Theoretical Study to Design Digital Disaster Learning Resources for Prospective Elementary School Teachers

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Abstract. Building awareness of disaster preparedness is indispensable for a country with high disaster risk, like Indonesia. Moreover, the need for knowledge about disasters is essential for prospective teachers or elementary school teachers. This paper is a theoretical study to design a mobile pedagogical framework that discusses the involvement of technology in learning to facilitate prospective elementary school teachers' disaster knowledge. The research method used is a paper library research review. The theories analyzed are the theory of mobile pedagogy (mobile assistance), the 5E model of the learning cycle, and TPACK. Adapting the mobile pedagogical framework (mobile assistance), the 5E model of the learning cycle and TPACK become a framework for designing digital disaster learning resource content that is used to facilitate knowledge transposition and didactic transposition of prospective elementary school teachers.

Keywords: mobile pedagogical · disaster education · elementary school · prospective teachers · teacher

1 Introduction

Indonesia is a region with a high level of disaster risk because Indonesia is a disaster-prone area located at the confluence of tectonic plates, namely Eurasia, Indo-Australia, the Philippines, and the Pacific [1]. Indonesia is also a region where two series of active volcanoes meet worldwide and have a large ocean area. So it is very potential for disasters, both geological and hydrological disasters. Based on disaster indexing data conducted by BNPB, the tsunami disaster was the highest risk in Indonesia with a score of 9.7 points, followed by earthquakes with 8.9 points and floods with 8.1 points. Based on the Disaster Risk Index Map issued by BNPB, most of Indonesia's territory is in a high-risk zone [5].

Knowing about disasters is very important for prospective elementary school teachers [6]. Disaster mitigation education is a form of effort to reduce victims or losses likely to occur due to natural disasters or disasters caused by human activities. Knowledge of disaster that prospective teachers or elementary school teachers must possess is knowledge of before, during, and after a disaster: (a) geological and hydrometeorological disasters; (b) earthquake disasters; (c) tsunami disasters; (d) volcanic disasters; (e) flood disaster; (f) landslide disaster; (g) hurricane disaster; (h) drought disaster; (i) forest and land fire disasters; (j) non-natural disasters; and (k) social disasters [7]. Therefore, the process of knowledge transposition and didactic transposition about disaster is essential for prospective elementary school teachers in the pedagogical space.

Disaster education is essential so individuals can face disasters during pre-disaster, emergency response, and post-disaster [9]. Places that can provide understanding to prepare communities for disasters in an integrated manner are educational institutions. Schools are one educational institution that becomes a reference for the community to learn about disaster prevention and preparedness [6]. One way to transfer knowledge and experience is through education. Education can be obtained through teaching, training [4], self-taught, or research that can be used to determine something. Attitudes and actions in doing something cannot be separated from the surrounding environment [10].

Knowledge construction and interpretation of disaster content for prospective elementary school teachers are essential and necessary [6, 15]. This construction is used to assist students in constructing the conceptual understanding possessed by students [16]. One form of building knowledge construction and interpretation of disaster content for prospective elementary school teachers is the provision of digital media. Digital media is a practical and suitable learning resource because teachers and students can find information/learning materials easily and quickly. Science and technology are developing rapidly in the digital or information age. The impact is the more open spread of information and knowledge from and worldwide across distance, place, space, and time. Human life in this digital era will always be related to technology. Therefore, education is also experiencing rapid development, including digital learning (digital learning). By utilizing the development of information and communication technology, education can reach all levels of society. Therefore, it is necessary to pursue a pattern involving technology, which is a "mobile" device called mobile pedagogy.

Mobile pedagogy is a framework that aims to help and guide teachers' thinking in designing learning using "mobile" devices, both inside and outside the classroom. In addition, mobile pedagogy helps and guides teachers in adapting mobile learning, whether it is done online or offline. One form of learning model from mobile pedagogy is mobile learning. Mobile learning is a learning model that involves mobile devices so that students can access learning materials, learning instructions, and learning applications without being limited by space and time, wherever and whenever.

This paper is a theoretical study to build a mobile pedagogical framework that discusses the involvement of technology in learning to facilitate prospective elementary school teachers' knowledge transposition and didactic transposition of disasters. Disaster knowledge possessed by prospective elementary school teachers is for provision in teaching disaster content to students in elementary schools. Therefore, the mobile

pedagogy framework designs digital disaster learning resource content for prospective elementary school teachers.

2   Methods

The research method used is a paper library research review. The research collected in-depth information and data through relevant literature, books, and previous research results to obtain answers and theoretical foundations regarding the problems to be studied. The steps for reviewing library research papers are as follows: (a) topic selection and information exploration; (b) determination of research focus; (c) collection of data sources; (d) reading and analyzing literature sources; (e) creating and process data and analysis; and (f) drawing a synthesis and concluding.

3   Result and Discussion

The Pedagogy-Space-Technology framework is a framework for the learning process that involves integrating pedagogy, space, and technology [17]. The integration and relationship between pedagogy, space, and technology serve as the basic framework for educational research with the involvement and use of technology and information in the digital era used in learning [18]. The involvement of technology in learning will result in learning that is not limited by space and time [19]. The pedagogy-space-technology framework integrates pedagogical, technological factors, and operational practices into a student-driven digital education model [18].

In addition to Pedagogy-Space-Technology, Technology Pedagogical Content Knowledge (TPACK) also has an essential role in developing a mobile pedagogical framework for developing digital disaster learning resource content. TPACK emphasizes the relationship between subject matter, technology, and pedagogy [20]. TPACK is a framework for understanding and describing the knowledge needed by a teacher to streamline pedagogical practices and understanding concepts by integrating technology into learning [21]. TPACK emphasizes the relationship between subject matter, technology, and pedagogy [22]. The interaction between these three components has the power and attraction to foster active learning focused on students [18]. The TPACK framework has a relationship between its constituent components, namely intersecting material components (C), pedagogical components (P), and technological components (T), which affect the learning context [22].

Then, the mobile pedagogy framework used to develop digital disaster learning resource content for prospective elementary school teachers adapts from the mobile pedagogical framework (mobile assistance) in Foreign Language Learning (EFL) learning. Mobile Pedagogy consists of teacher wisdom, tools, language dynamics, and learner mobility (Fig. 1). The implication is that teacher wisdom is strongly influenced by academic background, work experience, and understanding of technology, including pedagogical methods and strategies to guide students in learning [18, 23].

Adapting the mobile pedagogical framework in foreign language learning is used to design digital disaster learning resource content for prospective elementary school
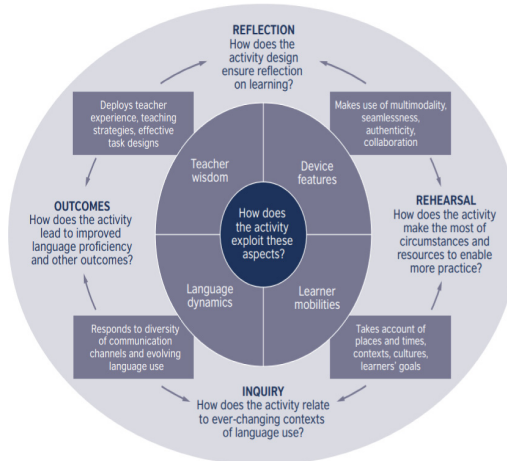
Fig. 1. Pedagogical Framework for Mobile Assistance [23]

teachers linked to the 5E learning cycle [24, 25]. The design of digital disaster learning resource content facilitates knowledge transposition and didactic transposition of prospective elementary school teachers.

The stages of designing digital disaster learning resource content used to facilitate knowledge transposition and didactic transposition of prospective elementary school teachers are as follows: (a) determining learning outcomes and objectives on disaster education content (Fig. 2). In addition, learning outcomes and goals are needed to measure learning achievement; (b) development of content materials adapted to mobile-assisted procedures combined with a learning cycle (Fig. 3).

Learning activities connect the 5E learning cycle, a constructivist theory, with a mobile (mobile-assisted) pedagogical framework. Learning activities begin with a rehearsal process (practice or experiment) which is carried out by exploring students' prior knowledge and ideas and being invited to make predictions about the phenomena

Learning Outcomes
- Able to identify threats before, during and after: (a) geological and hydrometeorological disasters; (b) earthquake disasters; (c) tsunami disasters; (d) volcanic disasters; (e) flood disasters; (f) landslide disasters; (g) hurricane disasters; (h) drought disasters; (i) forest and land fire disasters; (j) non-natural disasters; and (k) social disasters.

Learning objectives
- Students can explain the causes of (a) geological and hydrometeorological disasters; (b) earthquake disasters; (c) tsunami disasters; (d) volcanic disasters; (e) flood disasters; (f) landslide disasters; (g) hurricane disasters; (h) drought disaster; (i) forest and land fire disasters; (j) non-natural disasters; and (k) social disaster.
- Students can identify activities before, during and after: (a) geological and hydrometeorological disasters; (b) earthquake disasters; (c) tsunami disasters; (d) volcanic disasters; (e) flood disasters; (f) landslide disasters; (g) hurricane disaster; (h) drought disaster; (i) forest and land fire disasters; (j) non-natural disasters; and (k) social disaster.
- Students can simulate activities before, during and after: (a) geological and hydrometeorological disasters; (b) earthquake disasters; (c) tsunami disasters; (d) volcanic disasters; (e) flood disasters; (f) landslide disasters; (g) hurricane disasters; (h) drought disasters; (i) forest and land fire disasters; (j) non-natural disasters; and (k) social disasters.

Fig. 2. Learning Outcomes and Objectives on Disaster Education Content [7, 15]
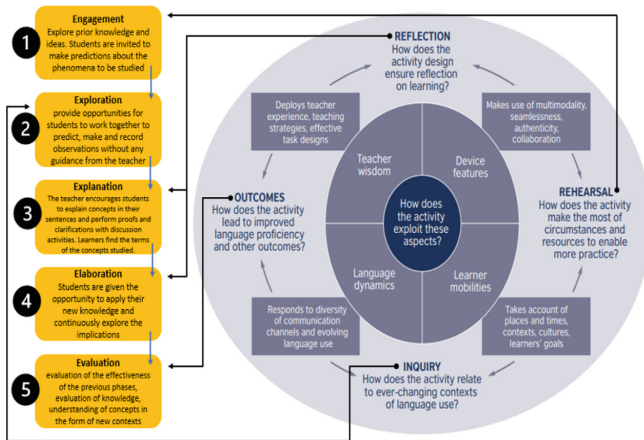
Fig. 3. Mobile-assisted Pedagogical Framework with Constructivism Model 5E (Adaptation of [23] and [29])

studied in disaster education (engagement phase). Inquiry activities provide opportunities for students to work together to predict, conduct, and record observations without guidance from the teacher (exploration phase). Then the reflection activity carried out two learning cycle stages: the explanation and elaboration phases. In the explanation stage, it encourages students to explain concepts based on their knowledge, and perform proofs and clarifications with discussion activities, so that students find the terms of the concepts being studied.

Moreover, students can apply their new knowledge at the elaboration stage and continuously explore the implications. Finally, the last activity is the outcome. This activity is done by evaluating the effectiveness of the previous phases, evaluating knowledge, and understanding concepts in the form of new contexts from students, which is a process of cognitive change, especially in learning outcomes about disaster content (evaluation phase).

Constructivism provides a pedagogical shift, namely mobile pedagogy, which provides a new concept where teachers help and facilitate students in reconstructing knowledge (Srisawasdi et al., 2018). The main framework is learner-centered learning (Schunk, 2014). Elements adapted to mobile pedagogy include teacher perceptions, academic background, the theoretical framework from the Zone of Proximal Development (Schunk, 2014) (Vygotsky, 1978), and the 5E model of the learning cycle [29]. Another component that is taken for mobile pedagogy is taken from the TPACK idea, namely material (C), pedagogy (P), and technology (T) [20, 22] which are influential in the learning context. These elements are used in designing digital disaster learning resource content to facilitate knowledge transposition and didactic transposition of prospective elementary school teachers.

4 Conclusion

Knowledge construction and interpretation of disaster content for prospective elementary school teachers are essential. This construction is used to help students construct their conceptual understanding. Adapting the mobile pedagogical framework (mobile assistance), the 5E model learning cycle, and TPACK become a framework for designing digital disaster learning resource content that is utilized to facilitate knowledge transposition and didactic transposition of prospective elementary school teachers.

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