Evaluating pre-service science teachers' concept mastery in the topic of biodiversity during distance learning under circumstance of Covid-19 pandemic

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Abstract: Students as pre-service science teachers have to reach concept mastery during learning process, since it includes in a teachers' pedagogical competence that has to be attained well. Although this current circumstance is under covid-19 pandemic, the distance learning should provide an effective situation that can gauge students' concept mastery. This study aims at evaluating pre-service science teachers' concept mastery in the topic of biodiversity during distance learning under circumstance of covid-19 pandemic. The research included in a descriptive quantitative study. The distance learning was conducted in the lecture of bioconservation during odd semester, on September 2020 toward 50 students in the year academic of 2017. Data were collected using an online test consisting of 10 multiple choice questions. Findings indicates that the pre-service science teachers' concept mastery reached a score of 53.0 in which was categorized as moderate criteria. Therefore, it can be concluded that the concept mastery has to be enhanced continually in every learning process in order pre-service science teachers are able to comprehend science concepts and enhance this mastery respectively.
Keywords: biodiversity, concept mastery, covid-19 pandemic, distance learning.

INTRODUCTION

Science as the body of knowledge discusses about life and its phenomenon. Science also contains of structure and process of the physical, chemical, and biological which can be carried out through investigation activities (Costa & Araujo, 2018). Furthermore, science learning presents facts, concepts, principles, laws, hypotheses, theories, and models (Müller et al., 2016; Rusilowati et al., 2015). Science also represents the investigative nature which reflects the process of scientific method such as observing, identifying, measuring, classifying, inferring, analyzing data, making calculations, and concluding (Fratiwi et al., 2019; Saprudin et al., 2020).

Science also acts as a way of thinking which represents a process of thinking, reasoning, reflecting, and creating scientific attitudes and skills. (Gumilar & Wardani, 2020; Rosamsi et al., 2019) One of topics that have to be learned in science is biodiversity. Biodiversity contains of concepts about diversities of living thing including its genes, its classification, and its interaction with environment (Littenberg-Tobias & Reich, 2020). This topic contains of plenty complex concepts that have to be mastered well by learners. Therefore, science is very significant to be learned by learners at schools and universities. However, science learning not only aims at transmitting science knowledge and information to learners but also enhancing its concept mastery (Prabowo et al., 2020; Satriawan et al., 2019). Concept mastery is defined as the process of learners in comprehending certain concepts. Pre-service science tachers have to reach concept mastery since they will use it later when they teach in the class (Nugroho & Suryadarma, 2018).

Regardless, the success of science learning and teaching process is strongly influenced by the educators' competences and the learning process (Rahayu, 2017). As it is already stated that teachers'

competencies includes pedagogical, personal, social, and professional. Pre-service science teachers have to master those four competencies, so that they are easily to create a learning design as expected. The successful learning also depnds on standard design learning that is conducted in which ensuring learners in participating during learning activities (Prabowo et al., 2020; Sadiqin et al., 2017).

Students as pre-service science teachers have to master science concepts. If they do so, therefore it will be easy when they are going to teach at the class. It is already explained that the concept mastery is related to pedagogical knowledge (Tamimiya & Suryadarma, 2019; Widiyawati & Nurwahidah, 2018). This knowledge has to be attained by students as pre-service science teachers. One of the ways to reach this knowledge is students have to understand the subject matter. However, during the learning process, students will catch various problems and challenges in comprehending concepts. As we know, science concepts mostly exemplify common instable structures of information, objects, principles, ideas, and activities (Badriyah et al., 2020). Furthermore, students also improve the concept comprehension at an early development when they undergo thinking and learning process, in which it can generate huge problem if the concepts that they understand are diverse from scientific considerations, this phenomenon is referred to as misconception (Goodsett, 2020; van Rensburg, 2018). This phenomenon should be minimized in order learners as pre-service science teachers can perform well in pedagogical knowledge.

In addition, if the concepts have been mastered well, learners can apply the concepts actively, by creating and realating the concepts to daily life. By working through various processes, creating different causes and effects, the learners are able to fully understand their own role in bringing about the consequences of their behavior, and fully understand what they can do differently if they desire different results (Kumari et al., 2020; Littenberg-Tobias & Reich, 2020). Furthermore, scientific pheno-menon are ubiquitous in students' everyday lives. Educators have to provide the varying experiences and prerequisites for learning in every learner's background (Mamun et al., 2020). Educators also have to ensure that classroom instructional quality is critical, because it provides the opportunity to foster students' domain knowledge and specific learning processes and to develop comcept mastery systematically (van Rensburg, 2018).

Pre-service science teachers should be prepared to be ready to think, solve problems, analyze challenges, make innovations, and decide conclusions. However, these skills are considered difficult to be taught and developed, so they are rarely deliberately included in the learning process. Outstandingly, these skills are crucial for all students today in facing challenges in the era of globalization and important for them when they will go teaching in a class (Afandi et al., 2019; Rusli et al., 2020). Therefore, educators have to ensure to develop pre-service science teachers in the future to be able to have concept mastery. As a consequence, pre-service science teachers are the most influential factor to transfer the science knowledge to students in learning process so that concept mastery have to be developed well.

As captured in the previous PISA 2015 assessment, educators have to explain how a science idea can be applied to a number of different phenomena (OECD, 2018). Educators also have to explain scientific ideas so that learners are easily to comprehend certain concepts. The quality of science teaching and learning process is also linked to the process of the way of educators teach, and the methods that they use to provide effective science learning process (Glaze, 2018; Jeong & González-Gómez, 2020). However, the current condition is under covid-19 global pandemic in which the government in many countries outfits rules that limit people coming together in public places (König et al., 2020). This rule impacts on learning process at schools and universities in which students and educators cannot attend the places and have face-to-face learning activities like before (Reimers et al., 2020). Additionally, the science learning process is conducted in distance.

Distance learning offers new learning experiences both for students and educators. During distance learning process, learners are able to study actively and responsibly. Students are also able to increase higher thinking during the online learning, because it provides a plenty of information that can serve as a flexible substitute for distance learning process (Kumari et al., 2020; Rapanta et al., 2020). Furthermore, by having distance learning, students can undergo best learning practice that leads to concept mastery. In contrast, for educators, distance learning offers essential adaptive challenges, in which they have to provide effective learning environments although in online form.

In addition, distance learning can be much more self-paced, allowing learners to evaluate and reflect more carefully on their interactions and assignments. An online learning process also can en-courage learners to develop social interaction, identify important knowledge, avoid useless information, and develop skills (Goodsett, 2020; Kumari et al., 2020). Distance learning also can provide students as

pre-service science teachers' valuable experiences by addressing individual differences, providing hands-on activities, encouraging students to have reflection, constructing a real-life context, and motivating them selves individually and actively (Littenberg-Tobias & Reich, 2020). Therefore, although the learning process is conducted in distance, the learners' concept mastery has to be developed gradually.

According to those previous views, this study aimed at evaluating pre-service science teachers' concept mastery in the topic of biodiversity during distance learning under circumstance of covid-19 pandemic.

METHOD

This study includes in a descriptive quantitative research. It is a descriptive quantitative since it described current conditions, used specific samples, and used a test to gauge the concept mastery. This research was conducted during odd semester in the academic year of 2020-2021, exactly on September 2020. The distance learning process was implemented asynchronously in the lecture of bioconservation toward 49 students from class A in the academic year of 2017 from a public university in Indonesia. The students in this class consisted of six boys and 43 girls.

This current study relies on a test-given technique to collect data. Tests given to the pre-service science teachers were used to evaluate students' concept mastery. The pre-service science teachers' concept mastery was assessed using an online test in the application of google form, consisting of ten multiple choice questions related to concept of biodiversity. The test of concept mastery contains of five indicators; defining, giving examples, classifying, explaining, and concluding. Furthermore for every indicator consists of two questions.

The test instrument has been validated and reviewed by two lecturers before given to students. The validation evaluated about the aspect of content in the test instrument. The results of validation revealed that the test instrument can be used to assess the pre-service science teachers' concept mastery. Furthermore, the test instrument was filled out the by students for 45 minutes individually. Score of concept mastery in every pre-service science teacher that has been obtained was categorized based on criteria in the Table 1.

Table 1. Category of concept mastery

Score	Category
85.0 - 100	Very high
70.0 – 84.9	High
55.0 – 69.9	Moderate
40.0 – 54.9	Low
0 – 39.9	Very low

RESULTS AND DISCUSSION

In this study, pre-service science teachers' concept mastery in the topic of biodiversity during distance learning under circumstance of covid-19 pandemic was gauged using an online test. Furthermore, the score of pre-service science teachers' concept mastery can be seen in the Table 2, meanwhile the number of pre-service science teachers who reach every category is presented in the Figure 1.
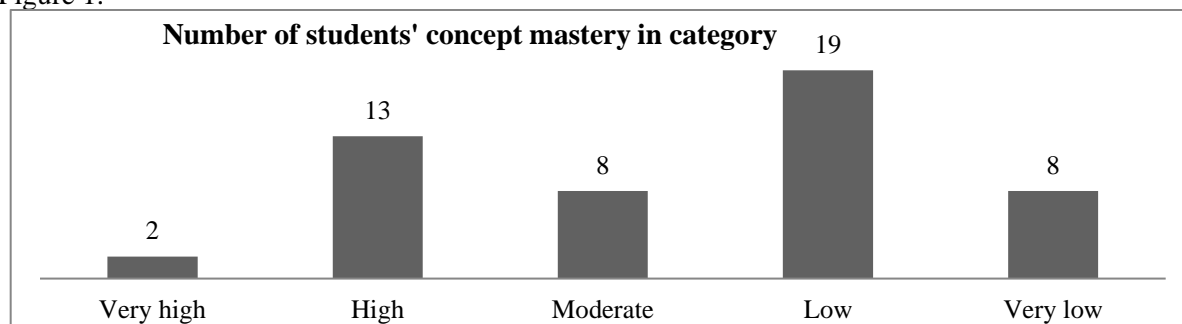

Figure 1. Number of pre-service science teachers' concept mastery in category

According to the findings on Table 2, it can be assumed that pre-service science teachers' concept mastery reached a moderate level, showing 53.0 on the average of a score. It also can be seen from Figure 1 that from out of 50 students, there were 19 students reached low concept mastery. Meanwhile, 13 students reached high concept mastery. Eight students reached moderate concept mastery. Furthermore, the other eight students reached very low concept mastery and only two pre-service science teachers reached very high concept mastery.

Table 2. Score of pre-service science teachers' concept mastery

Name	Score	Category
A1	50,0	Low
A2	60,0	Moderate
A3	70,0	High
A4	50,0	Low
A5	80,0	High
A6	40,0	Low
A7	30,0	Very low
A8	80,0	High
A9	80,0	High
A10	40,0	Low
A11	80,0	High
A12	40,0	Low
A13	50,0	Low
A14	40,0	Low
A15	60,0	Moderate
A16	90,0	Very high
A17	80,0	High
A18	50,0	Low
A19	40,0	Low
A20	40,0	Low
A21	40,0	Low
A22	60,0	Moderate
A23	80,0	High
A24	30,0	Very low
A25	40,0	Low
A26	70,0	High
A27	80,0	High
A28	70,0	High
A29	60,0	Moderate
A30	80,0	High
A31	50,0	Low
A32	60,0	Moderate
A33	20,0	Very low
A34	40,0	Low
A35	60,0	Moderate
A36	90,0	Very high
A37	40,0	Low
A38	20,0	Very low
A39	70,0	High
A40	50,0	Low
A41	60,0	Moderate
A42	40,0	Low
A43	50,0	Low
A44	10,0	Very low
A45	70,0	High
A46	60,0	Moderate
A47	50,0	Low
A48	10,0	Very low
A49	10,0	Very low
A50	30,0	Very low
Average	53,0	Moderate

Based on findings that were figured out in Table 2 and Figure 1, it can be assumed that the pre-service science teachers in the topic biodiversity during distance learning under condition of covid-19 pandemic should be enhanced in every learning process. Therefore, various interactive learning situations also have to be implemented to improve students' comprehension on science topics. Those data also indicated that some students cannot answer the questions correctly, especially on questions with indicators giving examples, classifying, and explaining. Mostly students argued that those questions were difficult to answer since they were also not easy to comprehend.

Based on the observation during this study, pre-service science teachers also did not get ready during the distance learning process since they only get ready to attain the concepts from lecturer. They also argued that they did not prepare the material by reading the learning sources before joining the class. This phenomenon often occur in the class among every learner in which students as pre-service science teachers are used to be passive users rather than active users, therefore evaluating concept mastery should be conducted to ensure whether pre-service science teachers are ready to learn or not.

One of the learning outcomes that have to be concerned by educators is the students' concept mastery. A concept is defined as a mentality that represents a stimulus from students. Concept can also be assumed as a category of objects, symbols, ideas, and phenomenons with the same characteristics (Prabowo et al., 2020; Satriawan et al., 2019). Furthermore, concept can be acquired in two ways, namely: a) concept formation; acquisition of concepts before students learn about a material in learning process, and b) concept assimilation; acquisition of concept during and after learning process (Rahayu, 2017; Sadiqin et al., 2017).

As concept mastery is very important, educators have to provide effectively meaningful learning process so that pre-service science teachers are able to reach this easily. The theory of a meaningful learning process by Ausubel states that a meaningful learning is a process of connecting new information to relevant concepts that are already present in a students' cognitive structure (Arulogun et al., 2020; Tamimiya & Suryadarma, 2019). The most optimal concept development can occur if the most general or inclusive elements of a concept are introduced first, then the more detailed and more specific elements of the concept are given afterward (Jeong & González-Gómez, 2020; Rusli et al., 2020). Therefore, to develop pre-service science teachers' competence, concept analysis is needed to improve.

In addition, pre-service science teachers' concept mastery also includes, (1) self-concept: the shift from one student who is dependent on others; (2) experience: many experiences can become learning sources; (3) readiness for learning: students are well-prepared in carrying out a new task and challenging assignments; and (4) orientation during learning process: learning process should be developed from learning-centered to problem-centered (König et al., 2020; Rusilowati et al., 2015). According to those situations, pre-service science teachers should be involved in actively diagnosing their learning needs. Furthermore, students will feel engaged and motivated well to learn if they learn as what they need.

Findings of this study also indicates that mostly students reached low concept mastery. It can be assumed that one of factors that influence the low concept mastery is an internal factor from pre-service science teachers. Students as pre-service science teachers are merely memorizing the concept material without understanding the concept whether they know what does it mean or not. In addition, if they only memorize without comprehend the concepts, the concepts will not be long stored in the memory. So that, the concepts are easily to be forgotten.

To learn and develop concept mastery, learners have to transfer knowledge from working memory (where it is determinedly processed) to long-term memory (where it is stored and later recovered) (Fratiwi et al., 2019). Students have limited working memory capacities that can be stunned by complex cognitive tasks. Comprehending new ideas can be obstructed if students are challenged with too much information at once. In addition, making content obvious through cautiously stepped explanation, description, modeling, and examples can ensure that students are not flabbergasted (Gumilar & Wardani, 2020; Saprudin et al., 2020). Content also should not be retained only from students because it is developmentally inappropriate. The way and the process of how students comprehend content material are developed, and educators have to ensure that learners are ready to study. If they are well-prepared, then the concept attainment is easy to reach.

Pre-service science teachers have to improve concept comprehension at an early development when they undergo thinking and learning process. As it is already stated that science concepts consists of a plenty of information, objects, principles, ideas, and activities, therefore concept mastery is very essential thing in learning process (Prabowo et al., 2020). However, it can generate huge problem if the

concepts that they understand are diverse from scientific considerations in which this phenomenon is referred to as misconception (Arulogun et al., 2020). This phenomenon should be minimized in order learners as pre-service science teachers can perform well in pedagogical knowledge.

In addition, if the concepts have been understood well, learners can apply the concepts actively in their daily life. By mastering science concepts well, pre-service science teachers are able to fully understand their own role in bringing the concepts in society and linking these concepts. Therefore, educators have to provide the varying experiences and prerequisites for learning in every learner's background. Educators also have to ensure that classroom instructional quality is active and critical, since it can provide the learning experience and opportunity to foster concept mastery on pre-service science teachers. To sum up, pre-service science teachers' concept mastery has to be enhanced continually during every distance learning process in order pre-service science teachers are able to understand science knowledge and enhance their concept mastery.

CONCLUSION

This study aims at evaluating pre-service science teachers' concept mastery in the topic of biodiversity during distance learning under circumstance of covid-19 pandemic. Although the current learning process is implemented in distance, students' concept mastery has to be evaluated well. According to the findings obtained in this study, it can be concluded that pre-service science teachers' concept mastery in the topic of biodiversity during distance learning under circumstance of covid-19 pandemic reached a score of 53.0 in which was categorized as moderate criteria. Therefore, their concept mastery has to be enhanced continually in every learning process in order pre-service science teachers are able to comprehend science concepts and develop their pedagogical skill.

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