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EXPLORING CLUNGUP MANGROVE CONSERVATION THROUGH VIRTUAL FIELD TRIP MEDIA : TO IMPROVE STUDENTS CRITICAL THINKING CAPABILITY

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ABSTRAK

Abstrak*: Penelitian ini dilatarbelakangi oleh permasalahan keterampilan berpikir kritis siswa yang tidak merata pada setiap siswa serta pembelajaran yang bersifat pasif pada materi konservasi. Penelitian ini bertujuan untuk mengembangkan media pembelajaran Virtual Field Trip (VFT) di Clungup Mangrove Conservation (CMC) yang mendukung pemahaman materi konservasi dan mengukur kemampuan berpikir kritis siswa. Penelitian ini menggunakan metode pengembangan 4D (Define, Design, Develop, Disseminate) dengan instrumen berupa wawancara, angket kebutuhan siswa, lembar validasi ahli, angket respons siswa, dan asesmen kemampuan berpikir kritis. Pengumpulan data dilakukan melalui analisis kebutuhan, validasi ahli, uji coba media, dan asesmen siswa dengan analisis data menggunakan skala likert. Hasil penelitian menunjukkan media VFT memiliki tingkat validitas sangat tinggi (93%), respons positif siswa sebesar 91.6%, skor kemampuan berpikir kritis rata-rata 81% (kategori tinggi) dan 94% siswa mencapai KKTP yang menunjukkan bahwa media ini membantu siswa dalam berbagai aspek berpikir kritis, seperti conveying simple explanations , forming basic skills, inferring, elaborating further explanations, dan organising tactics and strategies. Media VFT efektif dalam meningkatkan kemampuan berpikir kritis siswa, mendukung pemahaman konsep konservasi, dan menjadi alternatif inovatif dalam pembelajaran geografi.*

Kata Kunci: *Virtual Field Trip; Berpikir Kritis; Media Pembelajaran*

Abstract: This research is backgrounded by the problem of students' critical thinking skills that are uneven in each student and passive learning on conservation material. This research aims to develop Virtual Field Trip (VFT) learning media at Clungup Mangrove Conservation (CMC) that supports the understanding of conservation materials and measures students' critical thinking skills. This research uses the 4D development method (Define, Design, Develop, Disseminate) with instruments in the form of interviews, student needs questionnaires, expert validation sheets, student response questionnaires, and critical thinking skills assessments. Data collection was carried out through needs analysis, expert validation, media trials, and student assessments with data analysis using a Likert scale. The results showed that the VFT media had a very high level of validity (93%), a positive student response of 91.6%, an average critical thinking ability score of 81% (high category) and 94% of students achieved KKTP which indicated that this media helped students in various aspects of critical thinking, such as conveying simple explanations, forming basic skills, inferring, elaborating further explanations, and organising tactics and strategies. VFT media is

effective in improving students' critical thinking skills, supporting the understanding of conservation concepts, and being an innovative alternative in geography learning.

Keywords: Virtual Field Trip; Critical Thinking; Learning Media.

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A. INTRODUCTION

Media is a tool to convey information from source to receiver, including various intermediaries used by humans to communicate or spread ideas, ideas, and opinions, so that the message to be conveyed can be received properly by the intended recipient. (Anggun Cahyani & Hindun Hindun, 2023; Hasanah Lubis et al., 2023). Learning media plays an important role in improving Teaching and Learning Activities (KBM) by encouraging an effective and efficient learning process, where success is highly dependent on the clarity of information delivery. (Novaliendry et al., 2020). Media has three main functions, Firstly, the media acts as an instructor by providing guidance, instructions, or information on various topics to the receiver. Second, the media serves as a source of information, delivering news, facts, data, or knowledge. Finally, the media serves as a motivator, encouraging user involvement and action. The use of learning media can minimise the use of excessive verbal explanations, which can sometimes make concepts too abstract for students to understand. Choosing the right media is very important to achieve learning objectives. This selection should consider students' needs, characteristics, specific learning objectives, and previous media evaluation to increase learning effectiveness and ensure the message can be understood by the receiver. (Suryani & Suciptaningsih, 2024; Ummah, 2023).

In the merdeka curriculum, described in Phase F of Class XI, students will go through various chapters, including Patterns of Indonesian and World Biodiversity, with the subchapter Conservation for the Preservation of Flora and Fauna. At the end of learning, students are expected to understand the concept of conservation, analyse environmental impacts, and evaluate the impact of mangrove conservation in coastal areas. To make the learning process more contextual and relevant to environmental conservation efforts, Clungup Mangrove Conservation (CMC) was chosen as a research site. Located in Malang Regency, CMC is not only a conservation area but also a growing and popular ecotourism destination. Managed by the community group 'Bhakti Alam Sendang Biru', CMC was established based on a collective awareness of the far-reaching degradation of coastal mangrove ecosystems. The initiative emphasises the development of educational tourism for locals and visitors alike. The ultimate goal is to protect and preserve the mangrove ecosystem and coastal environment through a conservation approach. (Harahab, 2020; Sumarmi et al., 2023, 2021; Tri Joko Setyanto et al., 2024).

The results of interviews with geography teachers at SMA Panjura Malang revealed that the use of interesting learning media at SMA Panjura Malang makes it easier for students to understand the material, it is also known that students'

critical thinking skills in completing case studies still vary. As many as 53.3% of students focus more on the theory from the handbook without any direct experience in the real environment. Geography learning at the school has used modern media such as PowerPoint (PPT), PPT is generally linear and passive, where students only see slide after slide containing text, images, or diagrams (Derakhshan et al., 2022; Harsiati & Widyartono, 2023). Based on the explanation from the teacher, during learning students are often sleepy and unfocused, because students are not directly involved in the learning process, but only receive information, the teacher also feels that explaining material that is not visualised makes it difficult for students to understand the material. To overcome this, it is necessary to develop an innovative learning media, one of which is Virtual Field Trip (VFT). Based on the results of the needs analysis, 93.3% of students feel more helpful and happy when using interactive media. This is due to the high curiosity of SMA Panjura Malang students and their interest in new things, so VFT is expected to create more interesting and interactive learning. According to the geography teacher of SMA Panjura Malang, conservation material is one of the materials that is rarely visualised, so students often have difficulty in understanding the concepts presented.

Virtual Field Trip (VFT) allows students to explore and experience various educational locations remotely, eliminating the need to be physically present. (Khusniatul Vatyca, 2021; Klippel et al., 2020). VFTs provide immersive learning experiences and practice students' skills by presenting real-looking environments. VFTs align learning content with the curriculum, simulating the real world that encourages meaningful interactions between teachers, students and their learning environment. VFTs are a practical alternative to live field trips, with advantages such as accessibility, cost efficiency and flexibility. (Wen & Gheisari, 2020). To overcome these limitations, researchers developed a VFT that offers more accessibility and a wider range of exploration content. The content contained in the VFT was designed by combining photos, videos and 360 from various locations to provide a richer and more realistic experience, providing a more immersive and comprehensive learning journey while overcoming previous technical and exploratory challenges.

Integrating digital technology through VFT in education has been proven to improve students' literacy, academic ability and critical thinking skills (Khotimah et al., 2024; Khusniatul Vatyca, 2021). Integrating VFT into learning has great potential to improve students' critical thinking skills, a structured process that involves problem solving, decision making, evaluating assumptions, and conducting scientific investigations (Harsiati & Widyartono, 2023). Indicators of critical thinking, as mentioned by Ennis (1991), include providing simple explanations, forming basic skills, inferring, elaborating further explanations, and organising tactics and strategies in solving problems (Ennis, 1985, 1991; Hasanah et al., 2021; Septiany et al., 2024). Research shows that this method offers an experience that is closer to reality, increases students' understanding of the subject, and provides greater motivation through an interactive and engaging approach compared to traditional learning methods (Seifan et al., 2019).

However, the specific relationship between the use of VFT media and the improvement of students' critical thinking skills still requires further research. This study differs from previous research because a unique aspect of this study is the content design, which incorporates diverse camera angles and drone footage. In addition, the learning videos featured live presentations from CMC managers, which provided deeper insights into conservation efforts. Through interaction with

content enriched with multimedia elements, learners are expected to develop stronger skills in evaluation, analysis, and problem solving. The main objective of this research is to develop VFT with the main goal to produce media that can help learners develop critical thinking skills and evaluate its effectiveness in geography education.

B. METHOD

This research uses Research and Development (R&D)(Sugiyono, 2019). The development model used is the 4D model (Define, Design, Develop, Disseminate). (Thiagarajan., 1974; Andy Satria et al., 2023). Meanwhile, the product trial used the Discovery Learning model.

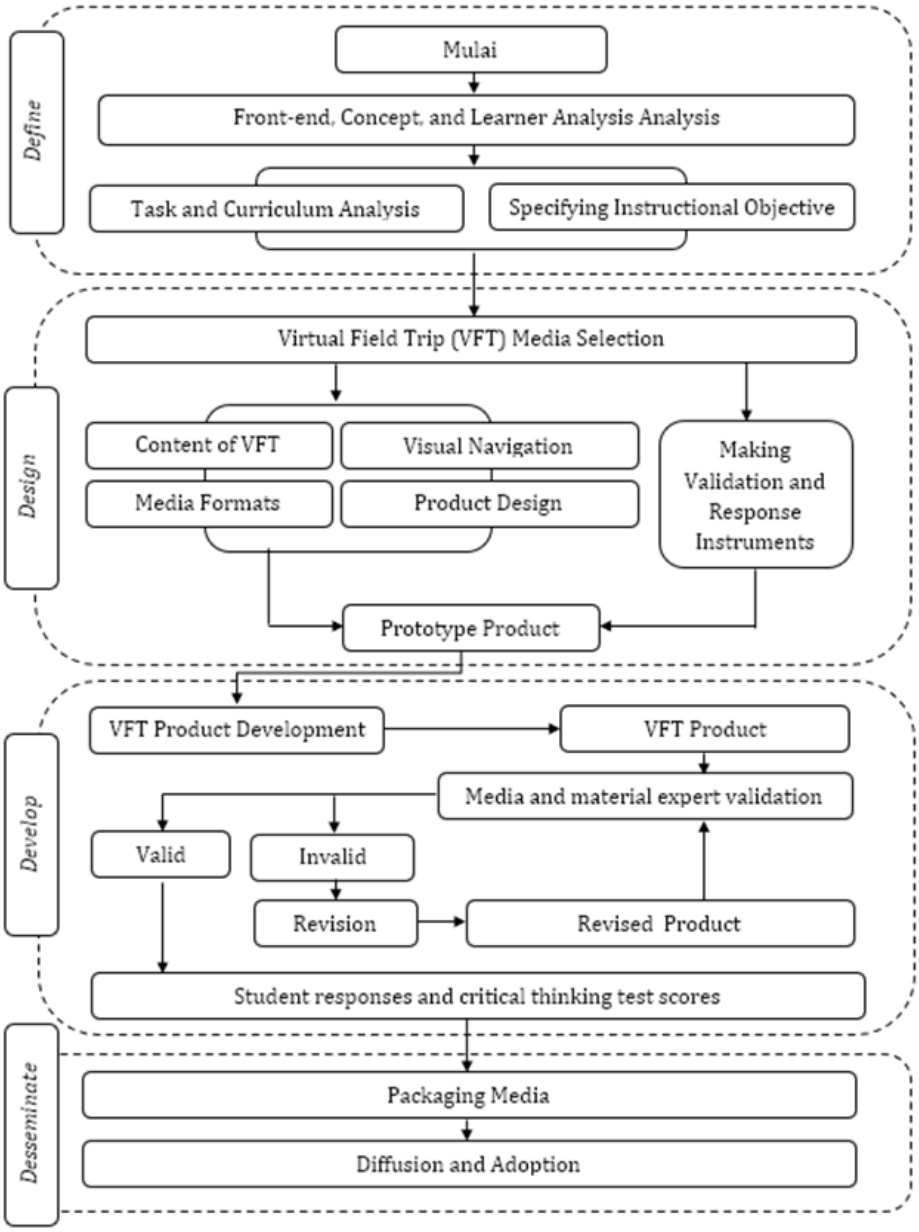

Figure 1. *Development Flowchart*

The data collection instruments used in this development are: (1.) Interview and Student Needs Questionnaire: This instrument is used to analyse the needs that must be met by the developed learning media. (2.) Material Expert and Media Expert Validation Sheet: This sheet is used to assess the feasibility of the developed media and the learning content used. (3.) Student Response Questionnaire: This

questionnaire was used to evaluate changes in students' critical thinking skills and to collect feedback on the VFT learning media. (4.) Test: This instrument was used to measure students' critical thinking skills(Ardiansyah et al., 2023).

Data analysis techniques are used to find conclusions from the data collected, which are then described in the results and discussion section. The analysis was done systematically to get a clear understanding of the findings. (Wibawa, 2020). There are two types of data analysis techniques used: (1.) Qualitative Analysis, which is analysing data obtained from validator comments and student responses. Qualitative data is interpreted descriptively. (2.) Quantitative Analysis, used for questionnaire results and critical thinking skills scores, Likert Scale was used to evaluate the questionnaire results. This scale is known for its high level of reliability, flexibility, and can be adapted to assess responses. The assessment criteria are as follows:

Table 1. Likert Scale of Validator Assessment and Student Response

Description	Score Scale
Strongly Agree	4
Agree	3
Don't Agree	2
Strongly Disagree	1

Source : (Sumartini et al., 2020)

The mean score for each category and overall response was calculated using the following formula:

$$N = \frac{X}{Xi} \times 100\% \quad (1)$$

Where:

- N: Calculated value
- X: Total score from respondents
- Xi: Maximum possible total score

The total score for all respondents was calculated using:

$$Total\ Score = T \times Pn \quad (2)$$

Where:

- T: Total number of student respondents
- Pn: Likert score values

To determine the percentage index:

$$Index\% = \frac{Total\ Score}{Y} \times 100\% \quad (3)$$

Where:

- Y: Highest Likert score multiplied by the total number of respondents

The results were interpreted into percentages and grouped into the following categories:

Table 2. Valid Criteria and Media Appropriateness

Description	Category
0%-19,99%	Very Unfits (STL)
20%-39,99%	Unfits (KL)
40%-59,99%	Undecided (R)
60%-79,99%	Suitable (L)
80%-100%	Very Suitable (SL)

Source: (Sumartini et al., 2020)

Furthermore, to get the test scores of students' critical thinking skills with indicators of conveying simple explanations, forming basic skills, inferring,

elaborating further explanations, and organising tactics and strategies, namely with the following formula:

$$N = \frac{X}{Xi} \times 100\% \quad (4)$$

Where:

- N: Calculated value
- X: Total score from respondents
- Xi: Maximum possible total score

The data that has been analysed is categorised according to the critical thinking ability category, for grouping there are 3 levels in the form of :

Table 3. Criteria for critical thinking skills

Description	Criteria of Critical thinking Skills
0 ≤60	Low
61≤75	Medium
76≤100	High

Source : (Rita Nuraini, 2022)

Achievement analysis is conducted to evaluate whether the Virtual Field Trip (VFT) learning media has met the Criteria for Achievement of Learning Objectives (KKTP). The media is said to be effective if it meets the achievement criteria of at least 61%. Achievement is calculated using the formula:

$$Achievement\ Percentage\ (\%) = \frac{\sum Students\ Complete\ the\ Achievement\ Criteria}{\sum Students} \quad (5)$$

The calculation results were then classified into categories as follows:

Table 4. Criteria for Achievement of Learning Objectives (KKTP)

Score Interval	Criteria
80% < □ ≤ 100%	Very Good (A)
60% < □ ≤ 80%	Good (B)
40% < □ ≤ 60%	Fair (C)
20% < □ ≤ 80%	Poor (D)
0% < □ ≤ 20%	Very Poor(E)

Source: (Nurul Fadilah Hidayati et al., 2024)

Validity test is needed to test the level of validity of the assessment instrument items using Pearson's Product Moment correlation with 5% significance, then continued the reliability test to determine the accuracy of the measurement results using Cronbach Alpha.

C. RESULT AND DISCUSSION

1. Result

The results of this study indicate that the Virtual Field Trip (VFT) learning media developed using the 4D model has reached an excellent level of validity based on the evaluation of material experts and media experts.

Table 5. Material and Media Validation

Validator	Assesment Criteria	Percentage	Category
Materia	Material	93% (Very Suitable)	89% (Very Suitable)
	Usage	93% (Very Suitable)	
	Benefits	75% (Suitable)	
Media	Purpose	90% (Very Suitable)	92% (Very
	Visual	90% (Very Suitable)	

Usage	96% (Very Suitable)	Suitable)

The learning media was declared feasible but with several comments, one of which was to improve the conservation material in the media and make instructions for using VFT, from these comments, product revisions were then made until it was feasible to be tested in the field. At the trial stage, the VFT media was applied to students at SMA Panjura Malang in class XI IPS 2. The following are student responses to the VFT learning media:

Table 6. Student Response to Virtual Field Trip Learning Media

Assesment Criteria	Percentage	Category
Preferences	92%	Very Suitable
Suitability	92%	
Usage	91%	
Accessibility	91%	
Interesting	92%	
Average	91.6%	

The trial results showed that students' responses to the media were very positive, with an average percentage of student responses reaching 91.6%. With a percentage of 91.6%, the media can be said to be suitable for use in learning at school. Furthermore, students work on an assessment in the form of five essay questions that have been made based on critical thinking indicators, the following are the results of student assessments:

Table 7. Student scores for each critical thinking indicator

Question	Indicator	Average Student Score	Criteria
1	conveying simple explanations	81%	High
2	forming basic skills	82%	High
3	inferring	85%	High
4	elaborating further explanations	91%	High
5	organising tactics and strategies	67%	Medium
Average		**81%**	**High**

Based on the data above, the result is 81%. shows that there is success in the assessment of students‘ critical thinking skills, so it can be said that students’ critical thinking is in the high category (Hasanah et al., 2021). the score is in the high category. In the indicator of elaborating further explanations, students obtained the highest score of 91%, which shows their ability to explain information in depth is very good. Other indicators such as inferring (85%), forming basic skills (82%), and conveying simple explanations (81%) also showed satisfactory results, where students had met the criteria for critical thinking skills. However, the results of this study also revealed weaknesses in the organising tactics and strategies indicator, which only reached a score of 67%. This score is the lowest among other indicators and is because the questions used to assess this indicator contain situations or concepts that are less familiar to students, confusing narratives, and students' ability to deal with problems that are different from daily learning can be an obstacle. Meanwhile, the individual student results can be seen from the picture below:

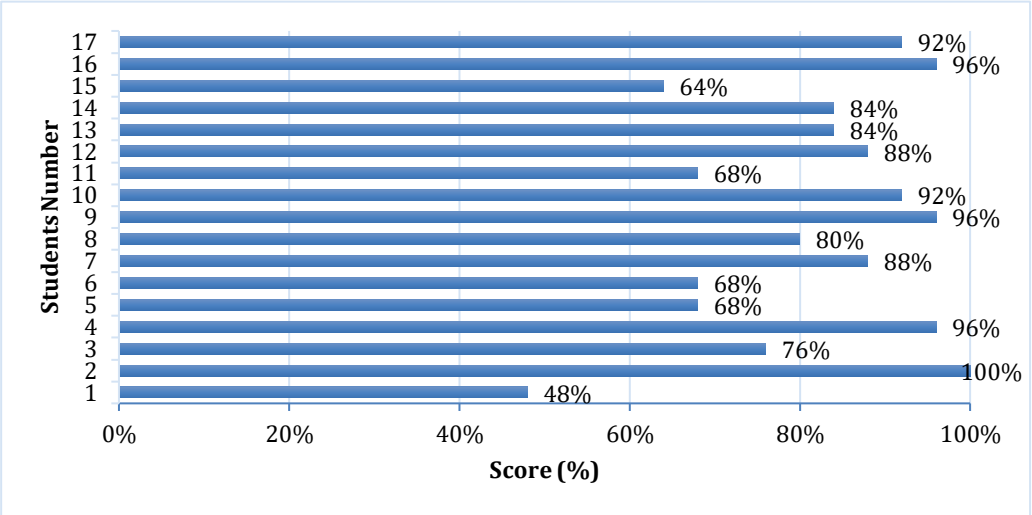

Figure 2. Student Assessment Score (%)

In this study, the assessment results showed that out of a total of 17 students who became research subjects, only one student had not met the Criteria for Achieving Learning Objectives (KKTP). This shows the success of VFT media in helping students master learning concepts according to predetermined learning outcomes (Nurul Fadilah Hidayati et al., 2024). VFT with the integration of interactive elements helps students practice critical thinking so that they not only understand the theory but are also able to analyse, evaluate, and make conclusions relevant to the subject matter.

Table 8. Students Passing Criteria for Learning Objective Completion (KKTP)

Description	Number
Students Fulfilling the KKTP	16
Students do not Fulfil the KKTP	1
Result	94%

Overall, this research shows that Virtual Field Trip learning media is effective in integrating critical thinking skills. This shows that the majority of students are able to understand conservation material well and show high critical thinking skills which are the main focus in learning using this media. Furthermore, the item validity test was carried out to determine whether or not a test used can be calculated using the Pearson product moment technique.

Table 9. Item Validity Test

Decription	Q1	Q2	Q3	Q4	Q5
R value	0.614	0.858	0.566	0.663	0.516
R table	0.482	0.482	0.482	0.482	0.482
Result	**Valid**	**Valid**	**Valid**	**Valid**	**Valid**

The five items were declared valid because the calculated r value exceeded the r table. The test reliability test was conducted to measure the consistency of the research instrument. An instrument is said to be reliable if its reliability coefficient is more than 0.6 (Sugiyono, 2019).

Table 10. Reliability Test

Cronbach's Alpha	N of Item
0.639	5

The Cronbach's Alpha value of 0.639 indicates that the critical thinking test tested is reliable and can be used for data collection in research.

2. Discussion

This research uses Thiagarajan's (1974) 4D model, which includes four stages: Define, Design, Develop, and Disseminate. The definition stage establishes the requirements for developing effective learning media through five main steps: front end analysis, learner analysis, concept analysis, task and curriculum analysis, and determining instructional objectives. (Thiagararan., 1974). This research conducted at SMA Panjura Malang showed that 93.3% of students prefer interactive digital media to facilitate understanding of abstract concepts such as conservation. The research identified a need for engaging and visualised content to overcome the problem of passive learning and improve critical thinking skills. Key learning objectives focused on understanding conservation concepts, analysing environmental impacts, and evaluating the impact of mangrove conservation on coastal communities. These findings informed the instructional design and content development for the Virtual Field Trip media.

The design stage focused on making learning devices through steps such as making tests to measure critical thinking skills with indicators namely conveying simple explanations, forming basic skills, inferring, elaborating further explanations, organising tactics and strategies (Ennis, 1985, 1991; Heard et al., 2020; Septiany et al., 2024), The selection of materials tailored to the learning objectives, the selection of formats for the delivery of materials that are easy to understand, and the development of initial designs using 3D Vista Virtual Tour software. The chosen media, Virtual Field Trip (VFT), which integrates interactive elements such as 360-degree visuals, videos, and hotspots, aims to facilitate geography learning by visualising abstract conservation concepts in conservation materials.

Figure 3. Buttons, hotspots, and materials

The development stage in this study involved two main steps: expert validation and pilot testing (Dibtasari et al., 2022). Expert validation assessed the Virtual Field Trip (VFT) media on aspects such as content, usability, visual quality, and relevance, which resulted in high validity scores (e.g., 93% for content and usability). Required revisions were made based on feedback from the experts to refine the conservation concepts and improve clarity. Development testing was conducted using a quasi-experimental design with a one group posttest only design. Student responses showed a response rate of 91%, indicating students' interest in understanding conservation concepts through the VFT media. In addition, 94% of students achieved the learning objectives, confirming that VFT media is effective and engaging to enhance critical thinking and facilitate geography learning.

The average student score for each indicator of critical thinking skills reached 81%, which is in the very good category (Nurul Fadilah Hidayati et al.,

2024). This score indicates that students have a fairly high critical thinking ability in understanding the material taught through the Virtual Field Trip (VFT) media. In the indicators of conveying simple explanations, forming basic skills, inferring, elaborating further explanations, students scored 81%, 82%, 85% 91%, indicating students' ability to draw conclusions from the information provided and indicating students' ability to develop explanations in more depth (Solikah & Novita, 2022). The last indicator, organising tactics and strategies, obtained a score of 67%, this score is the lowest compared to other indicators, this score is the lowest among other indicators and is because the questions used to assess this indicator may contain situations or concepts that are less familiar to students, With an average achievement of 81%, it can be concluded that the application of VFT media has a positive impact on the development of students' critical thinking skills (Salamah Embark Saleh, 2019). so it is in the excellent category. This shows the effectiveness of VFT as a learning tool that can encourage active involvement and improve students' critical thinking skills in understanding abstract geography concepts.

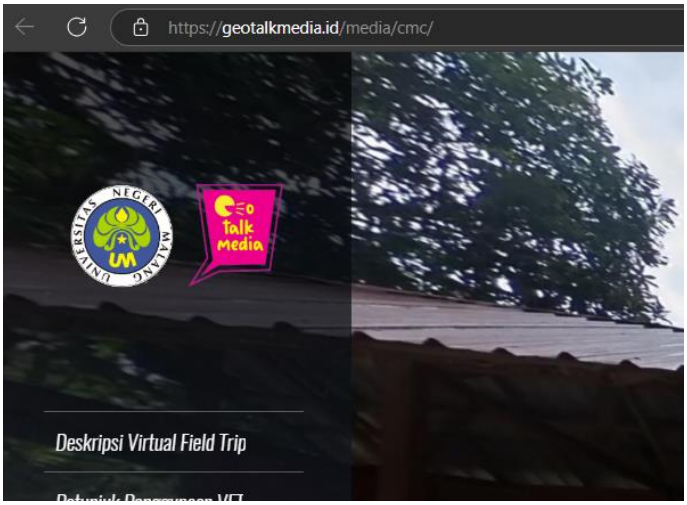

Figure 4. geotalk media website

The disseminate stage is the final stage of product development, the disseminate stage is divided into three stages, such as: packaging, diffusion, and adoption (Hariyanto et al., 2022). This stage is carried out so that the product can be utilised by others. Virtual Field Trip media packaging is carried out using a website with a domain .id on the geotalkmedia.id website which will then be disseminated through various content on tiktok and youtube social media so that it can be absorbed (diffusion) or understood by others and can be used (adoption) in their classes.

Virtual Field Trip (VFT) learning media has advantages in terms of flexibility, accessibility, and efficiency. VFT allows the integration of various formats, such as gform, drive, graphics, photos, and videos that encourage learning with a multimedia approach. With this flexible design, VFT can be accessed by a wide variety of people with different learning preferences and needs. In addition, the use of websites allows media to be accessed anytime and anywhere, efficiency is also an advantage of the media. By eliminating the need for transport, accommodation, and logistics, VFT presents a cost-effective learning solution. This approach allows educational institutions to still provide a rich learning experience without burdening students or school budgets.. (Mathews et al., 2012).

Another advantage is the ability of VFTs to present complex real-world conditions. By presenting these conditions in a virtual environment, students can develop more targeted critical thinking skills, such as problem solving, argument analysis, and data-driven decision making (Šašinka et al., 2019). In addition, VFTs have the ability to increase students' engagement and motivation. Immersively designed VFTs are able to arouse students' curiosity, creating a more enjoyable and meaningful learning experience. This factor is very important, especially for students who are more familiar with digital technology and need a learning approach that is relevant to their lifestyle (Wen & Gheisari, 2020).

Virtual Field Trip (VFT) learning media does offer a visual experience that is close to reality, but there are limitations in terms of direct interaction and real experience (Seifan et al., 2019). While VFTs can provide a clear picture of learning locations and materials, students only get visual and descriptive information, without experiencing the atmosphere or context of the environment directly. To overcome this limitation, there are several steps that can be taken. Firstly, as VFTs do not replace the hands-on experience of a field trip, they reinforce preparation for field activities. As a preparation tool, VFTs help students understand the context and related content before they engage directly in a physical field experience. As such, students will be better prepared intellectually and emotionally to utilise the field trip more optimally. Secondly, to provide a more immersive experience, technologies such as Virtual Reality (VR) or Augmented Reality (AR) can be integrated in VFTs. (Zhao et al., 2020) . With this technology, students can experience the sensation of being on location directly through virtual sensory interaction, which can enrich their learning experience .

In addition, another limitation of VFT media is the lack of interaction between students. Because VFT tends to lead to individual exploration of the material, the potential to build collaborative learning is often less than optimal. In fact, interaction between students is very important to improve social skills, teamwork, and the ability to think critically together (Han, 2021). To overcome this problem, several steps can be taken. Firstly, after the Virtual Field Trip session, teachers can divide students into small groups to discuss the material they have learnt. This group discussion will encourage students to share ideas, collaborate, and develop critical thinking together. Secondly, if the VFT session is conducted online, the discussion can be facilitated through digital platforms such as Google Classroom, Padlet, or other learning management systems (LMS). These platforms provide space for students to actively discuss, both during and after the VFT session, so that they can exchange views and deepen their understanding of the material collectively.

D. CONCLUSIONS AND SUGGESTIONS

This research successfully produced a development product in the form of Virtual Field Trip (VFT) learning media used as geography learning media, especially on conservation material at Clungup Mangrove Conservation (CMC). The results showed that the VFT media met the criteria of very high validity with an average score of 91.6% in student responses, and its effectiveness in improving critical thinking skills reached an average of 81%. This media is effective in helping students understand conservation material, especially in the indicators of elaborating further explanations (91%), inferring (85%), and forming basic skills (82%). However, weaknesses were found in the organising tactics and strategies

indicator, which only reached a score of 67%. While the overall student results based on the criteria for achieving learning objectives (KKTP) as many as 94% of students have fulfilled KKTP. To overcome the limitations of Virtual Field Trip (VFT) media, it is recommended to combine the use of VFT with real field trips so that students can gain more in-depth hands-on experience. In addition, the integration of technologies such as Virtual Reality (VR) or Augmented Reality (AR) can provide a more immersive learning experience. To overcome the lack of interaction between students, teachers can organise group discussions during and after VFT sessions or if online learning, utilise digital platforms such as Google Classroom and Padlet to encourage collaborative learning so that students can share ideas and strengthen their understanding of the material together

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