Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8, 739-743
2025
Publisher: Learning Gate
DOI: 10.55214/2576-8484.v9i8.9429
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Virtual reality-based learning digitization in disaster education for students in disaster-prone schools in Banggai district

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Abstract: Indonesia is a zone that has a high level of disaster potential because it is included in the ring of *fire* so that disaster events are at high risk which requires community preparedness to face all possible events. Banggai District of Central Sulawesi Province is a disaster-prone area based on *GIS (Geogrpahycs Information System)*. In the last 5 years, Banggai Regency has been hit by earthquakes, hurricanes and floods with a distribution of disaster-prone areas scattered in 19 disaster-prone sub-districts with a total hazard area of 81,632 hectares. For this reason, disaster management programs are a priority for the local government. Disaster management can be done through disaster education intervention as early as possible in the school setting, but the learning process needs to be improved to be more innovative and effective, one of which is through the *virtual reality-based* Audio-Visual learning digitization method. The purpose of this research is to design learning innovations towards *virtual reality-based* digitalization in disaster education at the school level. This research uses the *Mix Method* approach.

Keywords: *Digitalization, Disaster, Education, Learning, Virtual Reality.*

1. Introduction

Banggai Regency, Central Sulawesi, is one of the areas with high disaster vulnerability. In the last 5 years, it has been hit by earthquakes, hurricanes and floods with a distribution of vulnerable areas. Some areas even have high potential for tsunami waves. A total of 19 high potential disaster areas has a total hazard area of 81,632 hectares. For this reason, disaster management is a priority program for the local government. One of the current trends learning media is based on Audio-Visual digital information technology which is then implemented in *Virtual Reality* (VR). Disaster education does not only provide limitations on increasing knowledge, but how to form attitudes and skills towards disaster preparedness.

2. Research Results

This research began with the identification of disaster-prone locations in Banggai Regency, based on a joint study with the research team.

Banggai Regency, is one of the Level II Regions in Barnes, et al. [1]. The capital city is Lillywhite and Wolbring [2]. The district has an area of 9,672.70 km² (data from Law No 51/1999), and a population of 376,808 people [3]. Banggai Regency is one of the [4] in Central Sulawesi that has abundant natural resource potential, both in the form of marine products [5-8] various crops [9-13]

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History: Received: 2 June 2025; Revised: 7 July 2025; Accepted: 10 July 2025; Published: 13 August 2025
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(copra, palm oil, cocoa, rice, cashew nuts and others) as well as mining products (nickel which is currently in the exploration stage) and gas (Matindok and Senoro Blocks).

However, Banggai Regency is also a disaster-prone area, one of which is because it is located within a seismically active earthquake zone, where several micro tectonic plates create seismic activity in the Eastern[14] Indonesia region including Central Sulawesi and Banggai Regency itself. The highest seismic hazard occurs along [2] plate tectonic boundaries. According to the Directorate of Volcanology and Geological Hazard Mitigation (DVMBG), areas with seismic activity trigger earthquake and tsunami activity.

The following are disaster-prone areas based on the history of disasters during 2013-2023:

Table 1.
Disaster-prone areas based on disaster history from 2013-2023.

No.	Disaster-prone areas	Types of Disasters that have occurred	Year
1	All active fault points in Banggai Regency	Earthquake	2010, 2016, 2018, 2022, 2023
2	Luwuk	Flood	Every year the rainy season
3	Batui	Flood	Every year the rainy season
4	Toili	Flood + landslide	Every year the rainy season
5	Masama	Flood + landslide	Every year the rainy season
6	Kintom	Flood	Every year the rainy season
7	Balantak	Flood + Landslide	Every year the rainy season
8	West Toili	Hurricane Strong winds	2019
9	Mantouk	Flood	Every year the rainy season
10	East Luwuk	Flood	Every year the rainy season

Banggai Regency has 23 sub-districts, and 10 of them are vulnerable to disaster activities, especially earthquakes, floods and landslides. When these events occur, hundreds of residents are displaced, affected by disease and disrupted activities due to road damage caused by erosion. In some areas, missing persons and fatalities were reported.

Based on the data above, further identification of schools in disaster-prone areas is carried out.

Table 2.
Identification of schools in disaster-prone areas.

No.	Disaster-prone areas	School Name
1	Kel. Luwuk	SD Negeri 1 Luwuk
2	Kel. Batui	SD Negeri 1 Batui
3	Kel Toil 1	SDN Inpres Toili
4	Kel Masama	Tangeban Elementary School
5	Kel.Kintom	SD Negeri 1 Kintom
6	Kel. Balantak	SD Negeri 1 Balantak
7	Kel. Toili Barat	SD Negeri 3 Tolbar
8	Kel. Mantouk	SD Negeri 1 Mantouk
9	Kel. Luwuk Timur	Hunduhon Public Elementary School

2.1. Design of Digital Virtual Reality-Based Learning Media in Disaster Education Design

Disaster education in this study is shown not only to increase knowledge, but also how to form attitudes and skills towards disaster preparedness. So that this stage carries out a digitization-based design in learning media so that students can maximize the learning experience followed by visualization of disaster simulations and emergency response procedure efforts designed in a *virtual reality-based* learning media. In this case, the VR design is a set of 3D images and sounds that are computerized, so that they can represent real places or situations that make users seem to be in the virtual environment.

The learning media design includes a learning video that contains content including:

1. The school map and the vulnerability and resource risk markings are shown below:

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2. Early Warning System
3. Response Skills (SOP, Contingency Plan, simulation) and Provision of Disaster Supplies
4. Standard Operating Procedures Standard procedures for emergency response depend on the type of hazard, and should be tailored to the unique conditions of your environment. These procedures are organized around thefollowing six basic emergency procedures:
   a. Evacuation (from) buildings
   b. Protection-in-place
   c. Self-locking
   d. Gather and Take Shelter Outside
   e. Evacuate to a Safe Place
   f. Safe Family Reunification Process

2.2. Expert Design Test Results Virtuall Reality-Based Disaster Education Learning.

The content test method by providing an assessment by experts where this research uses four people, namely 1 person from the head of BASARNAS Kab. Banggai, 2 school principals, 1 IT expert, 1 student guardian.

Table 3.
Results of the Disaster Learning Digitalization Media Expert Test (n=5).

Question Code	SS		S		Neutral		TS		STS	
	n	%	n	%	n	%	n	%	N	%
P1	5	100	0	0.0	0	0.0	0	0.0	0	0.0
P2	5	100	0	0.0	0	0.0	0	0.0	0	0.0
P3	4	80.0	1	20.0	0	0.0	0	0.0	0	0.0
P4	4	80.0	1	20.0	0	0.0	0	0.0	0	0.0
P5	5	100	0	0.0	0	0.0	0	0.0	0	0.0
P6	5	100	0	0.0	0	0.0	0	0.0	0	0.0
P7	4	80.0	1	20.0	0	0.0	0	0.0	0	0.0
P8	5	100	0	0.0	0	0.0	0	0.0	0	0.0
P9	5	100	0	0.0	0	0.0	0	0.0	0	0.0
P10	5	100	0	0.0	0	0.0	0	0.0	0	0.0
P11	4	80.0	1	20.0	0	0.0	0	0.0	0	0.0
P12	4	80.0	1	20.0	0	0.0	0	0.0	0	0.0

Table 4.
Digital Learning Media Expert Test Results.

Indicator	Category	
	Good (%)	Less Good (%)
Content	90	10
Accuracy	90	10
Display (Visualization)	90	10
Ease of Use	90	10
Timeliness	90	10

The results of data analysis in the table above can be concluded that the Content/Content domain and accuracy, visualization, easy for use and timeliness on learning media obtained very good results (90% or without revision).

After the *expert* test is carried out, then proceed with the trial or test of understanding the contents of the media to 10 elementary school students. This trial was conducted to see students' understanding of the content and use of language in disaster education media.

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2.3. Disaster Learning Digitization Media Content Test Results on School Student Workers (n=10)

Table 5.
Students' understanding of virtual reality media in disaster education

Question Code	SS		S		Neutral		TS		STS	
	n	%	n	%	n	%	n	%	N	%
P1	10	100	0	0.00	0	0.00	0	0.00	0	0.00
P2	8	80.0	2	20.0	0	0.00	0	0.00	0	0.00
P3	10	100	0	0.00	0	0.00	0	0.00	0	0.00
P4	10	100	0	0.00	0	0.00	0	0.00	0	0.00
P5	10	100	0	0.00	0	0.00	0	0.00	0	0.00
P6	8	80.0	2	20.0	0	0.00	0	0.00	0	0.00
P7	8	80.0	2	20.0	0	0.00	0	0.00	0	0.00
P8	10	100	0	0.00	0	0.00	0	0.00	0	0.00
P9	10	100	0	0.00	0	0.00	0	0.00	0	0.00
P10	10	100	0	0.00	0	0.00	0	0.00	0	0.00
P11	8	80.0	2	20.0	0	0.00	0	0.00	0	0.00
P12	10	100	0	0.00	0	0.00	0	0.00	0	0.00

The results of the analysis in the table above can be concluded that school students' understanding of the content and use of language in disaster learning media is in the very good category (without revision), namely between the average score >90%.

3. Conclusion

Based on the results of the qualitative and quantitative descriptions above, it is concluded that the Audio-Visual-based Disaster Learning Media Design can be an excellent disaster education method to be adapted to Virtual Reallity-based digital development.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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ISSN: 2576-8484
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