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Research Article

Developing Science Edutainment for Prospective Science Teachers

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Abstract.
Providing public knowledge about disasters can be done through integrated learning in science. This study aimed to determine the various needs for implementing science edutainment for science prospective science teachers. This study was a qualitative descriptive research. The subjects of the research were two lecturers who teach Disaster Mitigation courses and 67 students prospective science teachers in Banten who received lectures on Disaster Mitigation and BPBD Banten. Data was collected using non-test instruments through document analysis, questionnaires, and interviews, as well as qualitative descriptions for data analysis. With regard to various needs in the implementation of science edutainment disaster, the results showed the implementation of disaster education needs to be developed, especially involving relevant agencies such as BPBD to develop the empirical experience of prospective science teachers. Additionally, it needs to be integrated with practicum using modules by utilizing technology used in socialization and disaster risk management. Development of Disaster Mitigation modules needs to be carried out, especially modules that improve natural disaster literacy critical and creative thinking skills of prospective science teachers.

Keywords: Science Edutainment, Prospective, Science Teachers

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1. INTRODUCTION

Professional science teachers are required to have science knowledge and skills in identifying themselves as science teachers. Science teachers should be understand other aspects of the science teacher identity, including beliefs about teaching science, strengths in teaching science (i.e. how one views oneself as an effective teacher), and

the nature of science (NOS). An understanding of science involves a good understanding of how scientific knowledge is constructed. A number of studies highlight the claim that teacher practice in the classroom directly affects student learning [1].

In order to prepare students to be scientifically oriented and ready for 21st century technological changes, science teachers need to develop the competencies of Technological & Pedagogical Content Knowledge (TPACK). Effective science learning abilities by prioritizing technology integration [2, 3]. It needs learning environment and ability to manage learning environment both indoors/outdoors. In other hand it needs collaboration and communication, as the ability to interact, communicate, work together, and solve problems, also interpersonal skills , personal abilities that reflect a stable, mature, wise, and authoritative personality, as well as having leadership skills, emotional intelligence, entrepreneurship, global citizenship, team working, creativity, critical thinking, communication and collaboration in order to become role models for students and the environment [4].

Indonesia has a high potential for disaster because of its geographical location at the confluence of three of the world's main tectonic plates, namely Eurasia, Indo Australia, and the Pacific. This makes Indonesia vulnerable to the potential for earthquakes, tsunamis and volcanic eruptions. The Indonesia Disaster Risk Index 2020 shows the three provinces with the highest risk, namely West Sulawesi (score 166.49), Bengkulu (score 162.00), and the Bangka Belitung Islands (score 161.54). Meanwhile, the three provinces that have the lowest risk index in the medium class are Papua (score 122.90), Riau Islands (score 116.40), and DKI Jakarta (score 64.02) [5]. The threats of natural disasters include: Earthquakes, tsunamis, floods, landslides, droughts, extreme weather, extreme waves/abrasion, forest and land fires. The impact varies, ranging from damage, loss, to causing fatalities which indicate a lack of preparedness.

To prepare community preparedness, disaster education can be done, namely through learning. Providing public knowledge about disasters can be done through integrated learning in several subjects, one of which is Natural Sciences. The true nature of science learning is based on empirical, scientific knowledge is tentative, but can last a long time; scientific knowledge is full of theory, but partly subjective; imagination and creativity play a role in science; and there is no single scientific method [6]. Connecting science with Socio-scientific issues such as local, national and global community concerns make science classes more challenging, improve students' problem solving and critical thinking skills.

Three possible conceptualizations for disaster education are: (1) based on temporal differences between education conducted at a regular or an unusual time; (2) apply

learning and teaching modes: formal, non-formal and informal; (3) establishing disaster education as a sub-discipline in the field of education is proposed: one sub-discipline is lifelong learning and the other is public pedagogy [7]. Empirical studies of disaster education in Indonesia are very limited [8], implementing the Maena for Disaster Education program in Nias, North Sumatra. The results show a positive effect on students' ability to cope with disaster risk and the likelihood of taking appropriate responses during an earthquake. Disaster education program in Indonesia is limited by time and funding, therefore it has not been able to reach other areas throughout Indonesia.

It is very important to handle and reduce disaster risk by using technology that is currently developing, namely utilizing social media, mobile phones and digital games for training and socialization programs [9–12]. One way to make learning fun is to combine education-entertainment (edutainment) [13, 14]. The edutainment program used can be in the form of fun games [15, 16]]. The existing Disaster Risk Reduction Program (DRR) requires large costs and involves many agencies and community groups so that it is difficult to get attention every year. Recommendations to intensity DRR is through integration in formal education, especially the Social Sciences and Natural Sciences subjects. Disaster education is important for science teachers to learn in the form of formal education in order to be able to take self-protection measures and reduce greater disaster risk.

Curriculum development for educational programs is oriented towards Pedagogical and Content Knowledge (PCK) or over time more towards Technological Pedagogical and Content Knowledge (TPACK). TPACK is composed of three elements, namely TK (Technology-Knowledge), PK (Pedagogy-Knowledge), CK (Content Knowledge) . Curriculum development also pays attention to various government policies and global education issues, including biodiversity conservation, climate change, and the Millennium Development Goals (MDGs). The era of the industrial revolution 4.0 demands a flexible study program curriculum design. Currently, students are not only equipped with their field of knowledge, but also need to have supporting skills or other alternatives when they enter the world of work.

The curriculum applied in the Science Education Study Program in Banten starting in the odd semester of the 2020/2021 academic year is a curriculum improvement based on a review and evaluation of the curriculum and tracer study by the study program with input from stakeholders and alumni of Science Education. Graduate Learning Outcomes (CPL) are formulated based on recommendations for knowledge groups, which are translated into specific courses by taking into account: profile of study program graduates; Industrial Revolution 4.0; 21st Century Skills; Technological and Pedagogical

Content Knowledge (TPACK); and the Curriculum of the Indonesian Science Education Association.

One of the subjects that is the focus of attention is Disaster Mitigation, which equips disaster education skills. This course is new in the 2019 Curriculum, in 4th semester of 3 credits. This course was previously the development of elective courses for Earthquakes, volcanoes and tsunamis, elective course in 5th semester of 2 credits. Based on Indonesian Science Education Association recommendation, it is hoped that the science education study program will become a study program that introduces and equips prospective science educators about natural disasters and how to overcome them. The course for disaster mitigation has only run for one period in the even semester of 2020/2021. This course is considered important to be provided to students of the Science Education study program. Therefore, this article aims to analyze the various needs of lecturers and students so that it is necessary to improve disaster education based on science edutainment. It is expected to develop learning program designs to improve the quality of disaster mitigation lecture content in equipping 21st century life skills, especially critical and creative skills, with global education issues, namely disaster education for prospective science teachers.

2. METHODOLOGY

This research uses descriptive - analytic method with a qualitative approach . The subjects involved in the research consisted of two lecturers from the Department of Natural Sciences Education in Banten and 67 students who had received lectures on Disaster Mitigation. Data collection techniques used non-test instruments which were carried out through document analysis, questionnaires and interviews. The data analysis techniques used are observational data analyzed by data generation. Percentage of observations for each side measured.

3. RESULTS AND DISCUSSION

The disaster mitigation course at the Science Education Study Program in Banten is a new course as a recommendation from the Indonesian Science Educators Association to introduce natural disaster literacy and disaster risk management through integration in learning. The content of the lecture material has been adjusted to the learning outcomes requested by The Indonesian Science Educator Association. The following analysis of the relationship between CPL content and competence is presented in Table 1. Not

many science education campuses in Indonesia teach the Disaster Mitigation in the curriculum structure that was developed. The curricula that have been collected are Science Education at UNNES, UNY, Trunojoyo University, Bengkulu University (UNIB) and UNS. Based on the analysis of curriculum documents, there are three campuses that teach MK Disaster Mitigation in the curriculum structure, namely S1 Science Education UNTIRTA, S1 Science Education UNS and Masters Science Education UNIB. Following are the results of the analysis of the lesson plan of Disaster Mitigation in Table 2.

The Constitutional Court on Disaster Mitigation has only been running for the second year, batch of 2020; 3 credits, with practicum it can't be done because of the pandemic. Have not utilized the technology that is currently developing in disaster risk management.The results of the study of documentation, questionnaires and interviews on disaster education indicate that the disaster mitigation lecture activities that have been carried out so far have not been able to play an optimal role in disaster education and train students for disaster preparedness. Disaster mitigation courses that have been running have not integrated practicum in the learning process with a load of 3 credits. This can be seen from the tasks and projects that are the outputs of which there are no instructions or practicum stages or demonstration activities about disasters and disaster simulation practices. The absence of modules or teaching materials used is a problem that needs to be solved. In addition, the pandemic conditions also make it impossible to carry out disaster simulation activities. The project is given as a final project in the form of preparing a disaster simulation scheme. Simulation activities and empirical experience obtained by students have not been obtained properly due to limited teaching materials.

The results of understanding disaster education for students who have contracted disaster mitigation courses have been structured quite well. It can be seen that there are 69 responses, 23% stating that disaster mitigation materials are not difficult. As many as 97.83% of students stated that natural disaster literacy had been obtained from the lecture activities they experienced. While the skills that provide disaster preparedness have not been clearly seen, it can be seen from the response as many as 47, 83% stated that they did not acquire the skills needed in disaster education.

Disaster Risk Reduction (DRR) requires a proactive attitude and high collaboration skills. The existing DRR program requires a large amount of money and involves many agencies and community groups so that it is difficult to get attention every year. Collaboration skills can be measured by peer assessment . Indicators that can be used to measure collaboration skills include: participation, leadership, attitude, feedback, cooperation and time management. Based on the results of the questionnaire, indicators

Table 1: Relationship of content with CPL and disaster mitigation competencies.

CPL	CPL Mastery	Competence	Study Material
Special skill	Knowledge		
Able to build students' scientific literacy skills through the implement-tation of science learning	Mastering theoretical concepts in the field of Natural Sciences (IPA), especially earth. Designing and using science concepts related to Banten local wisdom in an integrated manner in science learning.	Mastering basic knowledge of earth and space and can develop and apply it in learning in junior high school.	Natural events, disaster concept, disaster risk, Disaster risk reduc-tion efforts, Policy analysis

of good collaboration have not been well formed, while DRR requires a pro-active attitude and high collaboration and is one of the 21st century life skills. Indicators of critical and creative thinking skills have not been well formed, the highest is 77.61 and the lowest is 67.16

Critical and creative thinking skills are the demands of Indonesia's human resources in the future, especially disaster mitigation actions. This ability, does not necessarily appear by itself, should be developed gradually, one of which is through learning. Learning designed based on knowledge of ways of thinking and learning styles will be more effective in developing students' thinking skills [17, 18]. Creative thinking style makes students produce ideas that other people don't think of, are able to capture information according to the essence, and are able to communicate clearly through story telling. While the main characteristics of critical thinking include being logical, accurate and evaluating carefully before any action [19].

It can be seen that the materials study for disaster mitigation materials for the undergraduate level between UNT and UNS Science Education are different but still intersect, especially the concept of earth.

Based on interviews with Regional Disaster Management Agency, disaster education programs in schools have been carried out, but are still very limited. Collaboration that has been done is still limited with social institutions such as mapala, volunteers and Indonesian Red Cross, has not collaborated and integrated with formal education. Disaster education should be done through formal, informal and non-formal [20]. Based on interviews with two supporting lecturers, the limitations faced in lectures are that the studies carried out are still limited to local wisdom, and the need for collaboration between institutions in the field of disaster mitigation needs to be optimized. For the development of better disaster mitigation courses, it is necessary to develop a study of the characteristics of space and time so that it is more contextual and applicable.

Table 2: Analysis of lesson plan of disaster mitigation science education.

No	Characteristics	S1 P. IPA-UNT	S1 P. IPA-UNS	S2 P. IPA UNIB
1	Name and Code	Disaster Mitigation (IPA619208)	Introduction to Earth and Disaster Mitigation (PKMB - KB1714530)	Disaster Mitigation Education (S2IPA-126)
2	Number of Credits/Semeste	3 Credits/4	2 Credits/5	2 Credits/1
3	Material Study	Natural events (lithosphere, hydrosphere, atmosphere, sun and stars, planets and celestial bodies, moon and earth's satellites and natural resources), disaster concept, disaster risk, Disaster risk reduction efforts, Policy analysis	The structure of the earth's layers in the form of a layer of the earth's crust, the earth's blanket layer, and the earth's core layer, Types and properties of rocks The process of the formation of the earth's surface and the shape of the earth's surface Exploration of minerals beneath the earth's surface. Disaster mitigation	Earthquake Landslide Tropical Cyclone Flood Erupting volcano Dengue fever Midterm exam Mitigation of Local Wisdom Mitigation of Local Wisdom Mitigation of Local Wisdom Thalimodic Chernobyl Arsenic Mercury
4	CLO in PLO	Identify, analyze, forecast	Explain, detail	Analyze
5	Learning strategies	Discovery, PBL, Demonstration	Lectures, discussions (Offline and online)	PBL
6	Appraisal Technique	Tasks: identification and analysis of the history of natural events, case studies, journal analysis, demonstrations; Midterm Exam, and Final Exam	Tasks: active discussion, independent study, observing the environment, exploring experiences; Midterm Exam, and Final Exam	Assignment (group discussion), problem analysis, journal analysis; Midterm Exam, and Final Exam

In addition, institutional collaboration between universities and institutions related to mitigation needs to be intensified.

Based on the explanation above, various problems faced in disaster mitigation courses can be identified and the factors that cause them. To overcome these problems, among others: (1) Changes in the focus of lectures which were originally oriented towards theoretical studies to become practice-oriented and direct simulations with the real world in a contextual and applicable manner; (2) There needs to be stages in lectures that are oriented towards education and entertainment (edutainment), the learning process is fun by utilizing technology such as simulations, social media and

Table 3: Student questionnaire results.

No	Ideas	Yes (%)	Not (%)
1	The content in the disaster mitigation course prepares disaster preparedness	97.8	2.2
2	Difficulty to understand the materials/topics in disaster mitigation courses	23.9	67.1
3	Disaster mitigation courses contribute to preparing disaster preparedness	97.8	2.2
4	The type of task in disaster mitigation courses is a project	52.2	47.8
5	The implementation of the disaster course has been carried out well	95.7	4.3
6	Project assignments in disaster mitigation courses	80.4	19.6
7	Important topics have been emphasized or added in this course	100.0	0.0
8	The necessary skills related to disaster mitigation courses do not yet exist.	52.2	47.8
9	Topics that are important to be emphasized or added are already in the disaster mitigation course	84.8	15.2
10	Participate in group activities and are always present in group discussions	95.7	4.3
11	Effectively directing the group to stay focused on the material, providing encouragement and opportunity for each member	78.3	21.7
12	The ideas and suggestions of other members.	84.8	15.2
13	Constructive, on-topic feedback.	52.2	47.8
14	Respect and share the workload fairly.	84.8	15.2
15	Complete tasks on time and don't delay the entire project because of unfinished tasks.	95.6	4.4
16	Logically analyze, evaluate and be able to find the causes of natural disasters	76.1	23.9
17	The reasoning and methods to prepare disaster preparedness from an early age	77.6	22.4
18	More argumentative and like to discuss the most logical disaster management methods	73.1	26.9
19	Provide real visualization of natural disasters and appropriate disaster preparedness actions	67.2	32.8
20	Realize unique ideas to introduce real disaster preparedness on project assignment	70.2	29.8

games in disaster simulations; (3) There needs to be teaching materials or modules that are integrated with practicums that guide students on natural disaster literacy and disaster simulation by utilizing currently developing technology. (4) It is necessary to consider how to evaluate the process and project outputs produced by students and the various skills needed to prepare for disasters; and (5) Disaster Risk Reduction (DRR) requires a proactive attitude and high collaboration skills, collaboration with related institutions such as National Board for Disaster Management is needed for contextual and applicable experience development.

4. CONCLUSION

Based on the results of the study, it can be concluded that the need for science edutainment - based disaster education for prospective science teacher are: 1) The implementation of disaster education needs to be developed, especially involving relevant agencies such as BPBD to develop the empirical experience of prospective science teacher; (2) Needs to be integrated with practicum using modules by utilizing technology used in socialization and disaster risk management; and (3) Development of Disaster Mitigation modules needs to be carried out, especially modules that improve natural disaster literacy, critical and creative thinking skills prospective science teacher. Furthermore, the recommendation of this study is to design a science edutainment learning framework. The program is designed using a collaborative concept that combines science content, education and fun interactive activities such as simulations, role plays, videos or films and involves policy makers such as BPBD/BMKG as empirical experience in the field.

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