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Analysis of the Biochemistry Practicum Program on the Topic of Enzymes during the Covid-19 Pandemic

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Abstract: The COVID-19 pandemic is a new situation that brings challenges to all sectors, including education. One of the impacts is that there is an adjustment in the implementation of learning, including practicums, which are usually held offline, turning into online learning. In this study, an analysis of the implementation of biochemistry practicum was carried out for two semesters during the Covid-19 pandemic. This study uses a descriptive case study design. Research data obtained from document analysis and questionnaires. There are five classes used as samples of this study. Questionnaires were given to 116 students. The results showed that the implementation of the biochemistry practicum had been carried out well. This is marked by positive responses from students through questionnaires. Even so, there are significant differences in student achievement compared to conditions after the pandemic. This shows that practicum activities, especially those related to laboratory skills, cannot be facilitated with online learning.

Keywords: Biochemistry practicum; Covid-19; Enzyme; Online learning

Introduction

The emergence of a new type of virus, SARS COV-2, at the end of 2019 in China, was the beginning of the outbreak of Covid-19 throughout the world. Some positive cases of COVID-19 show no symptoms, some show flu-like respiratory symptoms in the mild or moderate category, but there are also cases that develop into a critical condition (Elezkurtaj, et. al., 2021). Other factors include age and comorbidities, such as cardiovascular disease, hypertension, lung disease, and diabetes, increasing the risk of chronic condition complications and even death (Poblador-plou, et. al., 2020). Various prevention and treatment efforts have been carried out to overcome the increase in cases of infection and death (Fan, et. al., 2020). Seeing the developments that have taken place, WHO has finally established a pandemic status for this disease. Indonesia is a country that has not been spared from being hit by the Covid-19 pandemic, where the first cases appeared in early 2020.

Covid-19 is a new situation that brings challenges to all sectors, including education. The Covid-19 pandemic caused major disruptions in school systems around the world. In most countries, educational institutions have had to close for several weeks or months in an effort to reduce the spread of the virus (UNESCO, 2020). UNESCO data shows that almost 1.6 billion students in more than 190 countries, 94% of the world's student population, were affected by the closure of educational institutions at the peak of the crisis.

The Covid-19 pandemic is so sudden that there is not much time for many schools to design and implement learning programs specifically designed to support children's learning while at home (Di Pietro, 2023). Nonetheless, as a form of adaptation to the pandemic situation, in Indonesia there have been quite significant changes in the learning process at all levels of education, from the pre-school level to higher education. Learning that is usually held face-to-face (offline) has changed to online learning, or in certain areas and

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conditions it is dominantly carried out in a blended learning manner (Nurmalahayati et. al., 2022).

Online learning is a form of learning between teachers, students, and all learning activities are carried out with the help of devices and the internet (Kuntarto, 2017). Online learning and instruction has emerged as a popular method and a potential complement to conventional face-to-face teaching and learning with the rapid development and integration of technology into education (AlMahdawi et al., 2021).

In practice, online learning requires the support of mobile devices such as cell phones, smartphones, laptops and tablets, which can be used to access information anytime and anywhere (Gikas & Grant, 2013). On the other hand, before the era of the covid-19 pandemic, developing countries had lower exposure and dependence on digital platforms (Jennifer & Lipin, 2020). Thus, it is understandable that the unavailability of mobile devices and the uneven distribution of internet access are the main obstacles to online learning in several regions in Indonesia.

In order for the process to run according to the goals to be achieved, online learning in the scope of formal education, including at universities, requires adaptation from the various parties involved. In general, at universities the effectiveness of the implementation of lectures in a study program can be evaluated based on the achievement of learning outcomes. Study program learning outcomes will usually be translated into learning outcomes for each course. In other words, the effectiveness of lectures can be seen from whether or not the learning outcomes of the course have been achieved.

Biochemistry lectures, especially for chemistry students, are of course not limited to cognitive aspects, but also psychomotor aspects which can be facilitated with practical activities. Technically, in the Department of Chemistry Education Universitas Pendidikan Indonesia (UPI), there is a Biochemistry Practicum course with a weight of 2 credits, which is separate from the theory course.

With the Covid-19 pandemic, several adaptations were made in organizing biochemistry labs. Adaptation is carried out from the start of planning, process, to evaluation. The semester learning plan (RPS) has been modified, especially in the aspects of the methods and media used. The use of online meeting platforms (zoom, google meet), and optimizing the use of the learning management system (SPADA), are examples of real changes that have occurred as a form of adaptation during the pandemic. In the evaluation aspect, changes occurred in the technical implementation of the test. If before the pandemic tests were usually carried out paper-based, then during the pandemic tests were carried out internet-based.

Method

This research uses a case study design. Case study is a detailed study of a specific subject, such as a person, group, place, event, organization or phenomenon. According to Stake, the researcher must view the case as a "limited system" and investigate it as an object rather than a process. He himself describes several attributes of the case in his conceptualization: the case is a specific, complex, functioning thing, more specifically an “integrated system” that has boundaries and working parts and a purposive (Yazan, 2015).

Yin argues that the system can be studied with one of three types of case study, depending on the purpose, namely exploratory case study, explanatory case study, and descriptive case study (Takahashi & Araujo, 2020). Descriptive case study was chosen in this study. This is in line with the main objective of the research, which is to analyze the implementation of biochemistry practicum on the topic of enzymes during the Covid-19 pandemic.

In general, the research data collected consisted of qualitative data and quantitative data. Qualitative data were obtained from the analysis of documents and questionnaires. Questionnaires were given to 116 students from four practicum classes. Meanwhile, quantitative data was obtained from the SPADA system, in the form of posttest results on the topic of enzymes, from four classes that carried out online practicums (during the pandemic) and one class which carried out offline practicums (post-pandemic).

Result and Discussion

Implementation of Biochemistry Practicum on the Topic of Enzymes

As the name implies, Biochemistry Practicum is a course that is more dominant in developing aspects of student skills. Technically, at Department of Chemistry Education UPI, this course is carried out together in one semester with the metabolism of biomolecules and genetic information course.

Apart from developing laboratory skills, many studies report that experimental activities are an appropriate medium for improving students' critical and creative thinking skills (Ghani, et. al., 2017; Trnova, 2015; Huri and Karpudewan, 2019; Supriyanti, et al., 2021). In line with this, experimental activities can also provide information regarding students' understanding of a topic, which can be seen from students' achievements. Thus, it is important to carry out a comprehensive analysis of the biochemistry practicum program during the pandemic, for example on the topic

of enzymes, to obtain information about student achievements.

Based on the results of questionnaire data analysis from 116 students, it is known that at the beginning of the lecture the lecturer delivered the syllabus and semester learning plan (RPS). The preparation of the RPS itself is fully carried out by a team of lecturers, without directly involving students.

The results of an analysis of the content in the online learning system (SPADA), show that the Biochemistry Practicum course presents 11 topics in accordance with the RPS. This course also presents a variety of learning resources, such as lecture materials in the form of text, power points, and external website links (Figure 1).

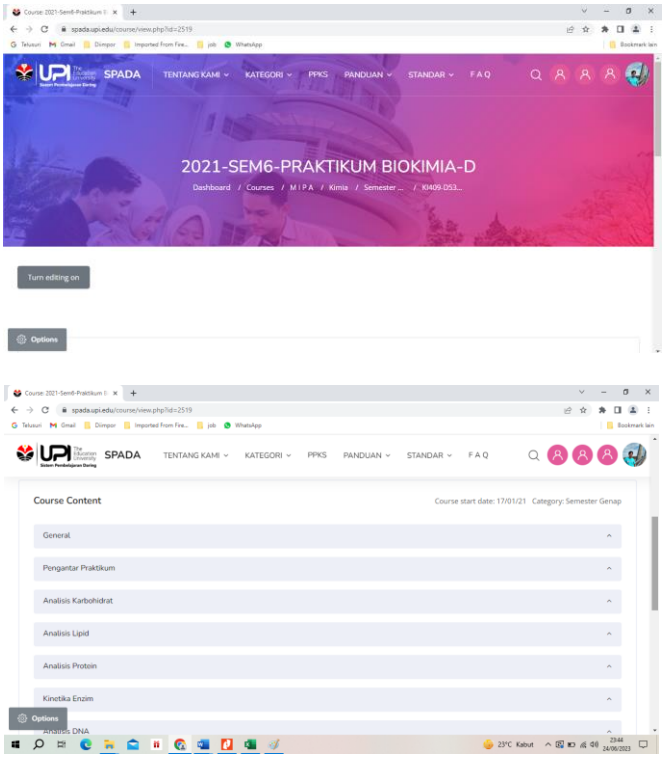

Figure 1. Screenshot of the SPADA Biochemistry Practicum course

Specifically for the topic of enzymes, SPADA contains introductory practicum materials to provide instructions to students on how to carry out practicums online. In addition, for quantitative analysis experiments, secondary data is provided which must be processed and reported by students. On the topic of enzymes, facilities are also provided for students to collect reports and carry out posttests (Figure 2).

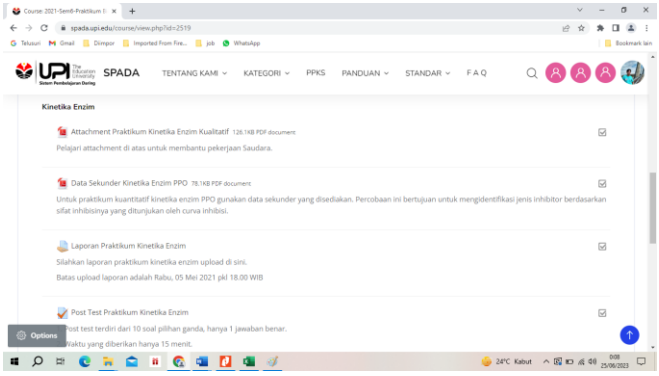

Figure 2. Screenshot of SPADA on the topic of enzymes

Based on the analysis of the questionnaire data, it can be seen how the learning process takes place according to the student version. The questionnaire consists of 10 questions covering aspects related to conducting biochemistry practicums, such as teaching preparation, approaches/methods used, learning media and tools (including zoom and gmeet), learning resources (including SPADA), assessment, and class management (Table 1). In practice, students fill out a questionnaire by selecting a score for each aspect asked, on a scale of 1-9. Interpretation of scores on the scale is 1-3 (poor), 4-6 (fairly good), and 7-9 (good), respectively.

The results of the analysis show that in general students consider the implementation of biochemistry practicum lectures to have been carried out well. This is indicated by the achievement of questionnaire scores for all aspects, which are classified as good categories, with an average of 8.02. The highest score was obtained for the aspect of teaching preparation, while the lowest score was obtained for the aspect of creating a learning climate (Table 1).

Table 1. Student responses to the implementation of the Biochemistry Practicum on the topic of enzymes

Aspect	Score	Category
Teaching preparation	8.24	Good
Relevance of material and lecture objectives	8.17	Good
Learning approaches and methods	8.02	Good
Learning media and tools	7.85	Good
Learning Resources	7.89	Good
Assessment of learning outcomes	7.98	Good
Assessment of the learning process	8.00	Good
Giving lecture assignments	8.06	Good
Class management	8.00	Good
Creation of a learning climate	7.94	Good
Average	8.02	Good

The low score for creating a learning climate compared to other aspects, can be suspected as a result of not being able to maximize the interaction process, both between lecturers and students and between students and students, because the learning process is

carried out online. This can be exacerbated by the condition of students who feel that their work is less interesting and useful, and they find it more difficult to study or practice at home (Kirsch & Vaiouli, 2023). Furthermore, practicum in the laboratory which cannot be carried out for a long time can cause stress for students (Vasiliadou, 2020).

Student Achievement on Enzyme Topic Practicum

In contrast to the implementation of biochemistry practicum which is well perceived by students, student achievement tends to fall into the sufficient category. This can be seen from the average student posttest scores on the topic of enzymes. In the 4 practicum classes, both those carrying out practicum in the even semesters of 2020-2021 (classes A and B), and in the even semesters of 2021-2022 (classes C and D), none of them achieved an average score above 70 (scale 100).

The average scores for the four practicum classes were A= 40, B= 41, C= 59, and D= 42 (Figure 3). These results indicate that there is loss learning in the biochemistry practicum on the topic of enzymes. This is quite natural, because without practical work, besides students not having direct experience doing experiments, they also lack the opportunity to use their understanding of chemistry in answering questions related to the experiments being carried out (Broad, Carey, Williams, Blackburn, 2023).

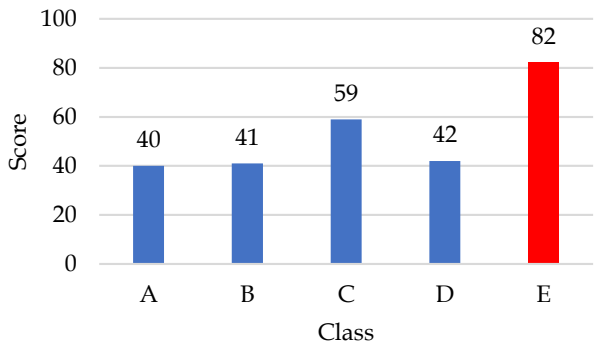

Figure 3. Biochemistry lab posttest scores on the topic of enzymes. A-D (pandemic class); E (post-pandemic class).

To see the difference in student achievement in biochemistry practicums, researchers took data on student achievement in practicum classes in the odd semester of 2022-2023 (post-pandemic), which carried out face-to-face practicums. In contrast to the pandemic practicum class (class A-D), student achievement for the post-pandemic practicum class (class E) is in the good category, with an average score of 82.

Based on the results of the ANOVA statistical test, with a significance level of 0.05, it is known that there is no significant difference in the average score between classes A, B and D. On the other hand, a significant difference in the average score is observed between class C and class A , B and D. Furthermore, the average score of class E is significantly different, both with class A, B, and D, as well as with class C (Table 2). Thus, in general it can be said that there are differences in student achievement in online practicum learning and face-to-face practicum learning.

Table 2. ANOVA test results

Class	N	Subset for alpha = 0.05		
		1	2	3
A	25	40.40		
B	23	41.30		
D	31	41.61		
C	37		58.92	
E	35			82.43
Sig.		.999	1.000	1.000

Means for groups in homogeneous subsets are displayed.

The research results showed that implementing online biochemistry practicum during the Covid-19 pandemic significantly reduced student achievement. This can happen because the implementation of online practicum has several limitations, so it cannot replace practicum carried out face-to-face offline. In online practicum or distance learning, the lab component presents the biggest challenge and some hands-on, supplementary, training might still be necessary (Papaneophytou, et. al., 2020). Other problems that can occur in online learning are weak supervision of students, lack of signal strength in remote areas, and high internet quota costs (Sadikin & Hamidah, 2020). This can result in a decline in student academic achievement, which is reported to be much greater in vulnerable groups (Whitley, et. al., 2021). However, the Covid-19 pandemic conditions have provided challenges as well as positive impacts for teachers so they can adapt and innovate when implementing learning. Various efforts to use and design suitable methods, models, media and learning approaches are examples of innovation that emerged from teachers as an adaptation to pandemic conditions (Lestari, et. al., 2021; Sudarsana, et. al., 2021; Kartimi, et. al., 2021).

Conclusion

The implementation of biochemistry practicum lectures on the topic of enzymes has been carried out well. This is indicated by the achievement of scores for all aspects of the questionnaire, which are classified as good categories, with an average of 8.02. Nonetheless, student achievement in the pandemic practicum class is known to be relatively low, and significantly different from the post-pandemic practicum class. This shows

that direct practicum in the laboratory is relatively difficult to replace by online practicum learning.

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The authors' contributions are as follows: Conceptualization, Gun Gun Gumilar and Asep Kadarohman; methodology, Nahadi; software, Gun Gun Gumilar; validation, Nahadi, Asep Kadarohman and F. M. Titin Supriyanti; formal analysis, Gun Gun Gumilar; investigation, Gun Gun Gumilar and F. M. Titin Supriyanti; resources, Nahadi; data curation, Gun Gun Gumilar; writing—original draft preparation, Gun Gun Gumilar; writing—review and editing, Gun Gun Gumilar; visualization, Gun Gun Gumilar; supervision, Asep Kadarohman; project administration, Gun Gun Gumilar.

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Conflicts of Interest
The authors declare that there is no conflict of interest regarding the publication of this article. Author's confirm that the data and the paper are free of plagiarism.

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