

Data Analysis Techniques

Obtaining data analysis after the trial results using validation sheets by media experts, namely design experts, material experts and language experts, questionnaires of class V students of SDN 1 Gempolrejo and class V teachers of SDN 1 Gempolrejo. In assessing the feasibility of the development media, there are score categories that can be seen in table 1

table 1. score categories

Score	Criteria
1	Not Good
2	Not Enough
3	Enough
4	Good
5	Very Good

Then the total score for each data obtained is calculated using the following formula:

$$Result = \frac{\text{total score obtained}}{\text{maximum score}} \times 100\%$$

From the results of the analysis above, conclusions will be drawn regarding the feasibility of the media using a Likert scale with the criteria that can be seen in table 2.

Table 2. Media Suitability Percentage Scale

average score	Criteria
0%-20%	Totally unworthy
21%-40%	Not feasible
41%-60%	Quite decent
61%-80%	Worth it
81%-100%	Very worthy

RESULTS AND DISCUSSION

RESEARCH RESULT

1. Analysis

The analysis stage is the initial step and foundation of any research. Analysis is conducted to gather information and identify problems that arise in the current situation. During the analysis stage, researchers conducted several analyses, including needs analysis, curriculum analysis, and student analysis. After conducting observations and interviews with Ms. Listrisal Puspa Yuniya, S.Pd., the fifth-grade homeroom teacher at SDN 1 Gempolrejo, it was discovered that SDN 1 Gempolrejo uses the Independent Curriculum, which is known to consist of eight chapters in two semesters of science learning for fifth-grade students.

Elementary school students are the alpha generation, closely connected to technology. According to Piaget, elementary school students are in the concrete operational phase, requiring learning media that can visualize the material so that it can be conveyed effectively. Therefore, media is needed as an intermediary to increase student motivation in learning. In addition, many students still feel bored and tired during science lessons. This occurs due to the lack of teachers' ability to provide learning variations and technology integration. Science learning is a learning process that is inherently rich in abstract concepts, including natural disasters. The learning method applied at SDN 1 Gempolrejo still focuses on the teacher as the source of material.

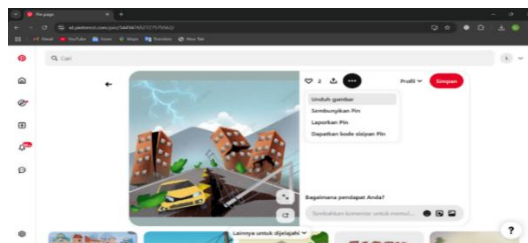
Based on this analysis, the learning media *Augmented Reality (AR)* very appropriate to the problem that occurred. By using *Augmented Reality*, students gain direct learning experience by actively participating in learning. *Augmented Reality* provide an impressive learning experience so that it can increase students' motivation in learning.

2. Design

The design or planning stage is the stage that is passed in order to design the development of AR-assisted learning media *Assemblr Edu Type Merge Cube*. In the design stage, researchers also designed media feasibility assessment instruments, created initial media development designs, and designed media product specifications. *Merge Cube*. Development media *AR* Starting from the initial design for a 3D natural disaster object, researchers utilized *platform pinterest* as a design illustration reference And *Canva* to design the illustrations on each side *Merge Cube*. Design each side *Merge Cube* different according to the material and types of natural disasters. There are 6 sides in *Merge Cube*. The natural disaster material that will be visualized is 5, so 1 side *Merge Cube* which is more used as a guide in using learning media *Merge Cube (how to use)*. The product specification design can be seen in table 3.

Table 3. Product Development Specifications *Merge Cube*

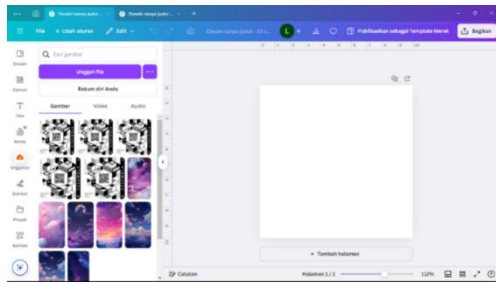
a.	Types of Cube Materials	: wood
b.	Sticker Types	: Vinyl
c.	Cube Size	: 8 cm
d.	Sticker Size	: 8,1 cm
e.	Picture	: There are 6 sides of <i>Canva</i> illustrations with the following specifications: 1) 5 sides related to natural disaster material, in the form of volcanic eruptions, floods, earthquakes, hurricanes and tsunamis. 2) 1 related side contains information on how to use the product (<i>How To Use</i>)
f.	Cube Color	: Brown
g.	Sticker Color	: Full Colour
h.	Image Design Letters	: Migra Font



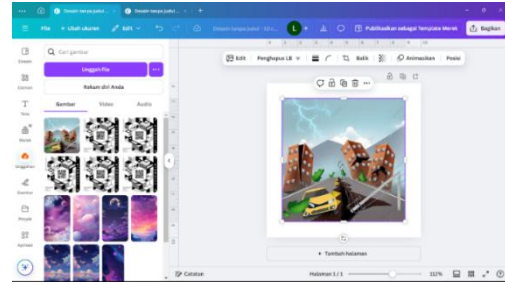
Picture 1. Illustration of an Earthquake in *pinterest*

Picture 1. Illustration of an Earthquake in *pinterest*

Picture 1 is an illustration of an earthquake used for a design in *Canva*. Researchers downloaded the earthquake image and pasted it into the *Canva* app.



Picture 2. Background design display in Canva



Picture 3. Illustration of an earthquake

Pictures 2 and 3 use the *Canva* application. Researchers used the *Canva* application as a tool to design each side of the illustration. *Merge Cube*. Apart from earthquakes, there are also other natural disasters, namely volcanic eruptions, hurricanes, floods and tsunamis.

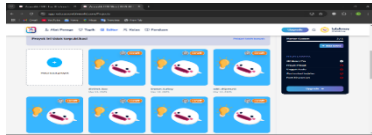
3. Development

The development stage is the stage of media creation. In addition, validation is also carried out by media experts, namely design experts, content experts, and language experts.

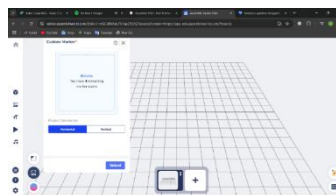
A. Media Production Process

The following are the steps in the learning media development process. *AR* assisted *Assemblr Edu Type Mergecube*.

Table 4. Media production

NO	Level Description	Appearance
1.	Researchers use the web <i>Assemblr Edu</i> , picture login platform start <i>Assemblr Edu</i> .	 Picture 4. Login <i>Assemblr Edu</i>
2.	After successfully logging in, the researcher created a 3D object by clicking on the "editor" tool and then clicking "start creating a project".	 Picture 5. View after login  Picture 6. Page editor view
3.	Researchers choose to use the "default editor".	 Picture 7. "Default editor" view

- 5 After that, a room will appear to edit the project to be created and customize the marker. The researcher clicks "browse" to upload the illustration that has been created on *Canva*.

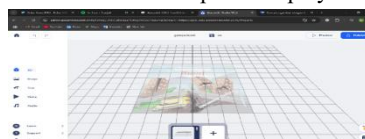


Picture 8. Displayroom editor

- 6 After that, an illustration appears that will be used as a marker, then the researcher clicks "upload".



Picture 9. Marker upload display

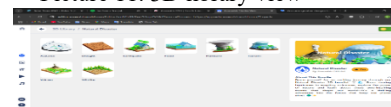


Picture 10. Illustration of an earthquake as a marker

7. The researcher clicked on 3d, clicked on search for the theme of natural disasters, namely "natural disaster"

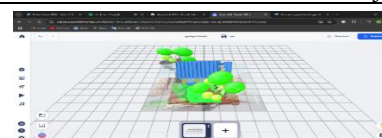


Picture 11. 3D library view



Picture 12. 3D view of natural disaster object

8. The researcher chooses a suitable 3d object, for the first one is an earthquake



Picture 13. 3D object view of an earthquake

9. Researchers provide titles or titles in 3D objects, as well as definitions, causes and impacts of natural disasters.

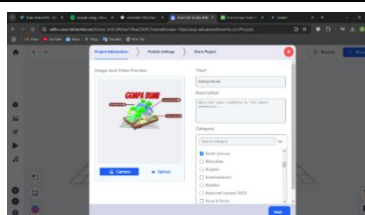


Picture 14. 3d object view of earthquake and title

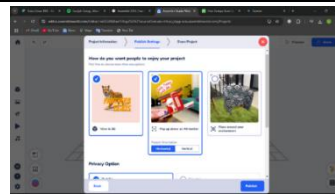


Picture 15. 3D object view and definition, causes and impacts

- 10 Penalty mem-publish project-nya by clicking "share", check mark "view in 3d" to be seen in its 3d model and click "pop up above on AR Marker" so that it can be seen in the open space above marker illustration.



Picture 16. Publish Object View



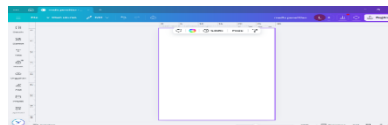
Picture 17. Project view options display

11. The researcher clicked “publish” and will appear qr codeits used for scan with camera device.



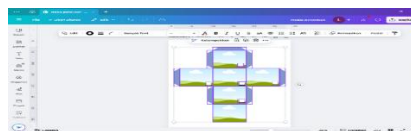
Picture 18. *QR Qode* Display

12. The researcher opened *Canva*, then made the size bacground A3



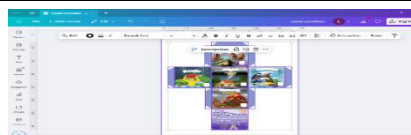
Picture 18. Display background A3

13. The researcher made an illustration of a cube net with a side length of 8.1 x 8.1 cm.



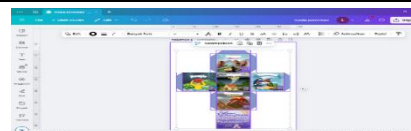
Picture 19. Net view of a cube

14. Researchers move the side illustration *merge cube* paging into cube nets



Picture 20. Side view illustration *merge cube*

15. After that, the researcher added the *QR Qode* that had been created and downloaded via *Assemblr Edu* according to the title of the natural disaster.



Picture 21. Illustration of a natural disaster and its effects
QR Qode

16. Researchers prepared wooden cubes measuring 8x8 cm.



Picture 22. Wooden cube and sticker attachment process

17. Researchers attached stickers to prepared wooden blocks and tidied them up.



Picture 23. Product *merge cube*

B. Media Suitability Test

The development stage aims to determine whether the media developed by the researcher is feasible. The media development stage will be validated by several experts. This aims to identify the shortcomings of the AR-assisted media. *Assemblr Edu* Type mergecube and revise according to the instructions given by the validator or media expert. Furthermore, it is used to refine the media to make it better. The following are the validation results from the media expert:

1) Validation by Design expert

The design expert validation was carried out by Mr. Wildan Kurniawan, M.Pd., a lecturer at STKIP Muhammadiyah Blora. He was chosen as the design expert validator because he has competencies related to creativity and design. The design expert validation was carried out in only one stage, because according to Mr. Wildan Kurniawan, M.Pd., the designs and illustrations developed by the researcher were quite good and attractive. The results of the design expert validation data are as follows:

Table 6. Design expert validation results

Validator	Total Score	Presentation	Criteria
Wildan Kurniawan, M.Pd	73	97%	Very Worthy

The results of the assessment by material experts by Mr. Wildan Kurniawan, M.Pd obtained an assessment of 97%, thus obtaining the criteria of "very suitable", in line with this, it shows that the learning media developed by the researcher is suitable for use without revision.

2.) Validation by material experts

Validation by material experts was carried out 2 times, namely stage 1 and stage 2 until the developed media was truly feasible and obtained the criteria for being implemented and used during learning. The validator who became a material expert was Mr. Bayu Eko Gumilar, M.Pd. He is a lecturer who teaches in the field of natural sciences at STAI Muhammadiyah Blora. In the validation stage 1 by the material expert, there were several criticisms, namely the letters in the explanations contained in the 3d object looked unclear and faded, the validator provided suggestions during implementation or practice at school to use a tripod as an aid, because the media is sensitive to perspective, the use of the media must be accompanied by an educator because it uses a device in the form of a mobile phone. After the revision was carried out, the researcher carried out validation stage 2, the following are the results of the assessment of material experts in stages 1 and 2:

Table 7. Results of validation by material experts

Validator	Total Score		Presentation		Criteria	
	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2
Bayu eko gumilar M.Pd	37	43	82%	95%	Very Worthy	Very Worthy

The results of the assessment by material experts by Mr. Bayu Eko Gumilar, M.Pd obtained an assessment of 82% in stage 1 and 95% in stage 2, thus obtaining the criteria of "very feasible", in line with this, it shows that the learning media developed by the researcher is suitable for use without revision.

3). Validation by linguist

Validation by linguist was carried out twice, namely stage 1 and stage 2 and was carried out by Mrs. Fulusia Nurmawati M.Pd as a lecturer at STKIP Muhammadiyah Blora. In the first stage of validation, the linguist validator provided several criticisms and suggestions, namely the need for improvements to sentences that were adjusted for the use of commas and periods between words, and to add references for explanatory material on the object that could come from journals or books related to natural disaster material. The results of the assessment by linguists obtained a score with an average of 4.7 or 5 with very good criteria, in line with this indicating that the learning media developed by researchers is suitable for use without revision.

Table 8. Results of validation by linguists

Validator	Total score		Presentation		Criteria	
	Level 1	Level2	Level1	Level	Level 1	Level2
Fulusia Nurmawati M.Pd	37	43	82%	95%	very worthy	very worthy

The results of the assessment by language experts by Mrs. Fulusia Nurmawati M.Pd obtained an assessment of 82% in stage 1 and 95% in stage 2, thus obtaining the criteria of "very suitable", in line with this, it shows that the learning media developed by the researcher is suitable for use without revision.

4. Implementation

After validation is carried out and the product is declared suitable for use, the implementation phase involves field trials. The implementation phase aims to determine the product's feasibility, thereby enhancing student motivation in learning and understanding the science and science material. To determine the media's suitability, the researchers used a questionnaire. The questionnaire covered the media's format, appeal, ease of operation, and usefulness.

Table 9. Results Of The First Trial

No	Student	Total Score	Presentation	Criteria
1	Student 1	32	91%	Very Worthy
2	Student 2	32	91%	Very Worthy
3	Student 3	32	91%	Very Worthy
4	Student 4	33	94%	Very Worthy
5	Student 5	32	91%	Very Worthy
6	Student 6	32	91%	Very Worthy
	Total Score		193	
	Average		32,1	
	Presentaton		91,7 %	
	Criteria		Very Worthy	

Table 10. Results Of The Second Trial

No	Student	Total Score	Presentation	Criteria
1	Student 1	32	91%	Very Worthy
2	Student 2	33	94%	Very Worthy
3	Student 3	32	91%	Very Worthy
4	Student 4	33	94%	Very Worthy
5	Student 5	32	91%	Very Worthy
6	Student 6	32	91%	Very Worthy
7	Student 7	32	91%	Very Worthy
8	Student 8	32	91%	Very Worthy
9	Student 9	32	91%	Very Worthy
10	Student 10	33	94%	Very Worthy

11	Student 11	32	91%	Very Worthy
12	Student 12	33	94%	Very Worthy
13	Student 13	29	83%	Very Worthy
14	Student 14	31	93%	Very Worthy
15	Student 15	33	94%	Very Worthy
16	Student 16	33	94%	Very Worthy
17	Student 17	33	94%	Very Worthy
18	Student 18	32	91%	Very Worthy
	Total Score		579	
	Average		32,1	
	Presentation		91,7 %	
	Criteria		Very Worthy	

5. Evaluation

The evaluation stage focuses on analyzing user reactions or responses to the learning media implemented in the learning process (Batubara, 2020). The evaluation stage also aims to collect data at each stage of the ADDIE research with the aim of improving the product. Researchers conduct evaluations by improving or revising the product, which consists of media. *AR Assisted Assemblr Edu Type Mergecube*. After receiving criticism and suggestions from validators including design experts, material experts, language experts, and educators or teachers, the evaluation phase uses a questionnaire instrument aimed at assessing the feasibility or practicality of the media developed by the researchers.

DISCUSSION

The result of this research and development is learning media that uses technology. *Augmented Reality (AR)*. The researcher began this study by analyzing the needs, curriculum, and characteristics of students. At this stage, data was obtained from interviews with the homeroom teacher of grade V of SDN 1 Gempolrejo. Based on the interview results, the researcher determined the development media that was appropriate to the problem and could be used by students in learning. This media was designed using the platform *Assemblr Edu* and presented in physical form as *Merge Cube*. The purpose of this media is to support the learning process of Natural and Social Sciences (IPAS) for fifth grade elementary school students, with a focus on the topic of natural disasters. *Assemblr Edu* is an innovative learning platform that combines the real and digital worlds through technology *AR*.

With *Assemblr Edu*, teachers and students can collaborate to create immersive and interactive learning experiences using 3D content (Primadona., 2024). In this study, the 3D objects developed include representations of five types of natural disasters: volcanic eruptions, floods, earthquakes, tsunamis, and hurricanes. Each 3D object designed using *Assemblr Edu* will be stored as a digital link in the form of a *QR Qode*. This *QR Qode* serves as a bridge that directs users to display 3D objects through digital devices by scanning the *QR Qode* with a phone or tablet camera. The illustrations were created using the Pinterest platform and designed using the *Canva* application to be placed on the side of each page. *Merge Cube* The illustration is printed and pasted on all six sides. *Merge Cube*. Five sides *Merge Cube* Features illustrative designs accompanied by *QR Qodes*, each leading to a 3D object related to natural disasters. The sixth side serves as a user guide for the media, allowing students to understand the steps for using it. *Merge Cube* both individually and in groups. With a simple yet functional design, *Merge Cube* developed in this study provides students with the opportunity to explore the material visually. These findings suggest that the use of technology *Augmented Reality* assisted *Assemblr Edu* Type Cube can be an effective interactive learning media and is able to adapt to the development of digital technology in elementary school environments.

CONCLUSION AND RECOMMENDATION

Based on the results of the research and development carried out, it can be concluded that the *Augmented Reality* (AR) based learning media assisted by *Assemblr Edu* type *Merge Cube* The media developed in this study has proven to be feasible and effective for use in teaching natural disasters in fifth grade elementary schools. This media provides an interactive, realistic, and engaging learning experience through three-dimensional object visualizations that can be accessed with simple devices. The media development process was carried out using the *ADDIE* model approach, which resulted in a final product in the form of a *Merge Cube* equipped with visual illustrations and *QR Code* which is connected to the *Assemblr Edu* platform.

The validation results from design experts obtained a score of 73 with a percentage of 97% so that it received a very feasible category, validation from material experts obtained a score of 43 with a percentage of 95% with a very feasible category, and validation from language experts obtained a score of 47 with a percentage of 94% with a very feasible category. In addition, feedback from teachers and students also showed that this media was very interesting, easy to use, and able to increase student engagement in the learning process. Based on the research that has been carried out, the researcher provides suggestions for subsequent researchers, namely by developing media *AR* assisted by *Assemblr Edu* type *Merge Cube* at another grade level. This is because the scope of the research is only focused on grade V.

THANK YOU NOTE

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