Profiling the context of natural history teacher candidate for the elementary school degree through web-based inquiry

Pramita Sylvia Dewi *, Diana Rochintaniawati, Parsaoran Siahaan

Universitas Pendidikan Indonesia. Jalan Dr. Setiabudi No.229, Kota Bandung, Jawa Barat 40154, Indonesia
* Corresponding Author. Email: pramita.sylvia.dewi@student.upi.edu

Abstract: Web-Based Inquiry is an important investigative activity that should be implemented in the classroom. Such investigative activity, or investigation in general, serves as the basis for a researcher to develop his or her study. In relation to this initiative, the ICT-based learning capacity becomes a significant part since this capacity serves as the basis for the utilization of the Web-Based Inquiry, which has been marked by the capacity of operating the overall investigation information from the ICT-based learning. Departing from this elaboration, the objective of the study is to describe the capacity of ICT information and the delivery of the preliminary information for the needs of the Web-Based Inquiry. During the conduct of the study, the purposive sampling technique was implemented in order to define the number of the sample. As a result, 66 students from Batch 2019 of Lampung University were selected as the subjects for the study. Then, the data gathering instrument that had been implemented was the investigation (ICT-Based Learning) questionnaire. The data that had been gathered then were descriptively analysed. The results of the study show that the biggest data portion has been found in the use of Internet-accessing tool although the score of this biggest portion falls into the "Low" category (under 25%). Thus, it might be implied that the Natural History teacher candidates have relatively not internalized the awareness and the best innovation in combining the lesson and the use of ICT through the ways that are more understandable for the students.
Keywords: ICT-based learning, preliminary skills, web-based inquiry

INTRODUCTION

Inquiry learning deals with the teaching of the effective strategies in understanding the science literacy and this aspect has been completely found in the investigation/consensus within the domain of Science (Minner et al., 2010). Although this kind of learning has not been fully accepted on the part of the Science researchers and teachers (Bevins & Price, 2016), the inquiry-based science learning might pose certain differences when it is implemented in the Science classrooms. These differences, which refer to the different skills, become the peculiar characteristics of the Science learning. Then, the scientific competencies that later will be discussed further within the study are commonly associated to the Elementary Pre-Service Teachers (EPT) (Cruz-Guzmán et al., 2017). The training programs that deal with the Elementary Pre-Service Teachers involver the way of teaching Science by observing and practicing what might be possibly and impossibly practiced under the belief on the understanding toward the teachings of Science (Cruz-Guzmán et al., 2017; Newman et al., 2004). Therefore, the learning approach assimilation by means of request and the Science learning acceptance by means of inquiry are undoubtedly considered as the ideal way for teaching Science but such ideal way has posed somewhat difficult challenges for the educators (M. Kim & Tan, 2011).

Through the conduct of the Elementary Pre-Service Teachers (EPT), the inquiry-based learning is more possible to implement especially when the students have previously mastered the necessary skills while the teachers have attended the preliminary training programs (García-Carmona et al., 2017; Yakar & Baykara, 2014). Unfortunately, in some cases the open-ended scientific investigation within the teacher-training programs is found to not be equipped with the laboratory innovation because there is not any investigation alternative that has been practically planned (García-Carmona et al., 2017; McLaughlin & MacFadden, 2014; Merino & Herrero, 2007). In this regard, the difficulties in practicing

the Elementary Pre-Service Teachers (EPT) become the main reason that lies behind the insufficient level of the teacher-candidates' scientific competence and the lack of confidence, which normally appears only during the Science learning (Cruz-Guzmán et al., 2017; Yoon et al., 2012). With reference to the statement, Appleton (2008) adds that there has been complexity among the teacher-candidates' training programs by means of inquiry-based teaching and learning (Crawford, 2007; Newman et al., 2004). However, all efforts should be pursued with regards to the management of Science teaching by means of inquiry-based approach since challenges will help the development on the use of the approach in the learning process (Zhang, 2016).

The 21st Century is a century of competition which demands novel and peculiar skills and capacities. The changes of the skills in the 21st Century demands a serious attention within the learning process, the assessment system, and the curriculum development (Rotherham & Willingham, 2010). The Science teachers, especially the teachers of Natural History, should be prepared to guide the students in understanding every single domain within the contents of Science, which have been intertwined among the interdisciplinary perspectives. Specifically, the teachers should be prepared to guide the students to understand the differences among science, investigation, and technology as the design as well as to understand the impact of the science and the technology on themselves, the community and the public health by means of observation, experiment, data gathering activities, and inferences. By doing so, the students will be able to test their idea and build their scientific concepts.

The competence in the 21st Century should display wide skills and dispositions, which cover technology, media literacy, collaboration skills, communication, and problem-solving skills (Dede, 2010; Voogt et al., 2013). Apart from the encouragement toward embracing the new learning culture, the teachers' capacity to exploit the digital environment culture in order to manifest the digital environment itself is still questionable (Kohen & Kramarski, 2012). Up to date, there has been wide dissatisfaction about the teacher capacity in designing the learning process that might involve the teacher-candidates into the 21st Century learning activities (Kopcha et al., 2014; Lee & Kim, 2014).

Technology provides authentic problems in order to improve the complex thinking skills and, at the same time, facilitates investigation, communication, expression, and knowledge construction. The perfect example of such technology is Internet. With regards to the statement, and in response to the teacher proficiency in technology, many training programs on the independent technology course have been designed and implemented (Kleiner et al., 2007). Unfortunately, the approaches that have been defined in order to cover the gap within this situation have often unsuccessfully prepared the teachers to teach with technology. The latest report from the National Centre of Educational Statistics the United States of America states that there are only 25% teachers who have had impacts on the technology utilization capacity in teaching process and the reason behind the low percentage is found to be associated with the lack of relevant ways or models for integrating the technology into the teaching process (Capobianco & Lehman, 2006; Gray et al., 2010; Zhou et al., 2011).

The meaningful context of technology-based learning process might be pedagogically found in the teaching process of the learning materials (Davis & Falba, 2002; Zhou & Xu, 2011). According to Bodzin (2005), the focus of the Science teachers, especially the teachers of Natural History for the Elementary School degree, is on the web-based scientific inquiry. Similarly, (Schwarz, 2005) states that the teacher candidates should be facilitated in performing computer modelling and evaluation and also in simulating the scientific pedagogy. As an alternative to solve this problem, Hoban (2007) suggests the use of slow animation or known as "slowmation" in involving the teachers into the understanding toward the actual content knowledge of Science. The understanding toward the Science learning, especially the one that is pursued through inquiry, should involve the presence of elaborating process, strategy, and collaborative problem-solving skills (Häkkinen et al., 2017). By doing so, the achievement of the success in the society life will impact the domain of Education with the presence of the experienced teacher-candidate in the inquiry-based approach and the critical thinking in technology utilization (Binkley et al., 2012). Departing from the overall elaboration, the study aims at describing the ICT-based learning capacity of the Natural History for Elementary School Degree teacher-candidate as the preliminary step in preparing the teacher candidates in this domain to master the Web-Based Inquiry. Through the information that has been attained and described in the study, it might be expected that the necessary skills will be mastered in order to deal with the learning challenges within the era of technology.

METHOD

The method that had been adopted within the study as the descriptive analysis method since the aim of the study was to review the quality of the relationship, the activities, or the situations through strong emphasis on the overall description of the details within all aspects of certain activities or situations (Fraenkel et al., 2012). The data for the study were gathered by distributing the questionnaire on the preliminary skills of the teacher-candidates' understanding toward the ICT-Based Learning.

The study was conducted in the Department of Elementary School Teacher Education the Universitas Lampung. The total number of subjects who had been selected as the samples for the study was 66 people; these students were from two classrooms in Semester 3 and all of the subjects were selected by means of purposive sampling technique. The students from the two classrooms were selected because they had equal grade academic points. Then, in line with the data gathering activities, within the study the questionnaire that inquired the ICT-Based Learning skills was distributed.

After the overall data had been gathered, the data were analysed descriptively based on the following stages: (1) access of information through Internet; (2) Internet source that has been used; (3) Internet source attainment; (4) type of information that has been found over the Internet; (5) implementation of written investigation; and (6) update of access strategy in learning process. The data that had been compiled were converted into the presentation form and the further description within the study was related to the identification toward the information about the Web-Based Inquiry.

RESULTS AND DISCUSSIONS

Information on the ICT-Based Learning Skills of the Natural History Teacher Candidates for the Elementary School Degree

The ICT-Based Learning skills are fundamental for the teachers. Due to the needs in the 21st Century, the teacher candidates are demanded to master the skills of observation especially with regards to the information access and information utilization in the written form. The increasingly rapid changes require the teachers to utilize technology in the teaching activities (Zhou et al., 2016). Indeed, assessing from the learning needs nowadays, the teachers are demanded to pursue further innovation in current implementation of the teaching-learning process. In this case, such situation certainly has influences on the weak background of Science (McDonnough & Matkins, 2010). This fact is quite surprising since it might be associated to the insufficient training programs for reconstructing the pragmatic instruction of knowledge (Sherman & MacDonald, 2007) and the lack of sufficient self-confidence and self-independence for teaching Science (Bergman & Morphew, 2015). These factors might inhibit the learning process, such as STEM for the students, within the school (Nadelson et al., 2013). Therefore, it is no wonder that the STEM education in the elementary school is still weak whereas it should have been strongly internalized (Hechter, 2011).

In this aspect, the students display high level of expertise in investigating the topics of developing the learning skills (Hao & Lee, 2017). This finding is in line with the findings of a study by Barak and Dori (2005). In addition, this finding has uncovered the preliminary indicators with regards to the students' efforts in combining the scientific aspects and the technological aspects of the subjects under investigation, which has similarly been uncovered in the real world. However, the integration is not in-depth because most of the teacher candidates perceive that this task is too challenging. At the same time, most of the teacher candidates also have difficulties in utilizing the Information and Communication Technology for presenting new topics. Interestingly, some of the students enjoy utilizing the structured classroom activities of Information and Communication Technology during the training sessions.

Table 1. The Indicators of the ICT-Based Learning Skills

No.	Indicators	Explanation
1.	Indicator 1	Accessing information device through Internet
2.	Indicator 2	Assessing the information source that has been utilized
3.	Indicator 3	Attaining information source
4.	Indicator 4	Describing type of information that has been attained from the Internet
5.	Indicator 5	Running written investigation
6.	Indicator 6	Updating access strategy in the learning process

The data in Table 1 show the explanation of each indicator, which has been based on the categorization of the ICT-Based Learning skills. The results of each indicator are presented in the form of percentage in accordance to the data that have been gathered from the questionnaire. The overall results might be consulted in Figure 1.
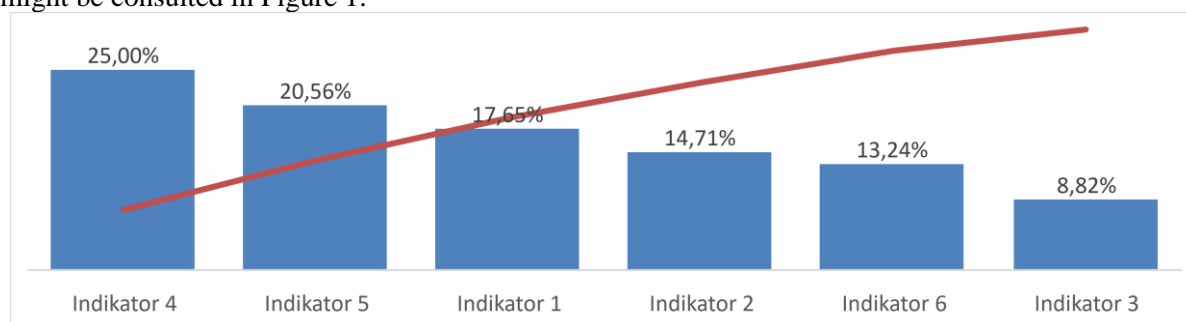

Figure 1. Percentage of Correct Answers in Relation to the ICT-Based Learning Skills

The data in Figure 1 show the six indicators that assess the ICT-Based Learning skills of the Natural History teacher-candidates for the Elementary School Degree. These indicators have been adapted from the indicators proposed by (Kurbanoglu et al., 2006). Then, the highest score is found in the information device through of Internet (25%). The reason behind such highest score is that the teacher candidates have low sense of awareness on the obstacles or the challenges within the technology utilization as the basis of the creative learning. Then, this figure is followed by information source utilization (20.56%) in the second place, information source attainment (17.68%) in the third place, information that has been attained from the Internet (14.71%) in the fourth place, implementation of written investigation (13.24%) in the fifth place, and access strategy update in the learning process (8.82%). All of these indicators have significantly declining percentage. Departing from these percentages, it might be concluded that the elementary school teacher candidates have weak understanding in performing their thinking skills. This statement indeed has confirmed the factors that are associated to the different domain of Science.

The rapid changes in technology, and not to mention the rapid changes in the Web-based technology, have encouraged the researchers to question and challenge the assumption within the traditional teaching practice with regards to the possibility whether the teachers have understood the ways of utilizing the digital environment productively (Collins & Halverson, 2010). Thomas and Brown (2011) state that every individual establishes his or her own teaching practice and the establishment results in the learning cultures. In response to the statement, B. Kim et al. (2015) explain that the new learning cultures include more than the mere learning process on certain knowledge domains. Unfortunately, there are not many teachers who have been expert in utilizing the Internet and who have internalized effectively and efficiently sufficient skills or strategies in negotiating the available domain of information on the new content knowledge (Ikpeze & Boyd, 2007).

As an inquiry, Science regards something that is more than mere collection of facts and that accomodates the tentative characteristics under the conditional traits in which the theory has been generated and the facts have been attained. This statement is contradictoryto the view of the Science as the static body of knowledge which is always true. When the scientists are involved into a study, the new ideas appear, the new perspectives are established, the new principles are developed and justified, and also the new learning materials are revised or redefined. Inquiry is not an activity that should adhere to the context. For example, the process of scientific inquiry is adopted in order to uncover the uncommon natural phenomenon that has been studied in science. In this process, the scientists formulate hypotheses, set experiments, gather data, and analyse the findings for testing their hypotheses. A solid example of such process is the Science-Mathematics inquiry which embarks from the complete abstraction and emphasizes the discovery of the relationship between the quantitative ideas and the new perspective creation (Martinello & Cook, 2000).

In this regard, the main benefit still lies on the part of the teachers. Indeed, it is the teachers who mostly enjoy lots of facilitation within the teaching process because ICT has been proven to facilitate the teachers in preparing and implementing the teaching process. If the teachers save the files of the teaching materials from the previous semester or the previous year, then they can use these teaching materials for the present teaching activities with or without modifications. In addition, the formulas that

have been developed by using the Microsoft Excel are very useful for calculating the students' scores. On the contrary, the students still enjoy few benefits with regards to the ICT-Based Learning because the teachers have not provided the students with many ICT-based assignments. When the teachers are using the Microsoft Power Point in the learning activities, they actually should assign the students to elaborate the given test items or case studies by means of ICT instead of paperwork. Thereby, the students who have been the active users of ICT will gladly complete the assignments from their teachers.

Despite the benefits that the ICT-Based Learning has, there are still several obstacles or challenges in turning the ICT-Based Learning into the basis of the creative learning. For the part of the schools, the obstacles are namely: (1) the inequal distribution of Internet access among the schools; (2) the expensive ICT equipment; (3) the insufficient time allocation for the teachers to learn about ICT; (4) the absence of soft loans for the teachers to afford laptop; and (5) the absence of Internet access procurement in the school. Then, for the part of the teachers, the obstacles are namely: (1) the lack of time allocation for the ICT training; (2) the declining age of the teachers; (3) the profit mindset (meaning that learning ICT might be associated to earning extra income); (4) the absence of willingness to learn teaching by using ICT (since it will not provide any benefit); (5) the fond of using the social media for having reunion instead for establishing online classrooms; and (6) the urgency for the teachers to master the ICT first prior to teaching the students (whereas the students already know how to utilize the ICT without having to be taught first).

Identification of the Web-Based Inquiry

The conceptual framework for operationally analysing a content has already been defined as "Web-based inquiry for learning knowledge." This aspect has been used as the basis for the Schwab's concept known as "inquiry teaching/learning" (Bodzin & Cates, 2003). The focus of the concept is on the activity inquiry instead of the Website inquiry on the wider basis. Thus, the implication is that the Web-Based Inquiry does not refer to the overall Website; instead, the Web-Based Inquiry refers to a Website that offers inquiry activities that have been defined as the full inquiry containing the five important features of classroom inquiry as having been explained in the inquiry itself and the National Science Education Standards (Olson & Loucks-Horsley, 2000). The five important features alone might be elaborated further as follows: (1) the students are engaged into the scientifically-oriented questions; (2) the students prioritize the evidence and such prioritization enables them to develop and evaluate any explanation that deals with the discusssions of the scientifically-oriented questions; (3) the students address the evidence-based explanation to the scientifically-oriented questions; (4) the students evaluate their explanation in terms of available alternatives which reflect the scientific understanding; and (5) the students establish communication with and justify the explanation that they have proposed.

According to Olson and Loucks-Horsley (2000), the Web-Based Inquiry, or also known as WBI, should display three perspectives and scientifically-oriented questions. These scientifically-oriented questions are intended to deal with the empirical inquiry and also the data gathering and the data processing for developing the explanations toward the scientific phenomena. At the same time, such questions might also deal with the knowledge or the possible impact of environmental decisions. Furthermore, teaching and learning Science by means of inquiry refers to a process in which the students attain knowledge. Such process of inquiry combines several scientific processing skills such as identifying problems, formulating hypotheses, designing experiment, collecting and interpreting data, and analysing data for drawing conclusions. In practicing these skills, an inquiry learner often makes use of learning strategies such as problem-solving, evidence -investigating, scientific-reasoning, and decision-making.

Inquiry in the Science classroom might describe multiple highly-structured forms in which the students direct the students to identify and take open-ended inquiry form that centers around the students. The recent teaching and learning technique, which utilizes inquiry, includes engaging the students into the authentic questions for both the local and the global inquiry (Crawford, 2000; Feldman et al., 2000), the project-based science instruction, or the role-play debate simulation (Bodzin, 2005). These techniques strive to engage the students into the meaningful questions about the daily activities, strive to emphasize the use of investigation method for critically evaluating several forms of evidence, and strive to engage the students into the social discourse for promoting the process of knowledge construction. The proponents of the inquiry-based approach argue that the inquiry-based approach provides an opportunity for the students to learn about the scientific practice and to be completely engaged into the scientific practice.

Based on the data from the ICT-Based Learning skills, it is found that the utilization of technology in the classroom has recently been a problem despite the fact that the advancement of Internet-based technology has resulted in huge impact for education. The World Wide Web, or known as Web, offers numerous activities for meeting the teaching and learning objectives. Educators might utilize the Web for accessing, disseminating, and delivering information; at the same time, the students might access the Web for gathering information, attaining knowledge, generating numerous ideas, and establishing communications with other people. One of the biggest advantages in using the Web is that Web enables its users to access information at any time and any place. However, the ICT-Based Learning preliminary skills seem to be in contradiction to the utilization of the Web, which provides information that are ready to be accessed by anyone. With regards to the statement, the National Science Education Standards has conducted an investigation that refers to multiple ways in which scientists study the nature and suggest explanations based on the evidence in their works. This kind of investigation certainly undergoes the development of knowledge and understanding toward the scientific ideas and deals with how the scientists study the nature, the teaching-learning activities, and the investigation design.

In order to overcome the problem, the first step that should be taken is holding a training program for reconstructing the pragmatic knowledge (Sherman & MacDonald, 2007). The reason is that the low level of ICT-Based Learning skills will lead to the insufficient teachers' self-confidence and independency for teaching Science (Bergman & Morphew, 2015). With reference to the statement, one of the pedagogical approaches that centre around the students is the inquiry-based learning. The results of several studies that have been previously conducted show the various inquiry-based pedagogy with their various inquiry-based learning results (Hakkinen et al., 2016). As a result, there is a need to implement the systematic scientific approach in order to measure the impact of the teaching activities based on the inquiry within education. Furthermore, there should be more studies for developing the theory of understanding the inquiry-based learning model and its practice among teachers, who play the central role in developing the future school. The main problem that has been related to the learning process over Internet includes navigation disorientation, excessive information, and disturbance (Bradshaw et al., 2002).

Navigation disorientation results from excessive information in which the students might be overwhelmed by the abundant amount of information over the Web and lose the trace of the subjects that they search. On another occasion, navigation disorientation also results from the students' exhausted. Similarly, the non-linear hypertext environment from the Internet implies that sometimes information has not been well-organized. Such situation has placed significant cognitive demands on the students in establishing the accurate connection among the available concepts (MacGregor & Lou, 2004). Not to mention, it is impossible that the students who utilize the Internet have sufficient skills and strategies for effectively and efficiently negotiating the available domain of information in order to learn the new content of certain knowledge.

Every academic discipline and specific domain has peculiar language, theory, and methodology for conducting an inquiry. Several studies that deal with the educational technology that discusses the preparation of the technology have found that technology-based teaching method for the purpose of presentation, of digital content display such as video and online sources, and of discussion over the specific representations on certain subjects has been consistent with the efforts of implementing the technology in the teachers' educational program (McGrail et al., 2011). In addition, critical-thinking and problem-solving are necessary in establishing competencies under the objective of ensuring that the objective of an education system is to learn and not to teacher (Dag & Durdu, 2017).

Teacher candidates learn about how to design inquiry (Web)-based learning activities in order to teach literacy, social study, Mathematics, and concepts of Science (Mouza et al., 2014). With reference to the statement, in the first stage the teacher candidates define the area of the content and the specific learning objectives. Then, in the second stage, the teacher candidates gather the Web-based sources that support the learning practice among their students. Next, in the third stage, the teacher candidates design the inquiry-oriented activities that involve the use of the Web-based sources when the students are engaged into the activities of learning the concepts for specific contents. Eventually, in the fourth stage, the teacher candidates describe the mechanism in which the students' work will be assessed. In relation to the self-efficacy, through the use of the Web 2.0 (Tomas et al., 2017) the teacher candidates who seem to be more prepared and more confident in implementing the learning strategies (the pedagogical knowledge) will have higher self-efficacy in improving the maturity on the focus of the implementation

on how innovations will be more beneficial for the teachers who are more knowledgeable, skillful, and competent. Consequently, such teachers tend to pursue innovations more intensely so that these teachers might be expected to modify the curriculum in order to take participation in the field-based laboratory practice and the activities that promote the professional competence development. The important objective of the Web-based Science education reformation is to deliver the experiences of scientific inquiry into the classroom (Bodzin, 2005). Up to date, the dydactical classroom instruction which focuses on the memorization of the scientific facts should be converted under the emphasis that the students' interest should be drawn in order to perform the learning process that facilitates their understanding toward knowledge. The participation in inquiry might facilitate the students in attaining the scientific thinking skills by developing deeper understanding through the process and the content of Science.

CONCLUSIONS

Based on the results and the discussions within the study, several conclusions might be drawn. First of all, there have been challenges on the part of the Natural History teacher candidates for the Elementary School Degree in utilizing the ICT-Based Learning as part of their preliminary teaching skills. At the same time, the awareness of implementing the ICT-Based Learning in the teaching-learning activities has still been low. As a result, the learning activities in the courses of Natural History for Elementary School Degree Education has less contributio toward the improvement of the ICT-Based Learning skills. Consequently, when the ICT-Based Learning skills are low the programs that utilize the already-planned the Web-Based Inquiry will be impacted.

The results of the preliminary information on the Web-Based Inquiry demand the teacher candidates to implement the Internet-based inquiry in the classroom. At the same time, the teacher candidates are demanded to understand the flowchart in accordance to the stage. The understanding should not only be developed based on the needs of a study but should also be socialized in order that the preliminary ICT-Based Learning skills of the teacher candidates might be better prepared. By doing so, the ICT-Based Learning skills of the teacher candidates can eventually be compatibly implemented into the learning process of the Natural History for the Elementary School Degree.

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