


Virtual Learning Media Exploration 3D View of the Konto River Watershed to Support 21st Century Learning

Feri Fahrian Maulana¹, Ifan Deffinika¹, Fatimatun Jazilah², Leela Balab Pokhrel³

¹Geography Education, Universitas Negeri Malang, Jl. Semarang, Malang, Indonesia

²Islamic Senior High School NU Pujon, Jl. Brigjend Abd Manan Wijaya, Malang, Indonesia

³Tashiding Lower Secondary School, Dagana, Ministry of Education and Skills Development, Bhutan

ARTICLE INFO	ABSTRACT
<p>Article History: Received: 2023-08-02 Accepted: 2023-09-20 Published: 2023-09-30</p> <p>Keywords: Hydrosphere; Innovation media; Learning Effectiveness; Technology</p> <p>Corresponding author: Ifan Deffinika Email: ifan.deffinika.fis@um.ac.id DOI: 10.34312/jgej.v4i2.21399</p> <p>Copyright © 2023 The Authors</p>  <p>This open-access article is distributed under a Creative Commons Attribution-NonCommercial (CC-BY-NC) 4.0 International License</p>	<p>21st-century learning has encouraged more interactive learning. The use of technological media in geography learning continues to be developed. However, the development of 3D view virtual exploration media is still rarely carried out. This research discusses virtual exploration of 3D view which can carry out direct 3-dimensional interactions to give students a better impression in learning geography. This research aims to provide innovation in developing Virtual Exploration as a learning media to support 21st-century learning in realizing environment-based learning. The research method used is R&D with the ADDIE model consisting of Analyst, Design, Development, Implementation, and Evaluation. The Development Phase is carried out in accordance with the research objectives. Data was collected using a mixed questionnaire consisting of (1) a closed questionnaire in the form of an answer checklist and (2) an open questionnaire in the form of direct answers from respondents. The data analysis technique used is the results of initial analysis data, data from material and media validity tests as well as student and teacher response data to the media. The media validation results were carried out by material experts with a percentage value of 90.50%, media experts at 84.5%, and geography teachers at 91.50%. The average student response from the media was 88.65%. Thus, the 3D view virtual exploration learning media on the sub-terrestrial hydrosphere material of the Konto watershed has the potential to be an effective learning tool in schools and gets a very positive response from students.</p>

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1. Introduction

Technological developments in 21st-century learning are currently very advanced. It cannot be denied that technological advances in the current century are specifically for the use and development of learning media (Ritonga et al., 2021). The use of learning technology on websites, applications, games, and video streaming platforms such as YouTube and other technology platforms has also brought many changes to the world of education, especially geography learning. Flexibility and comfort in learning through technology can improve the quality of learning (Nurmuhlisna, 2019). As stated (Hastini et al., 2020) there are 7-10 hours/day used by Generation Z (those born in 1995-2012) to access and interact with electronic media or digital media. There is an interrelated relationship between technological developments and the millennial generation (Fabrimal, 2018). So it is important to develop technology-based media that suits the needs of the times.

Media has different meanings from different points of view. In the educational context, media is defined as a tool that supports the delivery of teaching material by teachers to students. Not only as a tool, the use of media in the learning process can also increase active student participation in the classroom (Silmi & Hamid, 2018). Media literacy is a life skill for students to understand and critically analyze problems in learning. Moving away from the conventional concept which views media as limited to rigid printed learning aids, media in the 21st century is seen more as technology that contains teaching materials and other learning components with the aim of attracting students' interest in learning (Muzammil et al., 2023). The technological basis of this teaching media allows it to be integrated with various learning sources and with more flexible access. Therefore, the development of teaching media today should include elements of technology.

The results of the observations were carried out by researchers at NU Pujon Islamic High School. Students' motivation in learning is still lacking, the reason is that the learning media is not interesting because the use of technology in learning media is still limited. The results of distributing questionnaires to students in class As a result, the learning process becomes uninteresting. Therefore, efforts are needed to develop alternative media such as Virtual Exploration, to reduce the difficulties experienced by students in understanding the concept of Hydrosphere sub-Land Water during the learning process.

The use of Virtual Exploration 3D view as a learning medium in various institutions has various purposes, one of which is to make it easier for students to explore (Hendra et al., 2021). Virtual spatial exploration in geography subjects can be carried out in the hydrology material, and sub-discussion of land waters. The use of media in this material will make it easier for students to analyze and understand hydrological problems. This is supported by the main characteristics of VR-based 3D viewing media, which include being able to display virtual reality, input additional information, enable learning in hard-to-reach environments, and facilitate virtual experiments (Kim & Lim, 2019). The VR learning media produces a virtual environment that allows students to experience intuitive feelings and interact with learning objects (Jaalama et al., 2022).

One of the innovative media to support the learning process is Virtual Exploration 3D view technology. Virtual Exploration 3D view or panoramic 360 media allows students to carry out direct 3-dimensional interactions to give students a better impression of geography learning (Stojšić et al., 2017). Virtual Exploration 3D View technology raises curiosity about the "details" of geosphere phenomena, through this technology students do not journey into a virtual realm independently, but as a spatial prompt designed to provoke new questions for students who are already on the path to developing geographic understanding and imagination related to certain phenomena (Roelofsen & Carter-White, 2022). The interactive learning media Virtual Exploration 3D view or Panoramic 360 in geography subjects has succeeded in improving students' critical thinking skills in learning and students' learning motivation. These results can be used as a benchmark to further develop website learning media with various topics and diverse materials.

Research (Putra et al., 2021) in the learning context, there is a need for the presence of media as a tool for teachers to deliver material in a stimulating and effective way. This research explores the use of cards with Virtual Exploration 3D View technology as a visual tool to support the delivery of material and facilitate problem-solving in the learning process. Due to its ability to present virtual visual representations into the real world and to invite users to explore freely, Virtual Reality technology has significant potential (Arini & Nusa, 2023). In this context, combining illustrated cards with Virtual Reality technology will create interest for students and encourage their interest in understanding and exploring the learning material (Hastini et al., 2020).

The ability to process and analyze information can be obtained more effectively through the use of media as a component in the learning process (Silmi & Hamid, 2018). As explained by (Widianto, 2021), an approach to solving problems by combining media through the integration of Information and Communication Technology (ICT) in the learning context is considered appropriate for improving students' high-level thinking abilities. The growth in the use of integrated modern technology in everyday life also has an impact on the development of learning systems in the 21st-century era which consists of the 4Cs of communication, collaboration, critical thinking, and creativity (Fadlan, 2022). In the era of 21st-century education, educators are faced with the challenge of guiding students so they can contribute in the context of today's life. One of the essential literacy skills for students in facing the demands of the 21st century is technological and digital literacy skills (Hartono & Purwanto, 2017). This refers to students' skills in utilizing, assessing, and developing technology and digital content to overcome various challenges related to their learning process (Sylvia et al., 2021).

This research has been conducted by (Lucía et al., 2023) regarding virtual exploration media which is widely used and utilized as a creative learning tool in the form of applications on PCs. Research by (Yudintseva, 2023) on 360 panoramic image media improves learning outcomes on environmental material thereby increasing student experience. Research by (Oje et al., 2023) regarding Virtual Tour media in the form of an application has improved students' experiences without having to go to the field. However, none of the media has discussed Virtual Exploration 3D View which is integrated with the website. Therefore, the researcher will overcome the gaps in previous research with the aim of the researcher, namely to develop Virtual Exploration 3D View media which is integrated with the website as a learning medium for the Hydrosphere material. This media development research will create convenience for students in the learning process by being able to access it on all devices without installing an application. This media provides an alternative for educators in utilizing 21st-century learning media in the classroom environment.

2. Methods

2.1 Location and Research Objects

Media development research was carried out at the NU Pujon Islamic High School, located in Ngroto Village, Pujon District, Malang Regency, East Java Province. The research was conducted in class X-6 which consisted of 36 students. The duration of the research lasted for 5 months, from February to June, during the even semester of the 2022/2023 academic year and the research location for 360 panoramic data collection was carried out around the upstream to downstream of the Konto River in Pujon.

The research object for media development is Virtual Exploration 3D View, which is a series of panoramic images that are arranged and combined using the 3D Vista software tool to become a life-like image that can create a virtual experience for users in the form of a website.

2.1 Development Procedures

The research method uses R&D (Research and Development). In the development model, the ADDIE model is used. Five stages must be used in developing a product, namely needs analysis assessment, design, development, implementation, and evaluation. This research uses the ADDIE stages with modifications only carried out until the development stage in accordance with the research objectives. The product of this research is a 3D view exploration application based on inland sub-water material in the Konto River ([figure 1](#)).

The first stage in ADDIE is an analysis consisting of three aspects, namely needs analysis based on student and teacher learning characteristics, analysis of the latest curriculum, and analysis of the media used so far. Analysis of teacher and student learning needs is very important for solving learning problems, especially in the use of learning media. Apart from that, this needs analysis aims to find out how big the need is to develop learning media in accordance with the material, especially Watershed (DAS) material. In the needs analysis, a questionnaire was used with indicators on aspects of learning problems and student characteristics. Meanwhile, the questionnaire for teachers contains aspects relevant to the problem, possible solutions, and teachers' learning media needs. The next analysis carried out was an analysis of the material seen in the current independent curriculum. This analysis was carried out by examining the material in more depth using the cone of experience as a reference, as well as examining the depth of learning outcomes, and the material according to students' cognitive level and its relevance to the Watershed (DAS) material. Analysis of previous learning media was carried out with the aim of finding out the use of developments in media that had been used previously. This analysis is carried out by looking at studies related to other relevant research and tabulating the data so that the advantages and disadvantages of the media can be identified.

The second stage of the ADDIE model is the initial design or planning stage based on the results of the needs analysis that has been carried out. This initial plan was created to prepare various supporting elements, including reviewing watershed literature using relevant and valid references, identifying applications using 3D Vista, as well as determining the blueprint. Detailed design planning through storyboard color schemes, supporting media such as digital maps, layouts, backgrounds, graphics, and other media such as videos. Apart from that, at this stage a flowchart and storyboard are also created. Making a flowchart is intended to make it easier to describe the work steps in developing the Virtual Exploration 3D View product.

The third stage of ADDIE is the development stage. The development stage is a very important step after completing the planning or design stage that has been carried out. At this stage the researcher begins to realize the product that was planned in the second stage (design) so that it becomes a product that is ready to use to be deployed to test subjects. At this stage, the first researcher opened the 3D Vista software to develop the Virtual Exploration 3D View product. The researcher then determines the model that will be used according to the design steps. Determining a story map model is important because it relates to interesting aspects of the media being created. The next step is to create a story map title, document subtitle, and also a narrative explanation of the document. During development, researchers added digital maps, 360 images, videos, and graphics related to watershed documentation. To find out how the Virtual Exploration 3D view works optimally, a testing procedure was carried out. The final step in this development stage is material and media validation testing. The validation test is intended to determine the validity of the material and media analyzed using quantitative analysis techniques which are assessed according to the type of validity assessment according to Table 2. Validation is carried out using a mixed questionnaire by validators taken from validators who are media experts and material experts. Mixed questionnaires are mentioned in the form of closed questionnaires and open questionnaires combined in a questionnaire device. The validation results are intended to reveal deficiencies in the media created so that modifications and improvements can be made so that the media is valid. From the results of the questionnaire, two types of data were produced. The types of data are quantitative and qualitative data where the qualitative data comes from the results of mixed questionnaire answers in the open questions section (open questionnaire). Quantitative data is obtained from scoring criteria using a Likert scale provided by media and material experts as well as feedback from users, namely teachers and students during testing or implementation. Question indicators in the material expert validation questionnaire have four aspects, including appropriateness of content, appropriateness of presentation, appropriateness of language, and contextual assessment. Meanwhile, the question indicators in the media expert validation questionnaire include layout assessment aspects, media design aspects and media visual aspects. In the questionnaire assessment, three evaluation recommendations were made for material and media

expert sources including; suitable for use without revision, suitable for use with revision, and not yet suitable for use and must be revised.

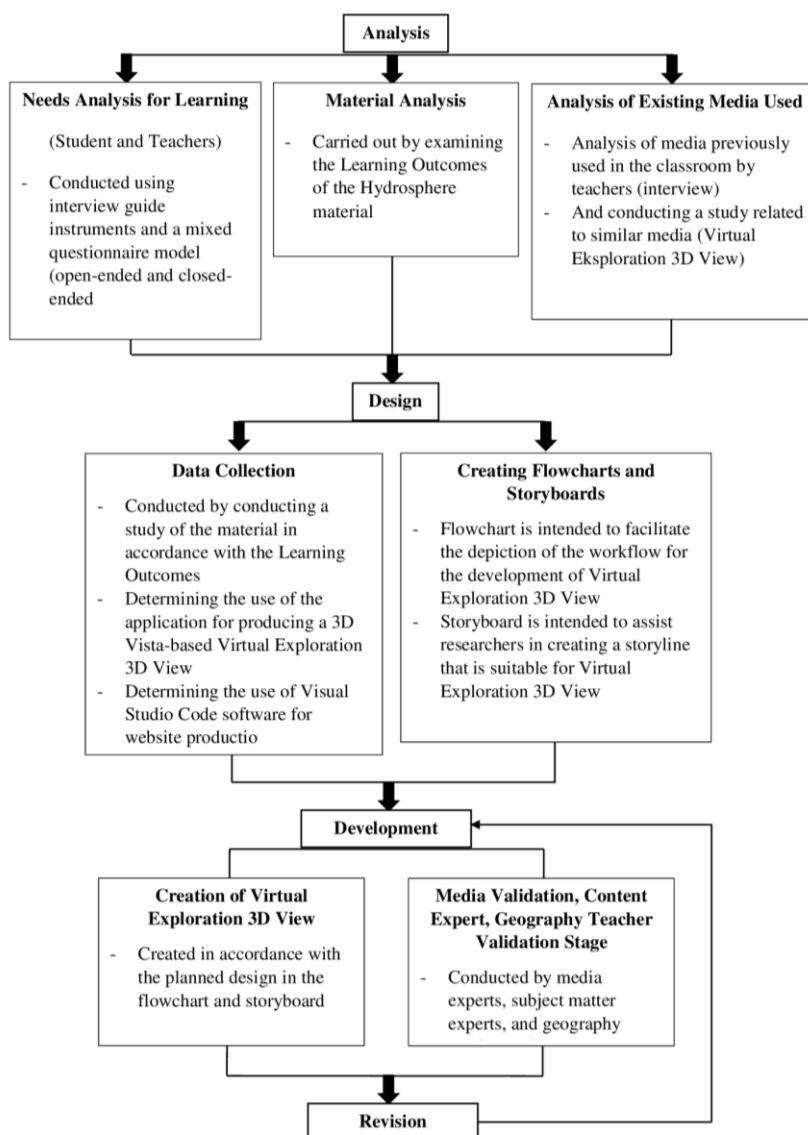


Figure 1. Research Flow

2.2 Data Collection Methods

The research method uses a mixed questionnaire. This type of mixed questionnaire is very suitable for use in this research because it is a combination of a closed questionnaire model (in the form of a checklist of answers) and also an open questionnaire (in the form of direct descriptive answers from respondents). Thus, the data obtained will be more varied, including quantitative data and qualitative data. Researchers created three questionnaires with different objectives, (1) a questionnaire to analyze the needs of students and teachers which was distributed directly to schools, (2) a questionnaire to test the validity of the material given to lecturers who were experts in Watershed (DAS) material, and (3) questionnaire to test media validity given to lecturers who are experts in media development.

2.3 Data analysis

Data analysis techniques are carried out to find out the correct answers from the results of data collection which are then explained in more detail in the results and discussion section in the next chapter. Based on the data obtained in the form of qualitative and quantitative data, analysis was then carried out. This analysis is based on the results obtained from respondents both from material expert validators and media experts as well as from teacher and student response questionnaires. Data from the assessment results from validators and test subjects from the questionnaire were analyzed.

This analysis technique was created in stages to make it easier for researchers to analyze research data needs (Wibawa, 2020). The analysis carried out consists of the results of initial analysis data, data from

material and media validity tests as well as student and teacher response data to the media. First, analyze the results of the student and teacher needs questionnaire using formula equation (1).

$$P = \frac{F}{N} \tag{1}$$

Description
 P: Student score percentage,
 F: Student score frequency,
 N: Number of students

Change the qualitative assessment of the results from the media expert and material expert validation questionnaire into quantitative data using a Likert scale with a score of 1 to 5 referring to the analysis technique developed by (Sugiyono, 2015).

Table 1. Likert Scale

Description	Score Category
Strongly agree	5
Agree	4
Neutral	3
Don't agree	2
Strongly Disagree	1

Source: (Sugiyono, 2015)

Table 1 Calculating the average value for each category and the overall answers from respondents refers to the method developed (Sumartini et al., 2020). To make it easier, formula equations can be used for each question category (2).

$$N = \frac{x}{xi} \times 100\% \tag{2}$$

Description :

- N : Value
- X : Respondent's total score in 1 question item
- Xi : Maximum total score in 1 question item

The following is the formula for calculating the percentage of all respondents' answers

$$Total\ Score = T \times Pn$$

Keterangan :

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

$$Indeks\% = Total\ Score \div Y \times 100\% \tag{3}$$

Description:

Y : Highest Likert score x number of student respondents

Based on the calculation results using the formula (3) and getting the overall answer from the respondents, namely media and material experts as well as test subjects. Then, the interpretation of the calculated data in the form of percentage data is carried out into 5 categories as in Table 2. Once it is known that it is categorized as feasible to very feasible, it can be said that the media developed is classified as feasible and can be implemented on test subjects without making revisions. If the results of a category show a scale of Doubtful to Very Unfeasible then revision is required.

Table 2. Valid Criteria and Media Appropriateness

No	Description	Category
1	0%-19.99%	Very Unfit (STS)
2	20%-39.99%	Inadequate (KL)
3	40%-59.99%	Undecided (R)
4	60%-79.99%	Worth (L)
5	80%-100%	Very Eligible (SL)

Source: (Sumartini et al., 2020)

3. Results and Discussion

The development of learning media products is carried out in stages, in accordance with the R&D research and development methods developed by ADDIE. To create quality media, a series of validations were carried out by experts in the fields of media, materials, and geography teachers. Apart from that, trials were also carried out on all students. This process aims to collect the data needed to make revisions or improvements so that it can produce effective and useful learning for students.

The development research produced a product in the form of Virtual Exploration 3D View learning media which was integrated with a valid and feasible website using 3D Vista software and Visual Code Studio on the sub-inland water hydrosphere of the Konto Watershed. This 33-view virtual exploration is made easy to understand and interesting for students. The media is accompanied by background music, 360 panoramic views, and documentary videos on each display, thereby increasing students' enthusiasm. This media is also equipped with problem-based question activities from 360 panoramic images so that students are required to solve problems from these images both individually and in groups, making students actively talk during learning activities in class.

3.1 Home Screen

In the initial display of [Figure 2](#), there is a title with the text Konto River Watershed, 360 panoramic image model, media menu consisting of the State University of Malang logo, learning outcomes, materials, quizzes, references, profiles, map images. If you press it, it will go to Google Earth. is the location of the Konto watershed and this display will increase students' enthusiasm because the learning media is displayed in real terms according to actual field conditions from the upstream part of the Konto River.



Figure 2. Home Screen Virtual Exploration 3D View

3.2 Display of learning outcomes

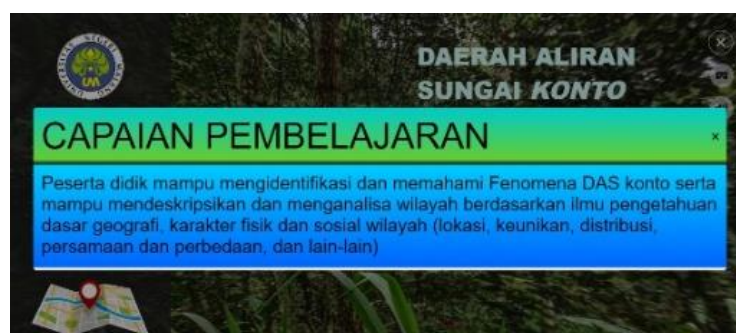
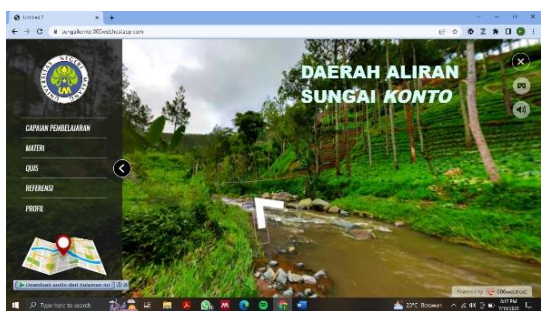


Figure 3. Material learning outcomes

In the display of learning outcomes in [Figure 3](#) there is a text of learning outcomes that must be achieved in learning material on the sub-terrestrial hydrosphere. These learning outcomes consist of skills and knowledge in identifying, describing and analyzing the problems that exist in the Konto watershed.

3.3 Display of material content and case studies



(a) Panoramic 360 Hulu DAS Konto



(b). Problem dan solution About river



(c). Panoramic 360 Lower Middle of the Konto Watershed

Figure 4. Material content and case studies

In the material display there is text, location maps, 360 panoramic images, natural sound background, as well as documentary videos about the rural environment around the Konto watershed. The 360 panoramic [Figure 4](#) displayed is in accordance with the real conditions of the upstream and downstream parts of the Konto Watershed, as well as a display of the activities of residents who often carry out around the Konto Watershed in their daily lives. So this will increase students' enthusiasm and interest regarding the sub-terrestrial hydrosphere material of the Konto watershed. In the documentary video presented there is a voice over combined with background sound, so that the delivery of the material is not from pictures and videos but is also explained with a voice over, the aim is to make it easier for students to understand the material about sub-land waters, especially the Konto watershed.

3.4 Assessment display

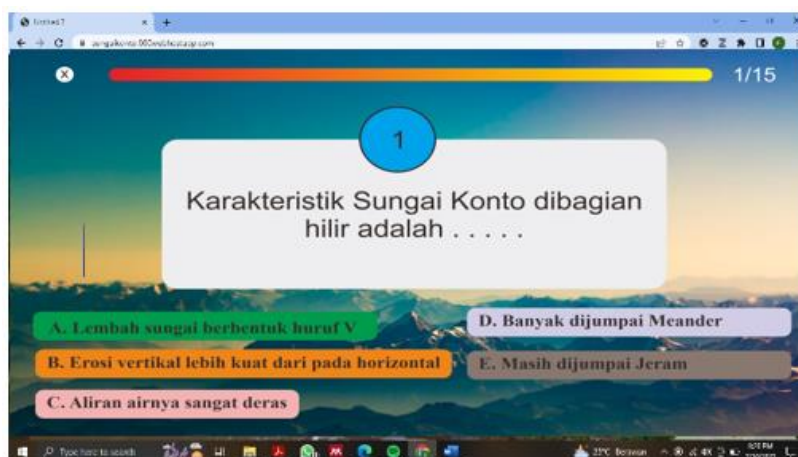


Figure 5. Assessment Activities

Question evaluation activities are adjusted to the learning outcomes and objectives to be achieved ([Figure 5](#)). This aims to encourage students not only to understand the material but also to think critically, overcome problems and be confident in carrying out evaluations (Muzaki & Mutia, 2023). Teachers also know students' knowledge through the answers given during evaluations, as well as assessing learning outcomes based on evaluation activities.

3.5 Reference display

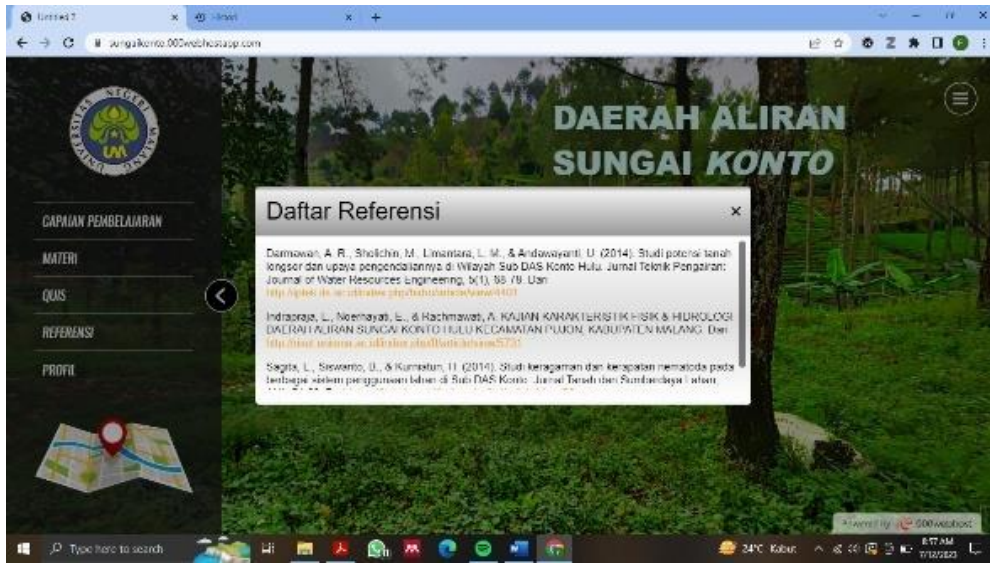


Figure 6. Reference display of material

In this Virtual Exploration 3D view media there are relevant material references for [Figure 6](#) sub land waters of the Konto Watershed, the references are taken from journals that are appropriate to the study of hydrological material, through this reference, students can obtain better material about the Konto Watershed. This reference provides a solid foundation for a deeper understanding of the Konto watershed environment and the challenges it faces.

3.6 Media Expert Validation Results

The virtual exploration 3D view learning media has been designed and evaluated by experts in the field of media and learning materials. The evaluation involves collecting quantitative and qualitative data. Qualitative data was obtained from comments provided by validator experts. Quantitative data is obtained through assessments carried out by validator experts. These two types of data were analyzed in more depth to assess the effectiveness and feasibility of the learning media being developed (Artawan et al., 2023). The results of the evaluation carried out by validator experts are seen in [table 1](#).

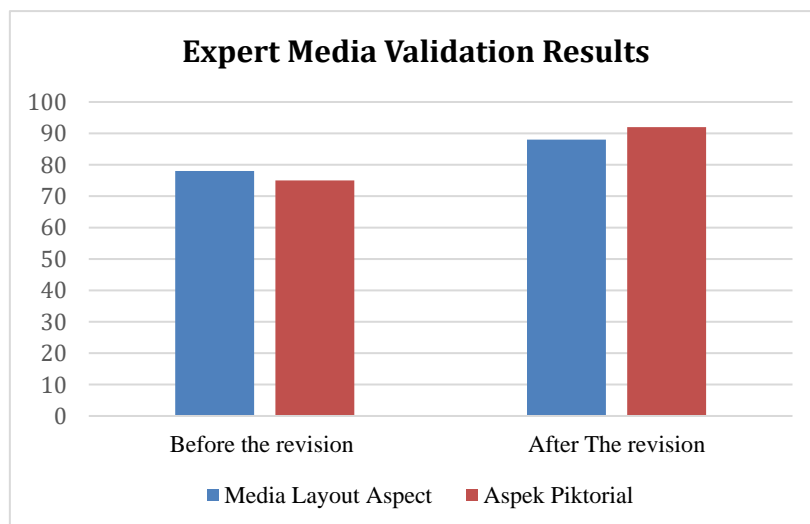


Figure 7. Chart assessment by media experts

Based on [Figure 7](#), after going through several revisions, the 3D view exploration learning media has achieved poor results. Before the revision, the media layout aspect got a score of 78 and the pictorial aspect got a score of 75. Then, after the revision, the media layout aspect reached a score of 89 and the pictorial aspect

reached a score of 92. Therefore, the validation results of this learning media can be categorized as very good or very valid.

The validation results of the learning media that have been developed can be considered valid if they are assessed based on an analysis of conformity with previously established criteria, namely including aspects of prototypes and pictorial access as explained by (Ou et al., 2021). (Putra et al., 2022) also explained that a learning media is considered valid if the results are in accordance with predetermined criteria, which means the test results are in line with these criteria.

3.7 Results of Material Expert Validation

The results of validation by material experts provide several improvements in the preparation of material in this media. These improvements can be found in detail in [table 1](#).

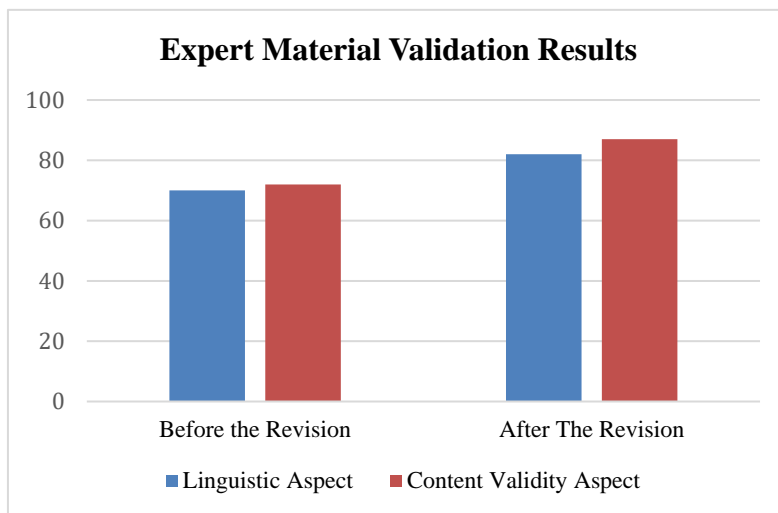


Figure 8. Assessment chart by material experts

Based on the data in [Figure 8](#), the results of the material expert validation show that before the revision the score for the content suitability aspect was 70 and the linguistic aspect was 72. Furthermore, after the revision it showed an increase in the content suitability aspect of 82 and the linguistic aspect of 87. Therefore, it can be concluded that the media is very good and worthy of development, considering the comments and suggestions provided by material experts.

3.8 The Validation Results of Geography Teacher

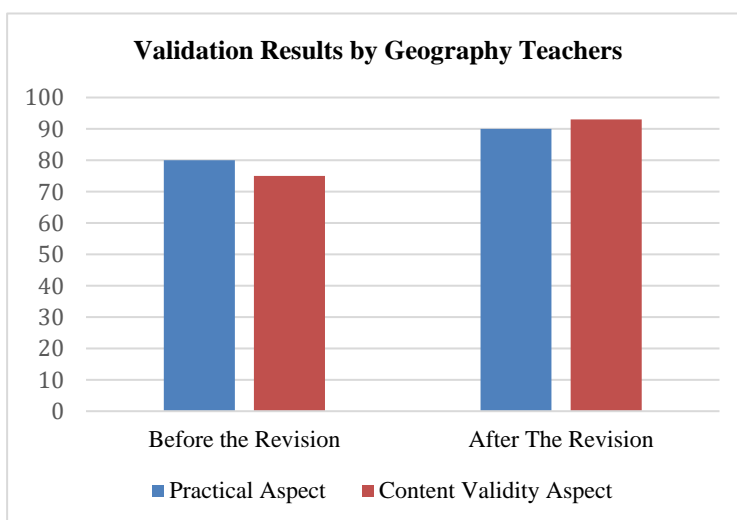


Figure 9. Geography Teacher Validation Results

Based on [Figure 9](#), the results of the geography teacher validation, and the results of the material expert validation show that before the revision, the score on the practicality aspect was 80 and the content feasibility

aspect was 75. Furthermore, after the revision, it showed an increase in the practicality aspect of 90, and the content feasibility aspect was 93. Therefore, it can be concluded that this media is very good and worthy of development, considering the comments and suggestions provided by material experts ([table 3](#)).

Table 3. Data results before revision and revision suggestions from validation media experts, material experts, and geography teachers

No	Before Revision	Suggestion Revision	After Revision
1	The order of materials is not correct	The order of the material is adjusted to the module being taught from upstream to downstream	The material is in accordance with the learning sequence
2	Learning material is still general, less focused on sub-land waters	Material that is one by one can be made into a separate display	Good, the learning material is good and detailed
3	Learning outcomes are too long	Learning outcomes are summarized again	Learning outcomes represent everything
4	The evaluation questions are too simple	The evaluation question must be related to the Konto watershed	A good evaluation is about the HOTS level
5	There are not many panoramic photos available	Adding 360 panoramic photos and videos for each sub-material	Panoramic photos are sufficient and appropriate

Based on the validity results, it was concluded that the 3D view exploration-based learning media for inland water material had been proven valid. The validity of the learning media, materials, and geography teachers is based on the suitability of the media content with the assessment aspects that have been determined. This assessment includes media appearance, suitability of material, language, and appropriate practicality. Thus, it can be said that the learning media has met the required validity criteria (Melinda et al., 2018).

Table 4. Summary of the Expert Validation Results.

No	Validation	Percentage (%)	Category
1	Media Experts	90.50%	Very Suitable
2	Subject Experts	84.50%	Very Suitable
3	Geography Teachers	91.50%	Very Suitable
	Total	266.50%	
	Average	88.83%	Very Suitable

[Table 4](#) shows the final validation results for the virtual exploration 3D view media, which obtained an average final score of 88.83%. This score indicates that the virtual exploration 3D view media is highly suitable and can be used as a learning tool for geography, especially in the topic of the hydrosphere, specifically inland waters. After revising the virtual exploration 3D view media, the next step is to conduct a trial with Class X-6, which consists of 36 students as respondents.

Table 5. Results of comments from several class X-6 students

Respons	Comment
Student 1	Virtual exploration 3D view is great, makes evaluation easy, and answers a lot of questions I want to ask
Student 2	Virtual exploration 3D view helps the learning process.
Student 3	PeLearning using virtual is easier.
Student 4	Virtual exploration 3D view good
Student 5	Thank you virtual exploration 3D view Very helpful.

Data from [Table 5](#) of student comments shows that students gave a good assessment of the media. This view is in line with the opinion of ([Jamil, 2019](#)) who stated that one of the criteria in selecting media is the appropriateness and suitability of the media to the needs of the learning task. It can be seen that the student responses have a score of 88.65%, which shows very decent results. This percentage reflects several aspects, including learning media that helps in understanding the material, language that is easy to understand, and clarity in visualizing material related to land waters. To meet the criteria for the practicality of learning media, it was stated a positive response was 50% to the aspects proposed in the respondent sheet ([Sekarsih & Mustopa, 2022](#)).

The statement about Virtual Exploration 3D View media is strengthened by research ([Armansyah et al., 2019](#)) which states that students will learn better when using Virtual Exploration 3D View or Panoramic 360 real illustrations which are used to demonstrate concepts and skills during learning. Panoramic 360 media research ([Yu et al., 2021](#)) regarding interactive multimedia, shows that the use of Panoramic 360 media is suitable for application in learning. The results of research regarding virtual tours or virtual panoramic 360 media have shown a significant increase in the level of user participation and involvement when compared to conventional methods. Meanwhile, media research ([Rizaldy, et.al, 2022](#)) states that the interactive learning media Virtual Exploration 3D view or Panoramic 360 in geography subjects has succeeded in improving students' critical thinking skills in learning and students' learning motivation. In media research ([Utomo et al., 2022](#)), the ability of Virtual Exploration 3D view or Panoramic 360 media to present virtual visual representations into the real world and to invite users to explore freely, Virtual Reality technology has significant potential. In this context, combining illustrated cards with Virtual Reality technology will create interest for students and encourage their interest in understanding and exploring the learning material. Virtual Exploration 3D view research ([Zammit, 2023](#)) allows individuals to engage in artificial environments created via computers, creating experiences similar to the real world. In the realm of research education ([Hong et al., 2023](#)) VR can be applied to provide interactive and authentic learning experiences, such as exploring a virtual museum or planetarium. Through its ability to provide direct experience, this technology is able to make learning material more interesting and easier to understand for 21st-century students.

The advantage of the Virtual Exploration 3D view learning media is that the first media can present information at various levels and display images from various perspectives simultaneously. For example, through the Virtual Exploration 3D view, we can see in detail the environmental conditions of the upstream, middle, and downstream parts of the Konto watershed. Second, diverse data from topography, geomorphology, and culture from each part. This media is also useful for accessing river areas that are difficult to reach, such as upstream areas due to funding, transportation, or limited accessibility. In addition, this media allows students to "visit the Konto watershed" repeatedly. Third, it provides access to information that students may not be able to access due to distance, time, or cost constraints. The use of this media can be accessed via a link https://youtu.be/iH_JCw2cWl4.

Limitations of learning media are Virtual Exploration 3D, the first view of media use is still faced with several limitations, including obstacles such as limited internet quota and the need for a stable network connection so that users can utilize the media. Both students tend to be less effective in developing field-based skills through this medium when compared to direct field trip experiences. These three media are unable to accurately depict the three dimensions of locations or objects and are unable to convey sensations of texture, aroma, or other subtle cues that contribute to interpreting information in the field.

4. Conclusion

21st-century skills are skills that students need to face the changes and challenges of the times to be able to adapt to change. Many educational practitioners adopt the 4C model, the skills that must be developed for the 21st century consist of the 4Cs of communication, collaboration, critical thinking, and creativity. Based on research, the Virtual Exploration 3D View learning media which is integrated with the website on the hydrosphere sub-land waters material, especially the Konto watershed, has successfully passed validation involving media experts, material experts, and geography teachers. In this validation, this media received an average score of 88.83%, falling into the "very feasible" category. The results of the trial on students showed an average score of 88.65% which was included in the "very feasible" category. Based on these results, it can be concluded that the Virtual Exploration 3D View learning media has met good quality and received a good response from students. Therefore, this learning media can be used effectively as a 21st-century learning tool in schools. This indicates that virtual exploration 3D view can be a good alternative as a learning medium. Development using 3D Vista has weaknesses, namely that the resulting media is limited to desktop displays and limitations and difficulties in adjusting existing features according to needs (customization). Therefore, it is very important for future research to carry out further development to create learning media that can not only be accessed via various devices but also offers interesting features that can be adjusted according to individual needs.

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