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Improve critical thinking skills through the virtual field trip learning media at Clungup Mangrove Conservation

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Abstract

This study aims to improve critical thinking skills through the development of Virtual Field Trip (VFT) learning media in the Clungup Mangrove Conservation. Critical thinking skills are essential in education, especially in understanding complex environmental issues. This research explores the use of VFT technology to enhance these skills in the context of environmental conservation education. This research utilizes a type of development research or Research and Development (R&D). The development model used in this research is ADDIE (Analyze, Design, Development, Implementation, Evaluation). The research combined qualitative and quantitative data collected through expert validation and student responses. questionnaires and interviews were conducted to collect detailed feedback. The validation results showed high scores, with an average score of 94.11% from the experts, indicating that the VFT media is highly suitable for educational purposes. Feedback from students showed an approval rate of 89.22%, indicating the effectiveness of this media in delivering conservation materials and improving critical thinking skills. The difference of the research is that VFT will be developed with the aim of improving students' critical thinking skills, besides that the advantage of this research lies in the content provided, the content is created using various shooting angles, including from cameras and drones, to provide a richer and more comprehensive point of view, also the learning video in this research also features CMC managers, to provide a deeper insight into the conservation practices carried out. This study concludes that VFT can be a valuable tool in geography education, especially for conservation topics.

Keywords: virtual field trip; critical thinking; learning media

INTRODUCTION

Media is a tool to convey information from source to receiver, including various intermediaries used by humans to communicate or spread ideas and opinions, so that the message to be conveyed can be received properly by the intended recipient (Cahyani & Hindun, 2024; Lubis et al., 2023). Learning media is important in supporting Teaching and Learning Activities to create effective and efficient learning, with success often dependent on the ability to convey information clearly (Novaliendry et al., 2020). The media has three main functions (Ummah, 2023). First, the media functions as instructors, which refers to their role in providing guidance, instructions, or information on various matters to the audience. Second, the media has a role in presenting information, whether in the form of news, facts, data, or knowledge. Lastly, the media also functions as a motivator, capable of stimulating user interest and action. The use of learning media reduces reliance on excessive verbal communication, which can make student understanding too abstract. It is important to select media that are relevant and appropriate to the learning objectives, based on student needs, student characteristics, specific learning

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requirements, and previous media evaluations, in order to increase learning effectiveness and ensure messages are well received (Suryani & Suciptaningsih, 2024). Considering the important role of media in supporting learning, it is necessary to select media that align with the curriculum and students' needs.

In the independent curriculum, it is explained that in Phase F class XI there are several materials, one of which is the Biodiversity Pattern of Indonesia and the World, with the sub-material Conservation for the Preservation of Flora and Fauna. After participating in learning, students are expected to be able to know and understand the concept of conservation, analyse the effect of conservation on the environment and analyse the impact of mangrove conservation in coastal areas. To make conservation learning more contextual and in line with efforts to preserve the environment through conservation, Clungup Mangrove Conservation (CMC) was chosen as a research site. CMC is one of the conservation sites in Malang Raya and is currently a new and exciting ecotourism destination. CMC is managed by a community group known as 'Bhakti Alam Sendang Biru' with a background of mutual concern due to the destruction of the magrove ecosystem on the coast which affects various sectors, CMC has developed with a focus on developing educational tourism for the local community and visitors. The main objective of CMC is to maintain and protect mangrove ecosystems and coastal areas with a sustainable conservation approach (Harahab & Riniwati, 2020; Setyanto et al., 2024; Sumarmi et al., 2021, 2023). An interview with a teacher in Malang City revealed that the use of interesting learning media makes it easier for students to understand the material, but students' critical thinking skills in completing tasks still vary. Many students focus more on the theory from the handbook without direct experience in the real environment. Geography learning at school tends to be less interesting despite using modern media such as PowerPoint (PPT), which still makes the learning atmosphere passive and boring. In addition, teacher explanations that are not visualized make it difficult for students to understand the material. To overcome this problem, researchers plan to develop modern media such as Virtual Field Trip (VFT). Considering that high school students have high curiosity and like to learn new things, VFT is expected to create more interesting and interactive learning.

Virtual Field Trip (VFT) allows students to visit various places of learning without being physically present (Adriyah, 2019; Klippel et al., 2020; Vatyca, 2021). Accessed through the internet and apps, VFTs provide immersive learning experiences and practice students' skills by presenting real-looking environments. VFTs connect learning content to the curriculum, creating near-real-world experiences that enhance interactions between teachers and students as well as students with 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 shortcomings, researchers designed a VFT that is more accessible and allows for wider exploration. In addition, this VFT will display videos from various spots to provide a richer and closer-to-reality experience, thus providing a more immersive and comprehensive experience, to overcome the technical and exploration limitations that have been an obstacle. This study is crucial, especially in topics such as mangrove conservation, where hands-on exploration and critical thinking are key. This research seeks to address the existing shortcomings of VFT by developing a more accessible and comprehensive virtual experience, by integrating stimulus, case studies and real-world problem-solving exercises specifically designed to enhance critical thinking based on Ennis' indicators. Given the urgency of environmental conservation, especially in coastal areas, enhancing critical thinking is not just an academic exercise, it is an important step to equip students with the skills to navigate and contribute to solutions to pressing ecological issues. Again, this research is crucial in advancing the pedagogical tools available for environmental education and the practical understanding students need to foster sustainable conservation efforts.

The use of digital technology with Virtual Field Trip (VFT) in education is proven to improve students' literacy, learning outcomes and critical thinking skills (Khotimah et al., 2024; Vatyca, 2021). Integrating VFT in learning has the potential to significantly improve students' critical thinking skills, which is a systematic process of solving problems, making decisions, analysing assumptions, and conducting scientific research (Aswan et al., 2023). Indicators of critical thinking according to Ennis include conveying simple explanations, forming basic skills, inferring, elaborating further explanations, and organising tactics and strategies in solving problems (Hasanah et al., 2021; Septiany et al., 2024). Research on VFT shows that it provides a near-reality experience, enriches understanding of the subject matter, and motivates students in a more engaging and interactive way than conventional methods (Seifan et al., 2019). However, the specific relationship between the use of VFT media and the improvement of critical thinking skills in students' needs to be further explored. Thus, the difference between this research and previous research is that VFT will be developed with the aim of improving students' critical thinking skills and measuring its effectiveness in learning geography, another difference from this research lies in the content provided, the content is created with various camera angles and drones, and in the learning video presents CMC managers directly for more in-depth learning about conservation, By interacting with content presented in a rich multimedia format, users can develop better evaluation, analysis, and problem solving skills.

METHOD

This research uses development research or Research and Development (R&D). The development model is ADDIE (Analyse, Design, Development, Implementation, Evaluation). The ADDIE model was chosen because it is systematically structured and simple and easy to understand and apply. The flowchart in Figure 1 illustrates the sequential process of product development carried out in this study.

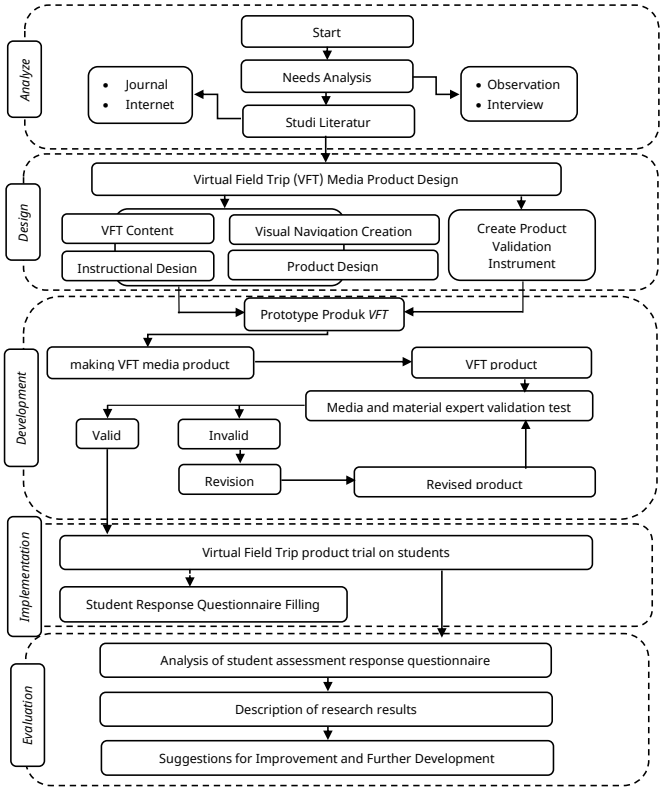


Figure 1. Development Flowchart

The data collection instruments used in this development consist of three types. First, interviews and student needs questionnaires are used to analyse the needs that must be met by the developed learning media. Second, material and media expert validation sheets are employed to assess the feasibility of the developed media and the accuracy of the materials used. Third, student response questionnaires are utilized to identify changes in students' critical thinking skills and their responses to the developed VFT learning media (Ardiansyah et al., 2023). After collecting the data using these instruments, the next step is to analyse the data through appropriate techniques.

Data analysis techniques are carried out to find answers to the results of data collection which are then explained in more detail in the results and discussion section in the next chapter. The analysis technique is carried out in stages to make it easier for researchers to analyse research data (Wibawa, 2020). There are two types of data analysis techniques carried out, namely qualitative data and quantitative data. Qualitative data are the results of validation and response questionnaires, the scores obtained are then calculated by calculating the average value. Likert scale is used as a questionnaire assessment. The Likert scale has high reliability, flexibility, and the number of alternative answers can be adjusted by the researcher in measuring the respondent's attitude towards the statement. The criteria used for the Likert scale in this study are shown in Table 1.

Table 1. Likert Rating Scale Validator and Students

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

Source: Nee and Yunus (2020)

Table 1 presents the calculation of the average value for each category as well as the overall responses from respondents, using the method proposed by Nee and Yunus (2020). To simplify the process, the formula is applied to each question category.

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

Descriptions:
N = Value
X = Total Score from Respondents
Xi = Maximum Possible Total Score

Formula for calculating the total score of all respondents:

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

Descriptions:
T = Total number of students respondents
Pn = Likert score numbers

$$Indeks\% = Total\ Score \div Y \times 100\% \quad (3)$$

Descriptions:
Y = Highest Likert scale score multiplied by the number of student respondents

By using the formula above, calculations are carried out and the overall answer is obtained, then the calculated data is interpreted in the form of percentages and grouped into 5 categories

as shown in Table 2. If the media developed falls into the feasible to very feasible category, then the media can be considered feasible to implement without the need for revision. However, if the results show the category of Undecided to Very Inappropriate, then revisions are needed.

Table 2. Valid Criteria and Media Appropriateness

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

Source: Sumartini et al. (2020)

RESULT AND DISCUSSION

Learning Media Validation

The Virtual Field Trip (VFT) learning media was validated by media experts and material experts who are competent in their respective fields. The validation process involved the collection of quantitative data and qualitative data. Quantitative data were obtained from the final evaluation scores provided by the experts, while qualitative data were gathered from the feedback, comments, and suggestions offered during the validation process. Both types of data were analysed comprehensively to determine whether the media is feasible, effective, and aligned with the intended learning objectives (Damayanti et al., 2018). Furthermore, the results of media and material validation also take into account expert feedback to enhance the quality of the developed learning media, as summarised in Table 3, which presents the comments and suggestions from the expert validators.

Table 3. Result of Comments From Expert Validator

No	Validator	Indicator	Comment
1.	Media Expert	Objective	Should detail the technical instructions
		Visual	Need to pay attention to the color and brightness of the background
2.	Material Expert	Material	Add material on the urgency of conservation

The validation results indicate that the Virtual Field Trip (VFT) learning media has been deemed valid. This conclusion is based on the alignment of the media content with key assessment criteria, including visual design, instructional material, objectives, usability, and overall benefits. The media successfully meets the established validity standards, confirming its suitability for educational use. A detailed overview of these findings is presented in Table 4, which summarises the results of expert validation.

Table 4. Summary of Expert Validation Results

No	Validator	Indicator	Percentage (%)	Category
1.	Media Expert	Objective	90%	
		Visual	93,75%	Very Suitable (SL)
		Usage	92,85%	
2.	Material Expert	Material	96,42%	
		Usage	91,66%	Very Suitable (SL)
		Benefits	100%	
Average			94.11%	Very Suitable (SL)

Table 4 presents the final validation results of the Virtual Field Trip (VFT) learning media, which achieved an impressive average score of 94.11%. According to Sumartini et al. (2020), this score falls within the "Very Suitable" category, indicating a high level of appropriateness for educational purposes. The strong performance across various validation criteria confirms that the VFT media is highly effective and well-suited as a learning tool, particularly for teaching geography topics related to conservation. Its robust design, which integrates visual elements, comprehensive material, and practical usability, ensures that it enhances students' learning experiences. Consequently, this media is not only appropriate but also a valuable resource for engaging students in environmental conservation topics, fostering both critical thinking and deeper understanding of the subject matter.

Media Result

On the Virtual Field Trip (VFT) home screen, the initial display welcomes users with an entry point to Clungup Mangrove Conservation (CMC), also known as Pos 1 CMC. The navigation panel on the left side of the screen features several key elements, including the logos of the State University of Malang and Clungup Mangrove Conservation, a detailed explanation of the VFT, user guidelines, stated learning objectives, the geographical location of CMC, the student response questionnaire, as well as information about the researcher and their affiliated institutions.

This interface is deliberately designed to capture students' attention from the very beginning, fostering engagement and enthusiasm for the learning experience. The layout and visual components were developed by applying fundamental graphic design principles (Gogahu & Prasetyo, 2020; Rahim et al., 2022), ensuring a balance between aesthetic appeal and functional clarity. Moreover, by reflecting the authentic conditions of the CMC site, the design provides an immersive and realistic experience, enabling students to better grasp and connect with the presented conservation materials. The visual representation of this interface is shown in Figure 2, which illustrates the VFT home screen.



Figure 2. Home Screen Virtual Field Trip

In the Learning Objective display in Figure 3, there are several learning objectives expected in the learning process (Kustandi et al., 2021), including skills, knowledge, and understanding that students need to master and achieve in learning about the material of Biodiversity Patterns of Indonesia and the World, with Conservation sub-material. By achieving these objectives, students are expected to have a comprehensive understanding of the importance of conservation and be able to contribute to biodiversity conservation efforts. The learning objectives also encourage students to adopt a proactive role as environmental stewards, preparing them to take meaningful

action in conserving biodiversity through informed decision-making and collaborative conservation initiatives.



Figure 3. Learning Outcomes

In the material display in Figure 4. there is a clearly visible hotspot icon that can be clicked to go to the material, the learning material consists of conservation material and study material about conservation activities at CMC, the existing material is adjusted to the indicators of critical thinking skills which are the objectives of this study (Hasanah et al., 2021; Septiany et al., 2024). The materials are further enriched with a comprehensive learning video that illustrates the mangrove conservation process in collaboration with CMC managers. This video is exceptionally detailed, offering an in-depth explanation of the steps and practices involved in conservation at CMC. The integration of drone footage and cinematic visuals adds a dynamic and immersive quality to the learning experience, making it not only visually appealing but also easier for students to grasp complex conservation concepts.



Figure 4. Material Content

The Virtual Field Trip (VFT) is equipped with a “View All Panoramas” feature that greatly enriches the user experience by enabling seamless navigation across multiple locations within the virtual environment. With just a few clicks, users can move intuitively from one site to another, making the exploration process both smooth and engaging. Each location is accompanied by descriptive information, providing essential context for the area being explored.

This combination of free movement and informative content fosters a stronger connection with the material and enhances comprehension, thereby reinforcing learning outcomes. As a result, the feature proves to be a highly effective tool for geography and environmental education (Maulana et al., 2023). The interface of this functionality is illustrated in Figure 5, which presents the “All Panoramas” view.

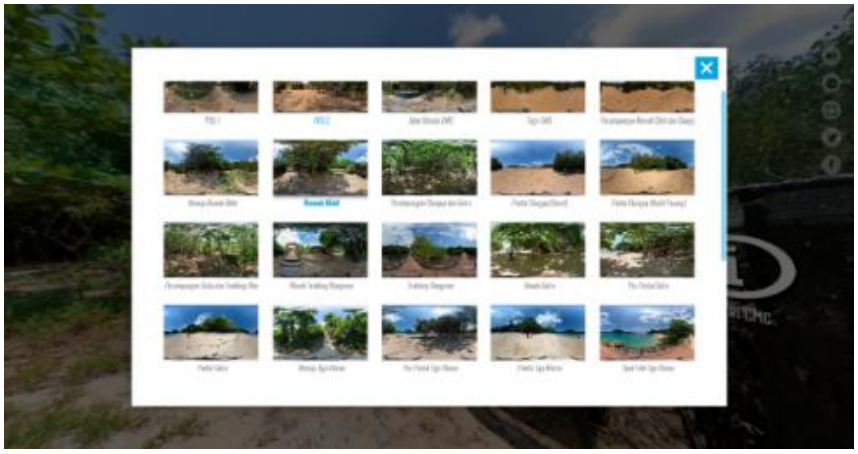


Figure 5. All Panorams Views

Assessment activities are closely aligned with the intended learning objectives, ensuring that students not only gain a comprehensive understanding of the material but also develop their critical thinking skills (Muzaki & Mutia, 2023). To achieve this, the assessments are structured through case studies and guiding questions designed to challenge students at varying cognitive levels. These tasks move beyond rote memorisation, prompting learners to engage in higher-order thinking processes.

Students are required to deliver clear and concise explanations, strengthen their foundational knowledge, draw conclusions from the learning material, and extend their reasoning through further elaboration. Moreover, the assessments encourage students to organise their ideas systematically, employing problem-solving strategies and methods to address more complex issues. The structure and design of these assessment activities are illustrated in Figure 6.

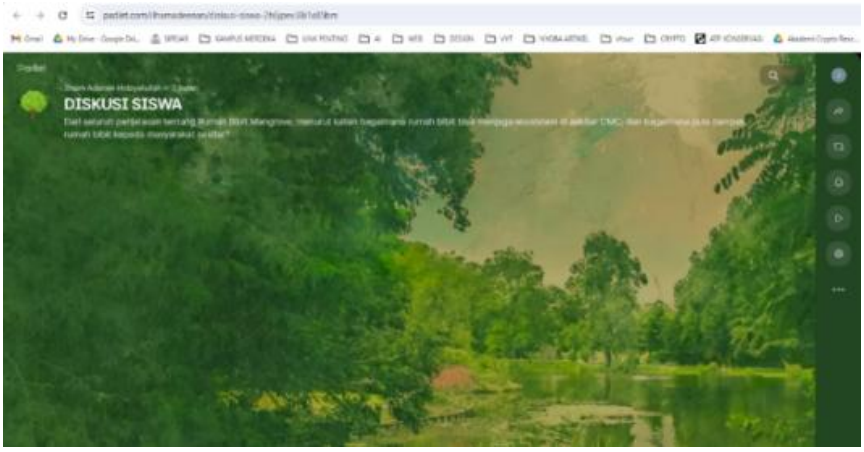


Figure 6. Assessment Activities

Result of Students Response and Improvement in Critical Thinking Skills

After the implementation of the Virtual Field Trip (VFT) learning media, students filled out a response questionnaire consisting of 15 questions with a Likert scale of 1-4. The results of the analysis showed that the VFT learning media received a percentage of 89.22%, which means that this media is very feasible to use in conservation materials (Wibowo & Setiawati, 2023). This percentage reflects several aspects, such as ease of learning, flexibility, and clarity in visualising conservation materials. To fulfil the criteria for the practicality of learning media, a positive

response of 50% to the aspects proposed in the respondent sheet is required (Sekarsih & Mustopa, 2022). In addition to assessing the feasibility of the VFT media, students' critical thinking skills were also evaluated.

The students were asked to answer questions based on indicators of critical thinking skills that include conveying simple explanations, forming basic skills, inferring, elaborating further explanations, and organising tactics and strategies in solving problems (Septiany et al., 2024). The results showed that the average student score was 81.4. This is in line with research by Amala et al. (2019) and Oktaviana et al. (2022) which found that students learn better by using VFT to demonstrate concepts and skills during learning. In addition, research by Rizaldy et al. (2022) showed that the use of interactive learning media such as VFT in geography subjects successfully improved students' critical thinking skills and learning motivation.

The difference between this research and previous research is that the VFT will be developed with the aim of improving students' critical thinking skills and measuring its effectiveness in geography learning, another difference that becomes the advantage of this research lies in the content provided, the content is created using various shooting angles, including from cameras and drones, to provide a richer and more comprehensive point of view. In addition, the learning videos in this study also feature CMC managers, providing in-depth insights into the conservation practices undertaken. This approach is expected to not only improve students' understanding of geography materials but also inspire them to care more about environmental issues through a more interactive and immersive learning experience (Jochecová et al., 2022; Šašinka et al., 2018). The limitations of VFT learning media are, first, the use of media tends to be less effective in developing field-based skills through this media when compared to the experience of direct field visits, second, users are required to download the VFT application first before using it, third, this media cannot convey the sensation of texture, aroma, or other subtle cues that contribute to interpreting information in the field.

CONCLUSION

The use of Virtual Field Trip (VFT) learning media in Clungup Mangrove Conservation proved to be very effective in improving students' critical thinking skills. The results of expert validation and feedback from students showed a high level of suitability and effectiveness of the VFT media in delivering conservation material and fostering critical thinking skills. This study concludes that VFT is a valuable tool in geography education, particularly for conservation topics, as it makes learning more interesting and effective. This innovative approach enriches the learning experience while motivating students through a realistic and interactive educational environment, thus enhancing student understanding and engagement. To overcome the limitations of VFT learning media, several solutions can be implemented in future research. First, the development of training modules designed to reinforce field-based skills can help overcome the lack of effectiveness in developing such skills. Second, creating VFT applications that are easily accessible and compatible with various devices to make it easier for users. Third, integrating augmented reality (AR) or virtual reality (VR) technologies to simulate texture and aroma sensations, as well as using additional devices such as haptic gloves, can add the missing sensory dimension. Thus, VFT can be more effective and closer to the experience of a live field trip.

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