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General microbiology teaching adaptation in the covid-19 period: Pre-service teacher perspectives and experiences

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ABSTRACT

As a result of the COVID-19 global pandemic, teaching activity for pre-service teachers enrolled in the second year of a teacher education program from mid-March of 2020–2021 at the Universitas Sultan Ageng Tirtayasa were changed in a remote learning setting. This study's objective was to investigate pre-service students' perceptions and personal experience toward the transition of General microbiology lecture to online learning during the global COVID-19 pandemic. The results described the efforts and adaptation to an online teaching model of the General Microbiology course using both online synchronous and asynchronous learning. The perspectives of the Pre-Service Teacher about this strategy were analyzed and showed positive responses. Despite some challenges, they could adapt to the new learning methods. In addition, the study also provided an analysis of faculty readiness and experiences through a process that can use as a foundation to tackle the pandemic situation in the future.

Introduction

Coronavirus infection disease 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), has arisen to become a global pandemic till now (Baloch et al., 2020). The virus develops unexpectedly globally, becoming the leading human pandemic to break in the 21st century (Contini et al., 2020). World Health Organization (WHO) has reported more than 30 million COVID-19 cases globally. From December 2019 to September 2020, more than 100.000 deaths occurrences were confirmed worldwide, spanning more than 200 nations (World Health Organization [WHO], 2020). President Joko Widodo of Indonesia declared the first case of COVID-19 on March 2, 2020, after which the number of confirmed cases increased rapidly (Djalante et al., 2020).

There has been increased attention on the pathogenicity and the risk of transmissibility of COVID-19. To manage the present outbreak, extensive efforts to reduce COVID-19 transmission from person to person have been adopted (Rothan & Byrareddy, 2020). Therefore regarding the rising concern about the

current COVID-19 pandemic, many universities worldwide have been forced to convert the course activities in the class to online learning from home (Perets et al., 2020). Santos and Castro (2021) argue that it is essential to have the pedagogical and content knowledge to be sufficient for teachers. Pre-service teachers study a lot about pedagogy and theory in teacher preparation programs, and they apply what they have learned in the classroom (Peterson-Ahmad et al., 2018). Aside from that, technology plays an essential role in assisting instructors in delivering lessons and students in learning. To overcome the needs, faculties must accommodate the learning process according to student requirements, such as providing digital learning resources, offering extensive data, and designing information technology-based learning (Suryawanshi & Narkhede, 2015). In addition, Sládek et al. (2011) also emphasize education services, stating that in addition to paying attention to learning and customizing modalities, knowledge must also provide agility and learning services at any time and place.

General Microbiology course is one of the introductory courses (i.e., obligatory course) delivered at the Department of Biology Education, Faculty of Teacher Training and Education at the Universitas Sultan Ageng Tirtayasa. This course's learning outcomes include student comprehension, knowledge, and ability in microbiological content through the learning process. It has been shown in Erikson and Erikson (2018) that the notion of learning outcomes is that education deals with the competencies that students are supposed to gain. As a result, students are attentive and focused; they must complete this to pass the course. Various basic concepts on microbe diversity, their essential roles, and their diverse activities in human lives mastered by the student, ranging from the causation of deadly diseases in organisms such as humans, animals, and plants to the production of valuable products that have an essential role to play in health, agriculture environment, and industrial aspect. As a result, they will develop critical thinking and problem-solving skills concerning microbiology. Moreover, apply their microbiology knowledge to tackle microbiology problems as they arise in society. Similar aspects also have been reported Buxeda and Moore (2000) stated that one objective in studying general microbiology is to determine the degree of student awareness of its surroundings and link course theory to environmental problems.

The online learning system used to deliver this course during the academic year of 2020-2021 (January–June) became very challenging. Moreover, this course involved some practical laboratory work (practicum). Practicum and experiment have been elements of the science learning process to promote process skills development, data management knowledge, and theory consolidation (Erduran et al., 2020). Consequently, universities are urgently conducting a fast and proper response to protect the students from limiting the spread of this deadly disease across the community and remaining the university closed temporarily (Dhawan, 2020) by promoting alternative learning process mechanisms. The COVID-19 pandemic has suddenly forced the education system to engage in online learning transformation even though it encountered all the equipment and forms of distance teaching in use (Iivari et al., 2020). Babinčáková and Bernard (2020) confirmed that science is associated with issues, observations, data, and experiments. Transitioning to the virtual environment was particularly difficult for teachers who sought to convert real-world classroom experiences into online classes. Teachers frequently asserted that they might be more efficient if they had the knowledge, abilities, and necessary equipment to offer online learning sessions. A general microbiology course was taught through learning management system (LMS) facilitated by the Universitas Sultan Ageng Tirtayasa called SPADA (Sistem Pembelajaran Daring) UNTIRTA. Through this online platform all teaching materials of the general microbiology course was delivered. Online discussion, homework and live class session was performed and posted on SPADA thus maintain the interaction between student and teacher virtually.

It is well known that the COVID-19 pandemic situation brings challenging situations in the education system across the world. In order so, it is essential to examine the perspective and experience of students during the crisis to provide adequate support for the student. As far

as we know, an overview of literature related to pre-service teacher experiences during COVID-19 Pandemic still few and insufficient analyses. Still, there have been several attempts to describe perceptions and experiences of the higher education student during the COVID-19 pandemic as described by Lovrić et al. (2020) in Croatia. Thus the descriptive study carried out by Kim (2020) in early childhood education in the USA was to provide students and teachers with possibilities to learn and teach online during the pandemic. This study's objective was to investigate pre-service students' perceptions and personal experience of transitioning the General microbiology course to online learning during the global COVID-19 pandemic. This study contributes to the existing literature by showing that the perceptions of the pre-service teacher towards online learning facilitated by the university in the COVID-19 pandemic contexts. In addition, there are further issues in terms of no previous study investigating pre-service teacher perceptions in general microbiology. Therefore this study gave an insight for evaluation towards improvement in the massive transition of the learning process.

Method

The study was conducted in both quantitative and descriptive methods. A modified questionnaire in the *Google forms* has been used to collect data from a total of 100 pre-service teachers of the Biology Education study program in the Faculty of Teacher Training and Education, University of Sultan Ageng Tirtayasa, as the respondents (Table 1). Those students were divided into three classes in the fourth semester in the academic year 2020/2021. There were two sections to the questionnaire. Students' personal information is collected in Section 1, including sex, age, computer skill, and device used for online learning. Section 2 of the Questionnaire used a 5-point Likert scale questionnaire ranging from strongly disagree to strongly agree for evaluating online learning's student perceptions during COVID-19. At the end of the questionnaires, the respondents were asked what they experienced while learning general microbiology online. Campos Filho et al. (2016) used this as an approach in the study here.

Table 1. Socio-demographic characteristics of the respondents

Variable	Categories	Total (%)
Sex	Male	6
	Female	94
Age	<21 years old	19
	≥21 years old	84
Computer skill	Mean	4.18
	St Dev	1.20

Data were analyzed and interpreted as the value level for the defined item indicators (Linjawi & Alfadda, 2018). The scale for interpreting the value level was created to reflect the interpretation of the 5-point Likert scale form used for all subject items in the questionnaire. Thus, the scale was set as follows: (1) Not positive level: if the item indicator's mean value is <2; (2) Less positive level: if the item indicator's mean value is ranged from 2 to 3; (3) Positive level: if the item indicator's mean value is ranged from 3 to 4; and (4) Very positive level: if the item indicator's mean value is ranged from 4 to 5.

Results and Discussion

Based on the demographics profile shown in Table 1, the respondents were categorized according to gender and age. Female students dominated this research, with 96% of the total participants. The ages of the participants were 84% over twenty-one years. Pre-service teacher computer skills were also assessed during the study, and the result indicated that the mean value was at a positive level. It showed that Biology pre-service teacher has good levels of computer skill to access the technology, assuring the online learning can be carried out smoothly. Computer skills, mainly digital skills, may become a limitation in online learning, as stated by Bączek et al. (2021), which means accessibility is a one-factor determiner of the success of e-learning. Biology pre-service teachers who enrolled in general microbiology courses were in the fourth semester; consequently, they used to have experience in online learning carried out before. Age, gender, prior computer literacy expertise, and individual learning styles are essential indicators of student technology adoption (Khan et al., 2020).

As seen in Figure 1, most biology pre-service teachers use mobile devices such as smartphones (50%) to conduct the online course by connecting to the SPADA Untirta. The rest are used Laptop and PC-Desktop. Nowadays smartphone is a high-technology device that combines the functions of a phone with those of a computer. According to Iqbal and Bhatti (2020), smartphones are almost universal machines that can be used to learn. Smartphones' capability is quickly expanding on the one hand, while their cost is falling on the other, making them more accessible than any other mobile device.

For students, smartphones have become the most often used Internet access device and the most widely utilized entertainment device. Mobile devices such as laptops, personal digital assistants, and cell phones have evolved into powerful learning tools to help students with online learning. Such findings are also seen in a recent report by Sung et al. (2016) mobile technology such as smartphones and laptops, according to him, offers much promise for allowing more creative teaching approaches. Using these devices, students to write, browse the information through the Internet, make presentations, do homework and other assignments or take tests.

The results are given in Table 2; an estimate on the scale of students' perceptions of online learning has a total average of 3.505 (SD = 1.01). It means that the perceptions of the pre-service teacher toward online learning during the COVID-19 pandemic are positive. The result is in agreement with Muilenburg and Berge (2005). Student hurdles to online learning, according to them, include administrative concerns, social contact, academic skills, technological skills, time and support for studies, Internet connection, and technical problems. The fact is still a source of debate. However, the result showed more positive value when the supporting facilities were available, and students were well-prepared to use online learning even not in the pandemic condition (Stormon et al., 2018).

In the current study, Biology pre-service teachers were satisfied with the online learning facilitated on SPADA UNTIRTA. It was a very effective way to save efforts, time, and affordability, as shown by the mean range from 3 to 4. On the contrary, less positive value showed on the item of motivation on learning. Based on the result in Table 2, the Biology pre-service teacher tends to choose online learning rather than face-to-face education as the interactivity with the faculty also showed the same trend. It showed by the mean 3.74.

Masiello et al. (2005) demonstrated that in a microbiology course, students' demonstrated preparedness for and favorable attitudes toward information technology by learning online utilizing a web-based learning system. This form of teaching revealed a potential long-term advantage from its use. The success of e-learning in the university also can be influenced by institutional support, especially in the pandemic era (George et al., 2014). Even though integrating technology into online learning and delivering relevant subject matter is not simple, faculties' ability to innovate in managing online learning to provide engaging and meaningful learning is necessary.

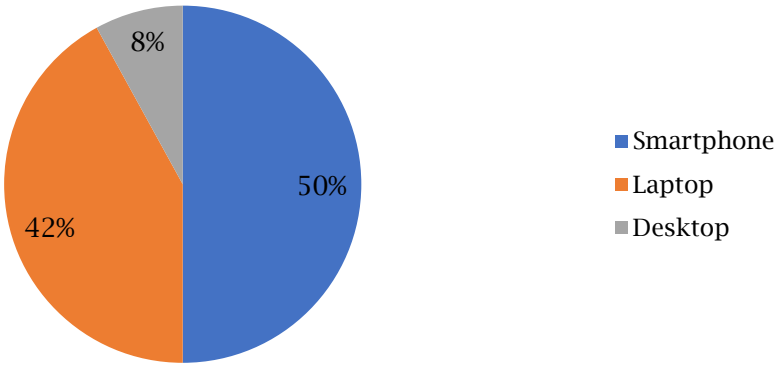

Figure 1.Devices used to facilitate online learning

Based on the result, in this study, biology pre-service teachers provided very positive value on institutional support, which showed by the ability of faculty in master technology and to carry out a practical virtual laboratory during a learning process by the mean of 4.05, 4.18, consecutively. It occurred as a fresh and young lecturer dominates the lecturer who teaches in the education department. However, in some cases, some senior teachers have a negative attitude to the technology and become a hinder in the continuity of the online learning process (Fuad et al., 2020).

Evaluation and recommendation to the university can be proposed based on the results for the continuity of the implementation of online learning. The evaluation of an LMS is essential to ensure its effective implementation and positive impact on the delivery of e-learning (Oliveira et al., 2016). The SPADA Untirta as an LMS has become increasingly active during Pandemic times. This LMS has been designed for education delivery, monitoring, and management. LMS's are range from training/educational administration management systems to reinforcements, distributing courses over the Internet, and providing online collaboration features (Mahnegar, 2012).

Management of software training/educational documents was provided for online courses purpose over the Internet and offered online communication features. The Learning Management System is online software that provides students with a learning and communication platform. An LMS may make instructors' and students' lives simpler by providing an online class atmosphere. SPADA Untirta is a portal that allows students to access course documents and additional course material outside of class at their leisure and submit papers online, check grades, and download class documents. SPADA's system provides students with a variety of services in addition to class notes, such as an online chat option. Students can have online conversations or with faculty members using this application. The chat option provides for a more intimate and personalized level of communication.

The interaction between lecturer and pre-service teachers in general microbiology learning occurred in synchronous and asynchronous mode. Synchronous mode is carried out through a web conference to provide a general overview of the content, and the discussion process has been created at one time. In facilitating the learning process, this synchronous activity is very successful. In line with González-Yebra et al. (2019) statement. They experienced the live lectures or recorded and uploaded via video conferencing package in the SPADA Untirta. The faculties' interaction also happens when they have the question to be asked or during the discussion time.

The laboratory work conducted by the online learning experience uses an inquiry-based approach. Jeronen et al. (2016) have proved that inquiry-based learning can be applied to the context of collaborative technology facilitates. The laboratory work offers genuine and hands-on training for pre-service teachers. Also, laboratory instructional tasks enriched with innovative teaching approaches other innovative approaches such as problem-solving, project, argumentation, and web-based interdisciplinary learning approaches can enhance pre-service teacher knowledge, awareness, and laboratory experiences (Orhan & Sahin, 2018).

The simulations and virtual laboratory exercises on several topics were additional activities to improve student understanding and psychomotor aspects. Dyrberg et al. (2016) showed potential benefits of virtual laboratory exercises perceived by the student that allowed interactive learning about the workflows and procedures of the experiments, the operation of relevant apparatuses, including the ability to adjust parameters and produce results. Seitz and Rediske (2021) confirmed that in Pandemic time, in the absence of laboratory work, the students of the microbiology course presented no statistical difference in their outcomes. Surprisingly, their pre-and post-test participation increases, showing positive attitudes and enthusiasm in this subject. Moreover, faculties need to perform an excellent strategy to satisfy students while the online learning process is completed. Using an online platform to combine fun learning and gamification in delivering the course materials could increase students' motivation and comfort in learning microbiology (Dustman et al., 2021).

Table 2. Findings on pre-service teacher's perceptions of online learning

Item	Mean	Std dev
There is general satisfaction with online learning on the SPADA UNTIRTA-university Learning System Management (LMS)	3.21	0.55
The SPADA Untirta is a very effective way and saves efforts and time to learn	3.46	0.75
The courses available on the university LMS are easy and affordable	3.27	0.94
Online learning on the university's platform of LMS is fun and can motivate the student to learn more on the subject	2.05	0.86
Online learning is better than regular education (face-to-face)	3.74	0.75
Using online learning promotes interactivity between student-faculty	3.74	0.75
Faculties are mastering the technology	4.05	1.28
Faculties have used excellent resources to carry out a practical virtual laboratory	4.18	1.20
The accessibility of the faculties and the quality of the feedback have been optimal	3.80	1.28
Total	3.505	1.01

In contrast with Gamage et al. (2020), the virtual laboratory also has shortcomings. Although this procedure works well for the development of information, it has constraints on improving one's functional laboratory skills by providing material and supervision of specific processes. For example, if students work in a laboratory environment, several expensive and complicated tools ad machines are often found. However, operating in a distance learning mode refuses beneficial functional exposure to such facilities and recognizes the subtleties of being immersed in such an environment. Since facilitating the mastery of sophisticated subject matter and developing process skills, a lecturer needs to challenge the learning process.

The pre-service teacher was instructed to work in groups and complete several experiential research projects related to the microorganism by performing a scientific method approach. For example, when the pre-service teacher examines the sampling results from the substrate containing the microorganisms that live in their resident environment, Winogradsky columns were made to illustrate different types of microbial metabolism colorfully. The microbes will separate into their habitats. Based on the experiment made, they need to arrange a report based on observation and made documentation. The evaluation process involves completeness, structure, data presentation and analysis, and strength of discussion. It is essential as the pre-service teacher perceived substantial improvements in several scientific process skills. In addition, it would help establish the subject matter and accomplish all course goals based on performing their mini-projects (DebBurman, 2002).

Conclusion

The Pre-service teacher was quickly adapted to online learning, and a mixed model of synchronous and asynchronous methodologies was used. During this time, most students have a negative impression of online learning. Students' opinions and attitudes about online learning, on the other hand, are the key aspect that cannot be overlooked and may be utilized as a basis for dealing with the pandemic scenario in the future.

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