The analysis of learning material on flood disaster based on regional physical condition in Sampang, East Java

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Abstract. Nowadays, disaster learning materials on SMA don’t use a suitable context based on conditions in the field. One of the material should be well understood by the student is flood. Susceptible area toward flood usually lies near coastal area. Sampang Regency physically identified as coastal area. It’s spread the entire northern part and southern part of Madura Island. This region is exposed by flood every year especially on the rainy season. Typical of a flood could be divided into three kinds; tidal flood, river flood, and combination of tidal and river overflow. The recent flood was triggered by Kali Kemuning. Kali Kemunings spills over every year on rainy season. It affects local inhabitant who lives along riparian and it's surrounding. Based on Indonesia Statistical Bureau (BPS) data people who exposed by flood in Sampang 1,793 each km2. Its large amount of people became vulnerable. This research was designed in qualitative research. The data is collected by primary and secondary. Primary data was collected from field observation and in-depth interviews. Meanwhile, the secondary data was collected from government institutions; Regional Disaster Management Agency (BPBD), National Disaster Management Agency (BNPB), Inarisk BNPB, and Central Bureau of Statistics (BPS). The result represents several parts in Sampang that are susceptible to flooding especially along the coastal area and river riparian. The recent condition in April 2019 showed that the Government build the river wall to reduce flood impact. Local people, insight view toward flood is a usual phenomenon. The condition above explains that before learning mitigation material in SMA, the students should understand well how to cope with flood disaster risk.

1. Introduction
Indonesia is an archipelago located in the equator. The position of Indonesia is located between two oceans that have a tropical climate and a high intensity of rainfall [1]. BNPB (2019) shows data on the number of disasters in Indonesia in 2019 as many as 1,830 incidents. The incident included 506 floods, 5 floods and landslides, 522 landslides, 696 tornado, 78 fire incidents, 4 volcanic disasters, 13 earthquake events, and 6 tidal waves.

The results of the BNPB study show that Indonesia is prone to disasters, especially hydro-meteorological disasters. This is supported by the number of islands in Indonesia consisting of around 17,500 islands with a coastline length of about 95,181 km which is the largest archipelagic country in the world. The territory of Indonesia is divided into one-third of the land and two thirds in the area of sea and ocean waters. There are coastal villages recorded at around 9,261 villages out of a total of 67,439 villages so that Indonesia had a high threat of coastal disasters [3].

Disaster risk reduction education is a way in education to anticipate the increasing levels of damage and incidents of hazards locally. Disaster risk can increase if the conditions of the community are exposed, vulnerable and not ready to face the threat of disaster. Disaster risk reduction education can be done by identifying, assessing and reducing the vulnerability of the physical, economic, environmental and social communities through a systematic and holistic approach [4]. This disaster risk reduction can be done through a structural and non-structural approach. The response of disaster risk reduction learning in Indonesia has been embodied in the education curriculum in Indonesia. The latest curriculum update in Indonesia was carried out in 2013 which became known as the 2013 Curriculum. The 2013 curriculum serves to develop and answer the problems of the previous curriculum. The essential advantages of the 2013 curriculum, namely: 1) using a student-centered natural (contextual) approach; 2) character-based and competencies that
underlie the development of students' abilities; and 3) there are certain fields of study and subjects that are more appropriate to use competency approaches and related skills [5].

The 2013 curriculum is also developed two modes of the learning process, namely the direct learning process and indirect learning. The direct learning process is done by five steps: observing, asking, gathering information, associating/analyzing and communicating in analytical activities. Indirect learning is a direct educational process but not designed in special activities [6].

The characteristics of the advantages of the 2013 curriculum can be applied in disaster mitigation learning at the high school level. The study in learning uses a natural/contextual approach and is based on students' abilities. One material that can be integrated is material about flood disaster mitigation. Learning about mitigation and disaster risk varies by region in Indonesia. This condition is based on the physical condition of the area including terrain, hills, mountains, volcanoes, and coastal areas. Each region has different disaster threat characteristics.

Disaster risk reduction education in class XI geography subjects is presented in natural disaster mitigation and adaptation material. Based on the assessment of natural disaster mitigation and adaptation material in the class XI High School Geography book, it explains the types of natural disaster management through education, local wisdom, and modern technology approaches.

The explanation of the types of disasters is based on geological conditions, climatology and extraterrestrial natural disasters in general. Examples of the types of natural disasters used in this book are incomplete disasters in Indonesia and abroad. This shows the need for material deepening using disaster case studies in Indonesia to implement the 2013 curriculum.

Student learning needs for disaster material are still general and limited. The characteristics of this learning are certainly not in accordance with the direction of the 2013 curriculum which is natural/contextual by developing the knowledge and skills of students. Therefore, research is needed to develop teaching materials related to mitigation and flood risk reduction.

Sampang is one of the coastal areas that face the threat of a flood. Based on data from Regional Disaster Management Agency (BPBD) in Sampang Regency, it shows that floods occur every year in urban areas with an intensity of four to five times which soak villages and villages in the city sub-Regency [7]. Reduction of flood risk in Sampang can be done by increasing people's understanding of the dangers of flooding, one of which is by instilling knowledge of the risks of flooding in school education.

2. Methods

This research is a qualitative descriptive study using the content analysis and observation approaches. Bogdan & Taylor [8] explained that qualitative research is one of the research procedures that produces descriptive data in the form of speech or behavior of people who are observed in a particular context studied from a whole, comprehensive and holistic perspective. Krippendorff [9] states that content analysis is a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use.

The data used in this study were primary and secondary data. The primary data was obtained by means of field observations/surveys and in-depth interviews. It functioned to collect flood disaster information as a case study and mitigation carried out by the community in Sampang. Interview activities were also conducted for several teachers to analyze learning needs about natural disaster mitigation. The secondary data was obtained from literature studies from government institutions of Regional Disaster Management Agency (BPBD), National Disaster Management Agency (BNPB), Inarisk BNPB, and Central Bureau of Statistics (BPS).

Content analysis methods were used to analyze the contents of a discourse. The document used in this research is a high school geography textbook, material for adaptation and mitigation of natural disasters. The standard used to measure the quality of the contents of textbooks uses indicators issued by the Indonesian National Education Standards Agency (2014), namely: 1) effective functioning of the media, 2) exposure to facts, concepts, generalizations, and 3) languages. The purpose of content analysis is the textbooks used can be valid and replicable conclusions. The data collection instrument used in this study is a documentation method that applies the aspect table used as an analysis of textbooks based on content standards.

Observation techniques were used for initial needs analysis. The results of this observation were data based on the results of interviews with high school geography teachers in Sampang. Analysis of
geography learning was carried out in classes and textbooks used during geography learning. Some geography teachers in Sampang, especially in Sampang District explained that geography learning in disaster mitigation material was still general. Learning by identifying local disaster threats had not done with deep treatment yet, so the material in high school geography textbooks is also not contextual according to conditions in the field.

Data analysis in this study was also used to measure the threat of danger, vulnerability, and community capacity to deal with floods in Sampang Regency. The results of the data analysis function to develop contextual disaster-based mitigation material, namely using case studies in Sampang Regency. This mitigation material analysis focuses on the threat of local disasters based on the physical condition of Sampang Regency.

3. Results and Discussion

3.1. Analysis of High School Geography Textbooks on Natural Disaster Mitigation and Adaptation Material

Content standards include criteria for material scope and competency levels of students to achieve graduate competency at certain levels and types of education. Content standards provide direction for government regulations that are tailored to the substance of national education goals. This includes spiritual attitudes and social attitudes, knowledge, and skills [10].

Students and teachers need textbooks based on national education standards as a mandatory reference. Teaching material books contain information to assist in learning activities in achieving national education goals [11]. Most teachers, students and schools in East Java rely heavily on teaching material books in organizing learning [12]. Based on this opinion, the need for analysis of high school geography teaching material books used by teachers and students in Table 1.

| No. | Aspect | Analysis |
|-----|--------|----------|
| 1   | Effective functioning of the media | Images do not have relevance that can clarify the material<br>The image used is black and white so it cannot be read/understood<br>Placement and size of images/media is not right |
| 2   | Exposure fact | The facts used as examples have not fully represented the subject matter<br>There are many discussions not supported by facts/case studies in Indonesia |
| 3   | Exposure concept | Hydrological natural disasters are interpreted as natural disasters caused by the movement and distribution of freshwater and saltwater underground and on the surface<br>The concept of community participation in disaster mitigation is defined as the rights and obligations of the community |
| 4   | Exposure generalization | Erroneous understanding of community participation in disaster mitigation and disaster management causes students to misunderstand that comes from generalization |
| 5   | The use of language | There are paragraphs having less than three sentences<br>There are conjunctions which are at the beginning of the sentence<br>There is a repetition of words in one sentence so that it is difficult to understand<br>There are uses of the wrong word, like volcanic eruptions written by erupting mountains |

Source: Adapted from Purwanto, et al. 2016

The results of the analysis textbooks material based on content standards indicate that high school textbooks materials have many errors. Errors contained in textbooks material consist of aspects of media function, facts, concepts, generalizations, and languages. Errors contained in textbooks have fatal consequences. Sitepu [11] mentions that textbooks material are the main reference books used by students and teachers in learning activities. The contents contained in the textbooks are minimal materials that must be mastered by students according to the applicable curriculum.
Media have an important role in learning activities. The results of the analysis of high school geography textbooks material indicate the ineffectiveness of media use. The form of media function errors lies in the use of images that are less relevant, the images used are too small and colorless, and the placement of images/media is not right. The use of media that is less clear or unreadable can make it difficult for students to understand the learning material. The results of interviews with teachers and high school students also show that teaching material books that use effective media can improve student learning outcomes.

The facts used in the textbooks material contain evidence to clarify the concept of learning. The facts listed in the textbooks material can be in the form of cases, supporting data, graphs, tables or images. Errors in exposure to facts are found in inappropriate uses. The material presented in the high school geography textbooks book still contains many topics that are not supported by facts/case studies in Indonesia.

Analysis of high school geography textbooks material also shows errors in understanding concepts. The use of concepts often uses language that is difficult for students to understand. This is exemplified in the sense that hydrological natural disasters are natural disasters caused by the movement and distribution of freshwater and saltwater underground and on the surface. The use of concepts that are less precise in high school geography teaching material books also shows a meaningful error.

Misconceptions and exposure to facts result in generalizations. The findings of new knowledge derived from the ability to make generalizations in the bottom-up resulted in stronger long-term memory for students [12]. Erroneous understanding of community participation in disaster mitigation and disaster management causes mistakes in students' understanding stemming from generalization abilities. This results in errors of meaning and explanation of facts that will be generalized by students.

The correct language can make it easier for students to understand the material. Language truths are valued from punctuation, vocabulary, sentences, and paragraphs based on Indonesian standard grammar rules and General Indonesian Spelling Guidelines (PUEBI) [13]. The results of language analysis show that there are errors in paragraphs that have fewer than three sentences, conjunctions that are at the beginning of the sentence, repetition of words in one sentence, and the use of conjunctions at the beginning of the sentence. These errors can result in students having difficulty understanding the material contained in high school geography textbooks.

The material presented in this textbook discusses the general concepts in the form of an explanation of the types of disasters and how to deal with them. The discussion of the material contained in the textbook is still dominated by concepts and facts. Presentation of material in a textbook on natural disaster mitigation only discusses C1 and C2 (knowledge and understanding). Material presentation based on a general discussion on the types of disasters and how to deal with them is not in accordance with the revised edition of the 2013 curriculum, namely learning that aims to apply high-level thinking skills. Giving examples and concepts that are not appropriate can cause students to misunderstand the learning material so that it does not achieve learning goals based on predetermined basic competencies.

3.2. Material for Hazard, Vulnerability, and Population Capacity Assessment in Facing Flood Disaster in Sampang

Geographically, Sampang Regency is located between 113°08’-113°39’S and 06°05’-7°13’E. Sampang Regency consists of 14 Sub-districts with five Sub-districts in the lowlands (0-100 asl) and nine other Sub-districts in the lowlands to the highlands (0-100 asl and 100-500 asl) [7]. Flat topographic areas are generally scattered around the coastal and downstream areas, while rough or steep topographic areas are located around the karst hills in the central part of Madura Island.

The coastal area of Sampang is prone area to flood hazards. This condition is caused by local flooding due to topographic conditions supported by climatic and hydrological conditions. Sampang Regency has a tropical climate with an average rainfall of 91.78 mm per year and the average number of rainy days reaches 6.47 rainy days per year. The highest rainfall is in Robatal Sub-district with an average of 146.70 mm which is the karst plateau and the lowest in Ketapang Sub-district with an average of 61.00 mm. The hydrological aspects are characterized by 36 rivers spread across three Sub-districts, namely Ketapang, Sampang and Torjun Sub-district.
Floods in Sampang Regency based on their causes can be classified as tidal floods (rob), river overflows and a combination of tidal and river overflows. Floods have a high threat index class with a total hazard area of 18,608.47 ha. The floods that occur in Sampang Regency every year are supported by the condition of the Kali Kemuning which is fed by many tributaries and sourced from the Robatal Sub-district. Forest damage in this area causes the flow of sediment to enter the Kali Kemuning, so the siltation of river flows causes floods every year with an intensity of four to five times (Inarisk, 2019).

![Image of Kali Kemuning Condition](image)

Data from BPBD Sampang shows eight floods in 2019. This disaster occurred in Sampang City and Sampang Sub-district. The causes of flooding in this region are mostly influenced by the Kali Kemuning overflow originating from upstream rain. The tidal flood occurred on Jl. Melati, Desa Banyuanyar, Sampang Sub-district every 13-15 Hijri with the peak of flooding on the full moon. This area is also a meeting area for water from upstream rivers and tides from the sea.

In general, residents of the southern coastal areas of Sampang Regency choose to live along the coast. This condition results in the majority of the population having a high vulnerability to tidal flooding. The area around the riverbank which is the location of flood overflowing when the capacity of the river is unable to hold water is also an area with high population density. Based on BPS data [14], Sampang Sub-district in the region with the highest population density, approximately 117,279 inhabitants. This supports that the population of Sampang Regency has a high level of vulnerability to flood disasters.

The vulnerability analysis of floods in Sampang Regency is based on physical, economic and environmental damage. Table 2 shows that Kecamatan Sampang has a high class of vulnerabilities. The total loss due to the flood disaster reached 2.30 trillion rupiah. The environmental damage caused by the flood disaster reached 241.7 hectares with the largest area of damage in Sreseh and Jrengik Sub-district [7].

| Regency    | Total Loss (million rupiah) | Environment Damage (Ha) | Environment vulnerability class | Disaster vulnerability class |
|------------|-----------------------------|-------------------------|---------------------------------|----------------------------|
| Sreseh     | 9,240.00                    | 594,849.43              | 604,089.42                      | High - Medium - Medium     |
| Torjun     | 21,282.94                   | 49,471.87               | 70,754.81                       | High - Low - Medium        |
| Pengarengan| 14,315.61                   | 550,469.55              | 564,785.17                      | High - Low - Medium        |
| Sampang    | 103,596.4                   | 223,754.59              | 327,351.06                      | High - Low - High          |
| Camplong   | 13,623.20                   | 39,824.78               | 53,447.98                       | High - Low - High          |
| Omben      | 8,534.39                    | 21,884.66               | 30,419.08                       | High - Low - Medium        |
| Kedungdung | 32,942.76                   | 55,742.19               | 88,684.95                       | High - Low - Medium        |
| Jrengik    | 9,451.31                    | 337,843.55              | 347,294.89                      | High - High - Medium       |
| Tambelangan| 26,327.46                   | 24,391.90               | 50,719.37                       | High - Low - Medium        |
| Banyuates  | 14,419.87                   | 30,139.49               | 44,559.35                       | High - Low - Medium        |
| Robatal    | 25,516.52                   | 26,172.73               | 51,689.23                       | High - Low - Medium        |
| Karangpenan| 10,502.55                   | 14,037.49               | 24,540.04                       | High - Low - Medium        |
The flood flows in Sampang are very high/heavy. This can cause casualties if the resident of Sampang is not careful in passing water puddles. Based on interviews with local residents, people who are often victims of floods are residents who do not understand the conditions of the flood flows/are not native. This condition also resulted in the absence of outside assistance when there was a flood, so the community prepared logistics in the form of food supplies during a flood.

Community understanding of floods in Sampang is a natural event that usually occurs every year. The community has understood that the flooding occurred in Sampang was caused by heavy rains and flooding of shipments from the rain in the upstream (north) area, but the community could not predict when the flood would occur. Structural and non-structural mitigation has been carried out by local governments to reduce the risk of flooding, such as the construction of river dikes and notification of river conditions at risk of flooding. The form of adaptation carried out by the community is to build high-rise houses, place items at a high place in the house by stacking boards/chairs or making a high place, preparing logistics and staying at home if possible. The community will evacuate when the floods that hit the area are quite large, but usually only carried out by mothers and children.

Coastal communities affected by tidal flooding consider this to be the usual tide that rises every full moon. The community also considers this is not a disaster, because the community can still do activities as usual. The biggest floods in this region occurred in 2001 and 2007. Evidence of floods in this area can be seen by the presence of moss marks on one wall of the community's house.

Different topographic conditions result in not all houses being flooded when the tide is high. The efforts of the regional government in the construction of sewers/ditches that are beside the road to drain water from upstream to river/sea. This structural mitigation can reduce flood disasters which usually occur due to a combination of tidal and river overflows. The adaptation of the community carried out in areas that are still submerged in floods is to build strong and high foundations so that they are not flooded. Different land elevation conditions in this area resulted in the community being able to estimate the height of their house so that it would not be flooded. The community also uses plastic waste as the initial foundation in building houses, then stacked with white brick foundations.
Disaster risk reduction through physical development and appeals for the threat of a flood disaster by the BPBD when a disaster is about to occur causes an increase in flood vulnerability in the future. This is known from the response of the people who feel safe about infrastructure development such as the construction of dikes, the construction of sewers, road repairs and notifications when there is a threat of flooding so that people ignore the danger of flood threats in their area. The mitigation that needs to be improved is counseling the introduction of disaster threat signs and conventional and modern disaster mitigation training to deal with natural disasters that occur around them.

3.3. Adjustment of Disaster Materials for Contextual Learning

Textbooks are used as a standard on certain subjects. Textbooks can take the form of references or as references or dictates that are used as independent learning (modules) [15]. The preparation of teaching materials includes content standards that are adapted to the applicable curriculum.

The preparation of teaching materials contains the subject matter developed through basic competencies (KD) and the development of learning indicators. The main material is the subject matter that must be learned and built by students as a means of achieving basic competencies (KD). The main material includes values, knowledge, attitudes, facts, concepts, principles, theories, laws, and procedures that are built in a sequence of procedures, hierarchical or combination. Things to consider in choosing the subject matter are accuracy (proven truth), really needed by students, useful for the interests of developing academic and non-academic abilities, feasibility, and attracting students to learn more [15].

The community experiences in dealing with disasters are largely determined by the culture of the local community, so there needs a changing mindset in the face of early disasters [16]. The results of interviews with teachers and students showed the need to develop the material contained in teaching materials in more depth, especially in the field of disaster adaptation and mitigation. The obstacle faced by teachers in delivering disaster mitigation material is a lack of information such as local disasters and time constraints faced by students to make field observations because they intersect with other subjects. Local disaster learning is considered important to deepen material on disaster mitigation. Contextual based learning is more effective because students are easier to understand applicative-based material based on the conditions of the surrounding environment.

Basic competencies used in disaster mitigation material is 3.7 Analyzing the type and mitigation of natural disasters through education, local wisdom, and the use of modern technology and 4.7
Sketching, sketching, and / or maps of potential local disaster and disaster mitigation strategies based on the map. The basic competencies (KD) used in the 2013 curriculum teaches students to analyze types, potential disasters, and strategies used in disaster mitigation in the area where they live. The material presented in this discussion should begin with the introduction of students to the potential and threat of disaster in their place of residence.

Learning materials should contain concepts that are supported by facts about the environment. Disaster material consists of at least several main elements including 1) geographical and physiographic conditions of the region, 2) characteristics of threats to disasters, 3) vulnerability to disasters, 4) community capacity to deal with disasters (disaster mitigation and adaptation). The material composition that starts with the introduction of concepts that contain facts about the surrounding environment can make it easier for students to understand the material. It can also develop students' knowledge and application in daily life [17].

The results of the testing of disaster mitigation teaching materials with Sampang flood disaster mitigation material show differences in learning conditions using teaching materials only sourced from high school geography teaching materials with teaching materials that have been prepared in accordance with the contextual conditions in which students learn. When students use high school geography textbooks, in general, they find it difficult to recognize the threat of disaster in their neighborhood. This is due to students understanding disasters with examples presented in general books. Different conditions are found when students use teaching materials according to the context in which they are learning. Most students are able to explain well the threat of disasters in their living environment.

Sampang flood mitigation teaching material is known to increase students' spatial knowledge. This is evidenced by the ability to show locations prone to floods based on previous flood conditions. Students are also able to predict locations that in the future have a vulnerability to flooding disasters. Students are able to analyze the risk of flooding exposure to risk elements such as residential settlements, buildings, roads, and other public facilities. Students can predict the potential damage and loss caused by floods in Sampang. The creativity of students also increases where they are able to predict flood disaster risk reduction by showing potential locations as temporary evacuation sites during floods.

4. Conclusions
Disaster learning materials should be proper with actual conditions with the environmental condition. Natural disaster material at general could be distinguished into two groups; 1) geological hazard and; 2) hydro-meteorological hazard. A flood occurs every rainy season as a hydro-meteorological hazard. Sampang Regency, East Java are vulnerable to flood hazards. Due to its condition disaster mitigation material in Senior High School (SMA) along coastal areas in Sampang should prepare a well-understand material towards flood. This research reveals the fact that learning material in SMA Sampang didn’t suitable for student learning. The development of material of disaster in Sampang nowadays enlarges with the true condition in Sampang. The result shows students increased well-understand toward flood disasters in Sampang after using the proper learning material to disaster especially flood in Sampang.

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