
DEVELOPING LEARNING MULTIMEDIA BASED ON GEOGRAPHICAL INFORMATION SYSTEM TO IMPROVE STUDENTS' SPATIAL ABILITY IN FLOOD-DISASTER MITIGATION

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Abstract: The research was aimed to: (1) define the students and teachers' need toward flood-disaster learning multimedia; (2) develop flood-disaster learning multimedia based on Geographical Information System (GIS), and (3) find out the effectiveness of the developed media in improving the students' ability in flood-disaster mitigation. The research used Educational Research and Development with three major stages, namely: Define, Design, and Develop. Define Stage consists of literature study and need analysis. Design Stage consists of product specification, material collection, product designing, and product validation. Develop Stage consists of field testing and product experiment. The setting of the research was in Surakarta district. The result of the research were: (1) from the need analysis, it could be revealed that 72% of the students stated that Geography was a boring subject, 69% of the teachers did not have any experience dealing with multimedia for teaching, and 85% of the students needed a more innovative Geography lesson; (2) the flood-disaster learning multimedia was designed in a form of text, animation, film, and map. The novelty of the proposed product was that more than 75% of the material in the developed product was collected through live-field recording, while the text and animation was originally designed by the researchers. The product consisted of several parts, namely: introduction, flood-disaster cause factors, types of flood, flood spatial, flood-disaster effect, and flood mitigation; and (3) experimental test was done to find out the effectiveness of the designed product in improving the students' ability in flood-disaster mitigation, and the result showed that the product was effective.

Keywords: Flood disaster, multimedia, spatial ability, mitigation

1. INTRODUCTION

BNPB (National Board for Disaster Management) noted that the trend of disasters in Indonesia has increased recently. In 2009 there were 1,246 disasters, in 2014 there were 1,475 disasters, while in 2015, until June 2015, it is recorded there were 1,116 disasters occurred. More than 90% of disasters in Indonesia are in a form of hydro-meteorological disasters (BNPB, 2015).

School preparedness in facing disaster is low. Based on a research in 2006 done by Indonesian Institute of Sciences (LIPI) and UNESCO in three major areas: Aceh Besar district, Bengkulu City and Padang City (the study aimed to see the level of disaster preparedness in schools, households, and communities with 5 school-preparedness parameters: knowledge about disasters, policies and guidelines, emergency response plan, disaster warning systems and resource mobilization), it was found out that the level of

school disaster preparedness was lower than the community's and the authorities'. (LIPI, UNESCO, ISDR, 2006).

Disaster-education competence should be used as a paradigm in the national education as an alternative to prepare the young generation to have a strong foundation of disaster-risk reduction values in their action for national development. In a broader scale, disaster education should become mandatory for the whole nation regarding the fact that a catastrophic event can happen anywhere, anytime and to anyone regardless of age (Rahayu, 2009). A paradigm shift in disaster management from emergency into risk management with the focus changed from post-disaster into pre-disaster also contributed to the acceleration of disaster-risk reduction policy through education (Demeter, 2009).

Information technology and telecommunication which is rapidly developed offers a wide range of new ease in learning which allows a shift in the orientation of

learning from outside-guided into self-guided and from knowledge-as-possession into knowledge-as-construction. Moreover, this technology also plays an important role in updating the conception of justification which was originally focused on learning as merely a presentation of various knowledge into learning as a guidance to explore the socio-cultural richness in knowledge (Idris,2008).

Education is not only aimed to transfer knowledge, but also improve the ability of analysis, synthesis, communication and connecting science to the real world. These aims could be achieved if the learning process is supported by technology (Cesar and Gamble, 2008). One of the learning technologies that now being developed is multimedia. Smith (2002) explained multimedia as the information environment which is formed by combining text, sound and graphics in a digital environment.

According to Heinich, Molenda, Russell and Smaldino (2002), multimedia presents various tools simultaneously or uses them in one program in a similar way. Roblyer (2003) described multimedia as "multi tools" or "combination of tools". Graham and Hussain (2006) emphasized that multimedia is integrating text, sound, any kind of graphic and a learning environment coherently in one digital information environment. However, according to Frey and Sutton (2010) while numerous articles addressed various aspects of multimedia development in higher education, a succinct set of guidelines that depicted the development process for multimedia learning objects is not readily available.

2. METHOD

2.1. Research Type

This research is using Research and Development method. The development model which was used was *Four-D Model* (Thiagarajan, et al., 1974). It consisted of four major steps namely Define, Design, Develop, and Disseminate.

2.2. Time and Place

Need analysis step, which is part of define stage, was done to teachers and students in 3 (three) senior high schools; they are *SMA 1 Karanganyar*, *SMA 2 Surakarta*, and *SMA 8 Surakarta*. Questionnaire was used to get the data.

The images and video recording for developing of the learning multimedia was done in the former Surakarta area which consists of Surakarta City, Wonogiri District and Karanganyar District since he potential users of this multimedia are the high school students in former Surakarta area, it was expected that images and videos shown are examples of actual events on field around the students.

The desining process of the multimedia was done on July and August 2015 in Sebelas Maret University, while the experiment research on the use of flood-disaster multimedia to improve students' spatial ability on disaster mitigation was done in *SMA 2 Surakarta* on September 2015.

2.2. Product Specification

The product which was developed was in a form of learning multimedia on flood-disaster education for senior high school students, particularly the students in former Surakarta area (Surakarta City, Klaten District, Wonogiri District, Sukoharjo District, Sragen District, and Boyolali District).

The novelty of the product was that most (more than 75%) of the product was originally made by the research team:

- a. Teks, pictures, and animations are (more than 75%) original creation of the research team,
- b. Voice recording of the explanation is original creation of the research team,
- c. Most of the videos is recorded originally from the subject area by the research team,
- d. Pictures and videos displayed in the multimedia are factual examples picturing the subject area of former Surakarta area.

2.3. Development Method

2.3.1. Define Stage

In this stage, it was done need analysis process to the teachers and students to know the need of learning multimedia about flood disaster education in senior high school. The instrument used was questionnaire. Besides, preparation was done through literature study and analyzing the ongoing curriculum. From the need analysis, literature study, and analyzing the curriculum, it was designed the form and content of the multimedia which was created.

2.3.2. Design Stage

In this stage it was done:

- a. Picture and video recording

- b. Animation making
- c. Maps making
- d. Data, pictures and videos searching (taken from the seconder data to support the product)
- e. Text making which was in lined with the multimedia appearance
- f. Voice recording which explained the content of the multimedia.

2.3.3. Develop Stage

In this stage, the following activities were done:

- a. After the materials were ready, Flood-Disaster Multimedia based on Geographical Information System was created based on the design stage result.
- b. Internal Validation was done using Focus Group Discussion (FGD) done by the research team.
- c. Limited field testing was done to the teacher and students.
- d. Expert validation was done by a learning-media expert.
- e. Product Revising was done based on the result of the evaluation done in the expert validation and limited field testing.

2.3.4. Disseminate Stage

After the Geographical Information System based Flood-Disaster Multimedia had been finished, experimental research was done. The experimental research was done to make sure whether the multimedia could be used to improve the students' flood-disaster-mitigation competence or not.

3 RESULT AND DISCUSSION

2.4. Define Stage

From the data analysis, there were several findings which could be concluded as follows:

- a. Result from interview to geography teachers showed that learning media which were usually used to teach were wall map, digital map, and pictures. From 5 (five) teachers who were interviewed, there were only 2 (two) teachers who had an experience involving multimedia in learning, and there was no one who had ever used disaster multimedia to teach disaster mitigation.
- b. Result from interview to students from 3 (three) different senior high schools revealed that teachers were rarely used multimedia in teaching geography and 72%

of the students stated that geography lesson was boring.

- c. From the interview to the students, it was also found out that 85% of the students expected an up-to-date, creative and innovative teaching and learning process of Geography subject.
- d. From literature study, it could be stated that multimedia which elaborate text, picture, video, and animation could be used to improve the teaching and learning process.
- e. From curriculum analysis, it was also found out that, materials related on disaster is given to the 10th grade students in the odd semester namely disaster mitigation and adaptation.

Based on the facts above, it could be concluded that multimedia for disaster learning was needed to teach the senior high school students in former Surakarta area.

2.5. Design Stage

From the data analysis, there were several findings of the design stage which could be listed as follows:

- a. Disaster learning multimedia which was chosen was flood disaster learning multimedia. It was taken since in every district in former Surakarta Area (Surakarta City, Klaten district, Wonogiri district, Sukoharjo district, Karanganyar district, Sragen district, and Boyolali district) there was flood prone area, particularly the area which was passed by Bengawan Solo River or Bengawan Solo Tributary.
- b. Based on the result from FGD, it was concluded that the content of the flood-disaster multimedia would consist of: Introduction, apperception, and explanation on: flood definition, flood cause factors, flood types, flood impacts, flood vulnerability analysis, and flood mitigation.
- c. Location of picture and video recording was focused on along and around Bengawan Solo River which includes Wonogiri District, Karanganyar District, and Surakarta City.
- d. The appearance of flood-disaster multimedia would be in a form of:

Text. It is used to describe the flood definition, flood cause factors, disaster mitigation types, and captions. All the text

provided in the multimedia was originally made by the research team.

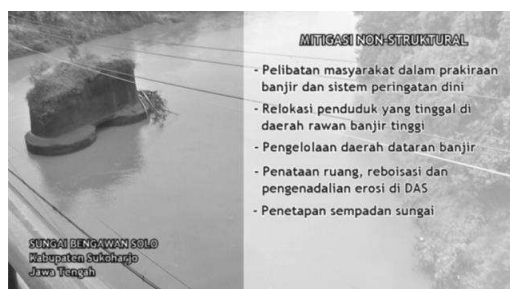


Figure 1: Example of text provided in the multimedia

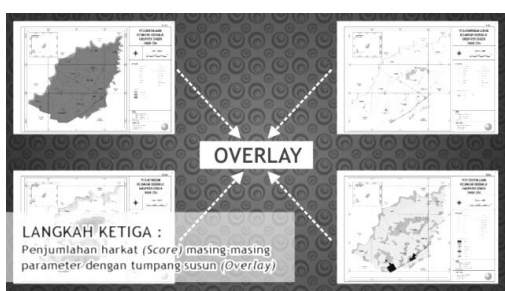


Figure 2: Example of map provided in the multimedia

Map. It is used to show flood vulnerability map, land use map, and slope map. Maps which were taken were those which were related to Bengawan Solo flood vulnerability.

Animation. It is used to animate over flowing flood type, flush flood type, and local flood type. All the animations was originally created by the research team.



Figure 3: Example of animation provided in the multimedia

Video. (used to show the number of settlements along the river bank, the damages on the infrastructure due to floods, flood mitigation, and the flood impact).



Figure 4: Example of Video provided in the multimedia

2.6. Develop Stage

In this stage, the following steps were done:

a. Internal validation

The research team who consists of environmental expert, educational expert, and IT expert did an internal validation which was done through FGD. This step was done once a week every Wednesday to examine every part of the product and discuss the weaknesses and the improvements needed to elevate the product. Improvements were done based on the result of the evaluation.

b. Limited Field Testing

After the media had been completely created and had been stated appropriate by the researchers, limited field testing was done by applying the multimedia to the limited teacher and students. This limited field testing was done in a single made-up classroom consisted of one teacher and 15 students. The result from the limited field testing was that in term of the product substance, the product had been feasible; however, some suggestions were still given in term of the performance. The evaluations were in the voice recording and background color. Improvements were done based on the evaluation.

c. Expert Validation

The last step in the Develop Stage is expert validation step. The expert validation was done by the educational technology expert, Dr. Nunuk Suryani. The result of the validation showed that the flood-disaster multimedia had been stated feasible and could be used in the learning process.

2.7. Disseminate Stage

Experimental research in order to test the effectiveness of the use of geographical-information system based flood-disaster multimedia was done. Quasi-experiment design was used in which four classes in four

senior high schools around former Surakarta area was used as the subject of the research. The sampling was done using cluster random sampling and pretest was used to define the homogeneity of the sampling. Two classes were then taken randomly as experiment classes while the other two were the control classes. The multimedia was then applied in experiment classes using Problem Based Learning model while conventional learning model was done in control classes. The result showed that $t_{\text{operation}} = 9.41$ while $t_{\text{table}} = 1.67$ (with $\alpha = .05$). It could be concluded that students who were taught using flood disaster learning multimedia had a better spatial ability on flood disaster mitigation than those who were taught conventionally.

2.8. Research Limitation

The development of this flood-disaster multimedia required a high cost, moreover in the development process since it needed to record the flood disaster phenomena directly from the disaster area around Surakarta.

5 CONCLUSIONS

Several conclusions could be drawn from this research as follows:

- a. From the need analysis done to Senior High School teachers and students regarding multimedia used in flood disaster learning, it showed that 72% of the students believed that Geography lesson was boring, 60% of the teachers admitted not having experience using multimedia in a learning process, and 85% of the students needed a more innovative geography lesson.
- b. The flood-disaster multimedia produced was in form of text, animation, video, and map. The novelty of the product was that more than 75% of the product was an original result of field recording, and the text and animation were originally made by the research team. The content of the multimedia consist of introduction, flood cause factors, flood types, flood spatial, flood impacts, and flood mitigation.
- c. The use of flood-disaster multimedia was effective to improve the students' spatial ability in flood disaster mitigation.

4 ACKNOWLEDGEMENT

The Research team would like to thank Research and Community Service Directorate, Directorate-General of Education and Student

Affair, Ministry of Research, Technology and Higher Education, which has funded this research through the University Leading Research Grants.

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