

# ONLINE BIOCHEMISTRY DISTANCE LEARNING: DENTISTRY STUDENTS' PERCEIVED OPPORTUNITIES AND CHALLENGES

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## ABSTRACT

Undergraduate courses such as biochemistry were prompted to embrace online distance learning triggered by the incursion of the COVID-19 pandemic. This study worked to help solve the issues and concerns related to teaching biochemistry as a foundational course for dental and other health-sciences programs in the status of the educational system. The case study method was deemed a good way to focus on the objectives of this research because the theme was dentistry students' perceptions and experiences dealing with the opportunities and difficulties that the COVID-19 pandemic brought with it in this circumstance. 11 purposively sampled dentistry students served as the participants of the study. Data were gathered through an online platform with open-ended questions which were thematically analyzed afterward. The identified opportunities were lumped into ROTE: Research works, Open and independent learning, Technology for education, and Education for health. Challenges encountered were grouped as DARE: Demand for technology, Acquisition of knowledge, Remote learning, and Environmental condition for studying. It is worth noting that the participants were enlightened on the academic and personal benefits of biochemistry online distance learning. The researchers appeal to future researchers and policymakers to anchor forthcoming steps to further augment the online teaching and learning experiences of teachers and learners.

**Keywords:** Biochemistry, online distance learning, COVID-19 pandemic, dentistry.

## INTRODUCTION

### COVID-19 Pandemic and the Educational System

Teaching and learning during the pandemic have been undeniably challenging for every stakeholder of the educational system worldwide, specifically the delivery of science courses through an online distance learning modality. It is highly evident that the COVID-19 pandemic greatly affected the entire educational system including the relevant sectors which led to a shift from traditional to distance setup. Though, university programs before the COVID-19 pandemic were increasingly delivered online because of improved digital technology, more student enrolment, and expanded accessibility of home-based computers and stable internet connections (Capra, 2011; Christensen et al., 2011; Hart, 2012).

Following public health officials' advice to maintain social distancing as a fundamental health protocol, the COVID-19 pandemic swiftly resulted in the closure of institutions, colleges, and universities (Murphy, 2020). As a result, educational institutions immediately embraced e-learning as a kind of remote education while prioritizing the resources and capacities which require huge improvements (Morgan, 2020). Babincakova and Bernard (2020) stated that educators from the basic to higher education sectors around the world faced numerous challenges to deliver classes online for the duration of the COVID-19 pandemic and lockdown. At the same time, students' study activities and university life have been disturbed by the COVID-19 pandemic, causing anxiety about when life will return to "normal" (Gamage et al., 2020). Until today, it is still arguable if the return to the traditional educational setup will be possible as schools and universities prepare for limited physical class meetings.

### **Existing Strengths and Weaknesses of Online Learning**

Just like other learning modalities, online learning has both advantages and disadvantages. When it comes to strengths, it was determined to be effective since it offered learners flexibility and ease. Students appreciated well-structured content and included recorded films found on university websites (Muthuprasad et al., 2021). Arnaud (2019) advised that students can also perform simple experiments at home using household items or chemical reagents provided for them. Additionally, travel costs and additional expenses are reduced in online learning as students are not required to be present in schools. As a result, both teachers and students learned to have the technological skills to attend their online classes and utilize computer gadgets (Kim, 2020).

In contrast, both teachers and students in online programs were physically exhausted and missed the classroom experience (Hindocha, 2020). It also brought up the subject of the digital gap and inequities in accessing the internet, which is a problem for many kids (Muthuprasad et al., 2021). Because of inadequate facilities and the absence of emotional connection with the students, online classes are tough for teachers, particularly in hands-on subject areas (Kulal & Nayak, 2020). Besides, several students felt that the teachers in online classes could have done a better job (Khan et al., 2021). Lastly, some advantages like the flexibility of the class schedule can also be a drawback, particularly for school students who have difficulty with self-management (Attardi & Rogers, 2015; Bediang et al., 2013; Dyrbye et al., 2009; Niebuhr et al., 2014). As both the strengths and weaknesses of online learning are discussed, educational institutions still find solutions to cope with the vast negative impacts brought by the pandemic.

### **Online Teaching of Biochemistry and Sciences Courses**

Globally, colleges and universities have relied heavily on online education to mitigate the effects of COVID-19 on education. Several distance-based degrees have included online undergraduate science courses as a standard component (Driscoll et al., 2012). Even prior to the pandemic, online teaching of lecture courses was initiated by selected schools but was still far from the realization of delivering laboratory courses in virtual or home-based modalities.

A similar shift has occurred in the medical industry, activities like online learning seminars, discussion groups, medical teleconferencing, and large group presentations are all becoming more popular (Purdy et al., 2015; Sharif et al., 2020). Furthermore, many health and allied health courses have successfully implemented online programs; however, these programs were carefully implemented over time by instructors who were properly qualified and equipped (Purdy et al., 2015; De Tantillo & Christopher, 2020; Prata-Linhares et al., 2020; Sharif et al., 2020).

Rice et al. (2009) stated at one point that both physical and life sciences rely on hands-on laboratory meetings, which are usually performed in small groups to imitate real-world laboratory conditions. Experiments are also crucial in chemistry education, while more research and understanding of the impact of practical chemistry laboratory works on students' understanding is even required (Kang & Wallace, 2005; Bretz, 2019). In the current time, virtual or online laboratory activities are integrated into the curriculum of courses that demand hands-on performance as course requirements to still deliver the required learning competencies.

## **The Transition from Traditional to Online Delivery of Biochemistry and Sciences Lessons**

Presently, online teaching is widely employed in undergraduate education—not as a stand-alone approach, but in conjunction with the traditional methodology where teachers serve as facilitators of learning (Blissitt, 2016; Sadeghi et al., 2014). Wisanti et al. (2021) discussed that transitioning from a traditional classroom to an online classroom assisted by advanced communication technology presents teachers and students with a new challenge for brand-new teaching and learning.

Most educational institutions and educators during the pandemic are looking into a variety of teaching software and application programs for students to help them learn online (Nassoura, 2020). As a result, teachers can effectively adopt online learning by considering significant factors such as dynamic learning, enthusiasm, and response (Yengin et al., 2010). Information technology was used to teach and evaluate students, which helped to close the learning gap that arose because of the lockdown (Henderson et al., 2020).

When students are not physically present on campus, computer-generated or remote-control laboratories, and video-recorded laboratory performances are appropriate options (Zhai et al., 2012). Even though online options have largely replaced face-to-face instruction, no effort was executed to capitalize on the abundance of possibilities afforded by university life for leisure, management, socializing, community action, and others (Gamage et al., 2020). Despite the threat of COVID-19, quality education delivered by schools worldwide continues for both students and teachers. As a result of this occurrence, the modalities of offering quality education have accelerated, shifting from traditional physical engagement to online meetings (Laudato & Punzalan, 2021).

From the prevailing circumstances and problems brought by the pandemic to the educational system as highlighted by the literature, this qualitative study aimed to analyze the dentistry students' perceptions and experiences of learning biochemistry lectures and laboratory courses through online distance learning modalities amid the COVID-19 pandemic. During this current state of the education system, this undertaking is pursued to help in addressing the problems and concerns on delivering the objectives of Biochemistry as a fundamental course for dental and other health-sciences programs. Finally, this study sought to answer the research question: What are the encountered opportunities and challenges of dentistry students toward the online distance learning of biochemistry during the COVID-19 pandemic?

## **METHOD**

### **Research Design**

This research employed a case study approach of qualitative design. The case study approach is particularly useful when an in-depth analysis of a concern, happening, or occurrence of interest in its actual real-life situation is necessary (Crowe et al., 2011). Case studies, according to Yin (2009), can be applied to give an explanation, illustrate, or investigate issues or phenomena in their natural settings. As the topic focused on the experiences and perceptions of dental students that deal with the opportunities and challenges that the COVID-19 pandemic brought in this condition, the case study was considered a suitable approach to target the aims of this research. This case was chosen due to its distinctiveness, which is of actual concern to the researchers, rather than because it is representative of other cases.

### **Participants**

The participants of this study involved second-year dentistry students in a private educational institution in the Philippines during the academic year 2021-2022. They were taking biochemistry lecture and laboratory classes during the conduct of the study. Such a course is a required course in their program taken online at the time. Likewise, the researchers requested the consent of the students to serve as participants in the study. There were 11 students taking biochemistry courses who expressed their participation in the study. These students were initially selected through purposive sampling by the researchers according to their ability to produce in-depth knowledge related to their perceptions and experiences of online learning. Purposeful sampling is used in qualitative research to recognize and choose knowledge-rich settings to make the most

effective use of inadequate means (Patton, 2002). Table 1 presents the demographic profile of the participants while Table 2 shows the technological tools used by the participants during online classes.

**Table 1.** Demographic profile of the participants

	N = 11	F	%
Sex	Male	4	36.36%
	Female	7	63.64%
Age	18	1	9.09%
	19	6	54.55%
	20	3	27.27%
	21	1	9.09%
Strand	GAS	1	9.09%
	STEM	10	90.91%

**Table 2.** Technological tools used by the participants during online classes

Technological Tools	N = 11	%
Tablet or iPad	3	27.27%
Laptop	10	90.91%
Audio Tools (e.g., earphones)	8	72.73%
Mobile phone	9	81.82%
Desktop	1	9.09%
Video Camera	1	9.09%

## Instrument

A researcher-made questionnaire with open-ended questions related to the informants' perceptions and experiences in learning biochemistry courses were utilized in this study. The researchers reviewed relevant literature to serve as a basis for instrument development (Rodriguez, 2021) in terms of its reliability and validity. Items formulated as part of the questionnaire were pursued to answer each research question which was divided into three. The first section is constructed to secure data privacy agreements from the informants. The second section is composed of questions to describe the profile of the informants in terms of name, gender, age, college program, senior high school strand, and technological tools listed in Table 2. Lastly, the last section is composed of the following questions (1) What are the challenges that you experienced in taking biochemistry classes through distance learning? What is the most difficult in distance biochemistry learning in lecture and laboratory classes? and (2) What are the new opportunities that you experienced in taking biochemistry classes through distance learning? Since open-ended questions allow participants to provide more options and viewpoints than would be allowed with a closed-question or multiple-choice survey measure, according to Allen (2017), qualitative studies using open-ended questions allow researchers to take a holistic and thorough look at the subjects being examined.

## Data Collection and Analysis

Having a background and expertise in handling science education courses and conducting relevant studies, the researchers asked for the permission of the dental students to serve as the participants in this study through a consent form. This form showed significant information about the investigation including its rationale and the benefit that it would provide to the body of knowledge for policymaking. After the participants have shown their interest in partaking in the study, they were given access to answer the questionnaire using an online platform. They were also allowed to ask for some clarifications about the questions and review their responses. After the data collection, the researchers analyzed the sets of responses from 11 participants through thematic analysis of qualitative data. Thematic analysis is a qualitative data analysis process that involves examining a data set for repeating patterns, evaluating them, and reporting them (Braun & Clarke, 2006). The responses together with their respective code/id for the confidentiality of the research were presented in tables for data analysis to analyze the codes, reasons, categories, and emerging themes. The researchers familiarize themselves with the data by reading through the transcripts and actively noticing meanings and patterns that arise across the data set before beginning the thematic analysis of the research data. The meanings and patterns found in the data were first represented by codes. After compiling the codes with supporting information, the researchers organized the codes into probable topics. The different codes were integrated, and any further themes that could be broken down into sub-themes were examined. In order to verify that each theme is distinct and has adequate evidence to support it, the researchers lastly went back and refined the themes.

## RESULTS AND DISCUSSION

There are four themes (specified as ROTE) generated under the category of opportunities from the conducted thematic analyses of the participants' responses to the questionnaire as shown in Table 3. These encountered opportunities were based on how the dentistry students experienced the conduct of online biochemistry learning and were identified as research works, open and independent learning, technology for education, and education for health.

The incorporated research works were able to enhance the understanding and skills of students on how scientific methods can solve problems in the field of biochemistry. One student mentioned that the integration of research article reviews as an activity in biochemistry online distance learning helped to enhance their reading comprehension and deepened their understanding of scientific innovations, especially in the field of biochemistry. It also served as preparation for their future research requirements to finish the dentistry degree program as it developed their critical thinking skill. Goldkuhl et al. (2017) stated that including both research and workable activities in the classroom is critical to providing students with a current and appropriate education that is highly suited to their future jobs. Similarly, because research and teaching differ so much across domains, the effective incorporation of research into teaching is heavily reliant on the scientific disciplines (Brew, 2010; Durning & Jenkins, 2005; Griffiths, 2004). Students' responses related to the incorporation of research works in biochemistry learning are presented.

*“Through our biochemistry classes, I was able to discover, examine, and understand different research articles, which I believe helped me in improving my reading comprehension and broadening my knowledge about the science field. I also learned how to manage my time and follow a schedule to be more efficient in doing my tasks for my online classes.” (C7)*

*“Most importantly, I had the opportunity to improve my analytical skills in doing article reviews and answering post-lab questions since during face-to-face classes back then, focused more on application, and it sometimes lack this kind of activities wherein we can practice academic writing that is essential in doing research papers.” (C9)*

Open and independent learning was considered an opportunity for dental students to study biochemistry in a better way despite being a challenging course via distance modality. The participants agreed that the situation made them manage their time efficiently to perform well in the coursework. Khan et al. (2021) revealed in their analysis that students have a good attitude toward online classes since they have served as a channel to minimize the learning disruption caused by school closures and have helped them keep their academic

concerns and progress during the ongoing COVID-19 pandemic. Online education allows students to learn at their speed and at a time that is convenient for them which means that the demand for online education is fueled by its flexibility and accessibility (Muthuprasad et al., 2021). Though, barriers or weaknesses of online learning include the need for more discipline, academic writing abilities, and self-enthusiasm, as well as the requirement for online clients to make time dedicated to studying (Golladay et al., 2000; Serwatka, 2003). Also, other issues raised by students were a lack of enthusiasm, poor time management skills, and a lack of communication devices such as smartphones (Wisanti et al., 2021). Meaningfully, proper time management is counted as a significant aspect to cope with the intricate concepts of biochemistry learning. In relation to open and independent learning, the students had the following responses.

*“Almost every class in biochemistry, I needed to ready myself for the quizzes.” (C5)*

*“I realized that I can further enhance my independent learning.” (C11)*

*“Distance learning allowed me to assess my existing knowledge on the topics it comprises as well as trying to adjust my focus during discussions.” (C9)*

The third theme under the category of opportunities in the technology for education explains that the online distance learning of biochemistry is suitable for the utilization of various educational technology programs available online especially in the delivery of laboratory course works. Many institutions on an international scale have been shifting courses and curriculum frameworks toward online education since the early twenty-first century, by establishing systems and collaborative digital platforms to enable the instruction of students who live far away (Palloff & Pratt, 2007, 2010; Salmon, 2013; Bao, 2020). Most significantly, laboratory classes give students opportunities for peer and group interactions to learn (Dalziel & Peat, 1998; Rice et al., 2009). As advances in digital technology have made virtual classrooms and distance learning possible, meanwhile according to Regmi and Jones (2020), these innovations have significantly altered the delivery of undergraduate education; much undergraduate health science and medical programs still involve a “hands-on” component. The responses of the students related to the use of technology in education are presented.

*“I also had the opportunity to browse through more online study materials or resources, such as crash courses and summary videos, that helps me understand lessons in biochemistry that I was not able to comprehend during lectures.” (C3)*

*“I got to see that there are many sources that are somehow similar to face-to-face experiments rather than the ones made digitally or with cartoons.” (C1)*

*“The new opportunities that I experienced are being able to adapt to the situation through online materials, understanding the laboratory experiments by watching them through online videos, and grasping the educational information through interactive presentation and teaching.” (C2)*

The fourth theme identified is education for health. During the pandemic, studying biochemistry and its relation to biomolecules and viruses is highly relevant for the application of knowledge to practice. Emphasis is given to understanding biochemistry concepts, especially during the pandemic due to the demand for valuable health education. As agreed by Chaney et al. (2010), biochemistry is one of the core sciences that define the elements that make up the body and mind, how they work, and how that function is regulated to keep people healthy. Biochemistry plays a substantial role in the formation of unique new scientific methodologies by combining the key tenets of biology and chemistry and it has benefitted a variety of fields, including public health (Louis, 2020). Lastly, students’ responses in connection to biochemistry as a source of health education are presented.

*“Dietary consumption is one of the concepts/opportunities I experienced in taking this class since it has led me to re-evaluate my food consumption. Understanding different pros and cons of different biomolecules.” (C4)*

*“The subject is focused on relating more to a real-life situation and health-related topics. (C5)*

**Table 3.** Generated themes on opportunities encountered by dentistry students toward the online distance learning of biochemistry

Category	Generated Themes	Non-verbatim response with frequency	Selected Codes	Theme Description
Opportunities (ROTE)	Research works	Article review allows the students to discover, examine, and understand different research studies related to biochemistry. (3)	Reviewing research articles helps to improve reading comprehension and broaden the knowledge about the science field (C7)  Integrating research works improve analytical skills and practice academic writing (C9)	Integration of article review is one way to enhance the higher-order thinking skills of the students.
	Open and independent learning	Learning new techniques like time management and readiness for tasks. (3)	Opportunity to have more control of student's time with personal and academic matters (C6)	Proper time management helped the students to cope with the complex topics of biochemistry.
	Technology for education	Various interactive presentations and teaching materials are readily available. (3)	Browse online study materials and resources like crash courses and summary videos (C3)	There is a maximized use and appreciation of various educational technology that helped learners to better understand the topics.
	Education for health	Understanding the pros and cons of different biomolecules helps to evaluate the diet and educate other people. (2)	Share new knowledge about biomolecules and viruses for the benefit of others (C6)	Health education is emphasized learning biochemistry, especially during the pandemic.

Transitioning from a traditional education setup to an online distance environment also paved the way for teaching-learning challenges encountered by school communities worldwide during this pandemic. This study generated four themes defined as DARE under the category of challenges as shown in Table 4 including the demand for technology, acquisition of knowledge, remote learning, and environmental conditions for studying. Besides the mentioned opportunities, however, there are still several difficulties in handling undergraduate science courses like biochemistry. Also, it is difficult to resume classes in a secure, traditional structure, especially in medical and science practical and laboratory meetings (Anderton et al., 2021).

Demand for technology is extremely considered one of the challenges brought by online distance learning. Internet connection and availability of devices are important to think about for dental students to engage with the course work, especially when watching virtual laboratory experiment videos. In this study, most of the students utilized laptops and mobile phones to attend their online classes and accomplish their tasks. Corlatean (2020) and Muthuprasad et al. (2021) acknowledged that students and their families have been battling in less developed countries known for the digital divide and inequalities, even in poor socio-economic circumstances in several developed countries, where internet and equipment resources are scarce. Likewise, Babincakova and Bernard (2020) pointed out that students with a weaker internet connection or those compelled to use small-screen devices like mobile phones would be able to watch the video recording later when they have access to a stronger internet connection or another device. For example, students confront challenges and complications in online classrooms, such as difficulties completing assignments and attending online classes, because most students take online classes using mobile phones, which are not designed for them (Khan et al., 2021). Not only in the case of the students, but lack of internet connection was also a technology element that caused trouble for teachers as well, even though the internet is one of the most significant requirements to study in an online setting (Wisanti et al., 2021). The following is a sample of the students' responses related to the technology's demand.

*“I think the challenges that I commonly experienced are the internet connection and the effect of what is happening in the surroundings. The most difficult in distance biochemistry learning is the internet connection because there are times that my connection is getting slower, and I was not able to understand the lesson properly.” (C2)*

*“For me, having an internet connection problem or a weak reception is the most difficult part of distance learning, as well as the lack of experience in hands-on experiments. Since we only watch the experiments through YouTube, we cannot fully familiarize ourselves with the laboratory apparatus, reagents, and other chemicals used in the experiments.” (C7)*

*“The only problem I have is my internet connection. It is often unstable around morning and night so I could not properly attend biochemistry classes. I think the lessons are kind of difficult-- not exactly difficult, I think they are just complex.” (C11)*

The second theme that emerged under the category of challenges is the acquisition of knowledge. Because of their diverse learning styles, such as the lack of lab supplies for kinesthetic learners and restricted teacher engagement, some students find it difficult to learn through online classes. A student stated that there is a limited presence of the right person to ask for clarification about the biochemistry lessons. Khan et al. (2021) revealed in their study that most of their respondents revealed that online programs lack interaction with lecturers and that they lack the motivation to study because of numerous distractions at home. Along with other issues, the absence of traditional ways of direct collaboration in schools is a key worry in delivering online classes (Muthuprasad et al., 2021). Anderton et al. (2021) explained that the implications of failing to offer students some of these basic learning opportunities are expected to worsen as they progress through their science degrees. This is applicable for the students taking the dentistry program as they are required to engage in hands-on activities when taking clinical courses. Moreover, the following is a sample of the students' responses related to the student's knowledge acquisition.

*“Biochemistry is challenging and there were times when not everyone can perform at their best so I think that group studies can be helpful or even just having a companion while studying. In the laboratory part, it is difficult to acquire practical experiences and knowledge since we are not the ones doing the experiment. Also, I think that laboratory classes in distance learning are hard because we cannot compare results with one another which makes learning fun though challenging since mostly, we interpret the same data.” (C6)*

*As for laboratory classes, in my opinion, hands-on experiments are more effective in terms of gathering or learning information rather than just observing how other people do it. (C1)*

The third theme is identified as remote learning which reveals the limitations of social interaction, collaboration, and peer teaching. Adnan and Anwar (2020) implied that students felt separated in online classes because there were few group projects, little communication, and restrictions on outdoor activities, all of which contributed to social isolation. Despite the opportunity that dental students can manage their time efficiently to accomplish the biochemistry course work, remote learning modality still contributes to students' poor academic performance. Chandra (2020) stated that isolation procedures have resulted in students and teachers being confined to their homes because of the pandemic. Due to the pandemic, it is worrying for teachers and students to reach an effective interaction in an isolated atmosphere. Most of the foregoing possibilities are hindered at best and denied at worst by online delivery in a solely asynchronous mode (Gamage et al., 2020). This means that the combinations of synchronous, asynchronous, and face-to-face class sessions are better options to continue the appropriate delivery of biochemistry and other health sciences courses. The sample of the students' responses related to remote learning are as follows:

*“The most difficult in distance biochemistry learning in lectures is the lack of social interactions with classmates. Biochemistry is challenging and there were times that not everyone can perform at their best so I think that group studies can be helpful or even just having a companion while studying.” (C6)*

*“It is quite difficult for me to catch up immediately since I don't want to disturb my classmates.” (C5)*

*“I experienced the difficulty of understanding some complex topics. It is also hard taking lessons with no one to physically ask for help or question when I am confused with something.” (C3)*



Lastly, the environmental condition for studying emerged as a theme under challenge. Some dental students raised the negative influence of the uncondusive surrounding on learning biochemistry via online distance modality. This led the teachers and students in online programs to be physically exhausted and to miss the classroom experience (Hindochoa, 2020). Additionally, Farooqui (2020) said that the lack of real classroom conversation and detachment from the university library are the two most significant disadvantages of online lectures. Numerous distractions at home resulted in a lack of motivation to study (Khan et al., 2021). Alternatively, the results of the study by Baczek et al. (2021) unveiled that the option to remain at home, constant access to online resources, the flexibility to study at your speed, and relaxing environments were the most often mentioned benefits of e-learning by informants. Finally, the sample of the students' responses associated with the environmental condition are as follows:

*"I have a short attention span so even a small distraction in my study space can shift my focus from studying. The quiet and loud noise, the shouting, seeing my bed makes me sleepy, and more."* (C8)

*"I cannot focus on the lessons during the online classes because of the situations happening in my surroundings."* (C2)

**Table 4.** Generated themes on challenges encountered by dentistry students toward the online distance learning of biochemistry

Category	Generated Themes	Non-verbatim response with frequency	Selected Codes	Theme Description
Challenges (DARE)	Demand of technology	Internet connection and the performance of the gadgets used as hindrances. (8)	Online laboratory and lecture classes heavily rely on the conditions of the devices and internet connection used (C3)  The implementation of online classes is not advisable with the current technologies in the country (C6)	The existing technological tools including the internet connectivity used by the students are extremely important for them to participate actively in online learning.
	Acquisition of knowledge	Limited knowledge and skills are acquired. (5)	Explanation of complex lectures verbally is challenging to be learned (C1)  The limited presence of the right person to ask for clarification (C3)  There is a lack of experience in hands-on experiments (C7)	It is a big challenge for some students to learn from online classes because of their different learning styles like the absence of lab materials for kinesthetic learners and limited teacher interaction.
	Remote learning	Lack of social interactions with classmates. (2)	No one to physically ask for help or question (C4)  Group studies can be helpful or even just having a companion while studying biochemistry (C6)	As absent in remote learning, peer teaching can enhance the students' learning through face-to-face social interaction.
	Environmental condition for studying	Negative effects of the conditions in the surroundings to studying biochemistry. (2)	The loud noise and presence of the bed are distracting for learning (C8)	A conducive environment for learning is not always present or available for each learner.

## CONCLUSION AND RECOMMENDATIONS

The emergence of the COVID-19 pandemic has engendered institutions to shift to online learning including courses that demand both lecture and laboratory components such as biochemistry. While everyone has been caught off-guard by this, this study engulfs the need to gather the lived experiences of dentistry students in terms of opportunities and challenges. Opportunities perceived by the dentistry students encompass the research relevance, learning preference, integration of tools, and health connection of the biochemistry lessons delivered online. Meanwhile, the learners highlighted the challenges brought by the technological demands, gaps in knowledge acquisition, scarcity of social presence, and availability of a conducive environment at home while learning in the digital realm.

As the initial step in exploring the opportunities and challenges of dentistry students, the researchers recommend points for consideration for future researchers and policymakers. They can use the results of the study as their take-off point in promoting an improved learning environment for courses like biochemistry which requires both lecture and laboratory components. The research questions used by the researchers can be contextualized to explore teachers' lived experiences relevant to this matter. This paves the opportunity to look at the core of the study using a different lens that can reinforce the results. Also, this study can serve as the pedestal for future researchers in rolling out a quantitative study focused on online distance learning of undergraduate courses like biochemistry. These can promote triangulation of the result and proceed to even model a framework for an online distance learning course in preparation for future disruptions in the academe.

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## REFERENCES

- Adnan, M., & Anwar, K. (2020). Online learning amid the COVID-19 pandemic: Students' perspectives. *J. Pedagogical Sociology and Psychology*, 2(1), 45-51.
- Allen, M. (2017). *The sage encyclopedia of communication research methods* (Vols. 1-4). SAGE Publications, Inc. <https://doi.org/10.4135/9781483381411>
- Anderton, R. S., Vitali, J., Blackmore, C., & Bakeberg, M. C. (2021). Flexible teaching and learning modalities in undergraduate science amid the COVID-19 pandemic. *Front. Educ.*, 5. <https://doi.org/10.3389/educ.2020.609703>
- Arnaud, C. H. (2019, January 3). First-ever online biochemistry degree builds momentum. *Chemical and Engineering News*. <https://cen.acs.org/education/undergraduate-education/First-ever-online-biochemistry-degree/97/i1>
- Attardi, S. M., & Rogers, K. A. (2015). Design and implementation of an online systemic human anatomy course with laboratory. *Anatomical Sciences Education*, 8(1), 53-62. <https://doi.org/10.1002/ase.1465>
- Babincakova, M., & Bernard, P. (2020). Online experimentation during COVID-19 secondary school closures: Teaching methods and student perceptions. *Journal of Chemical Education*, 97(9), 3295-3300. <https://doi.org/10.1021/acs.jchemed.0c00748>
- Baczek, M., Zaganczyk-Baczek, M., Szpringer, M., Jaroszynski, A., & Wozakowska-Kaplon, B. (2021). Students' perception of online learning during the COVID-19 pandemic: A survey study of Polish medical students. *Medicine*, 100(7), e24821. <https://doi.org/10.1097/MD.0000000000024821>
- Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Hum. Behav. Emerg. Technol.*, 2(2), 113-115. <https://doi.org/10.1002/hbe2.191>
- Bediang, G., Stoll, B., Geissbuhler, A., Klohn, A. M., Stuckelberger, A., Nko'o, S., & Chastonay, P. (2013). Computer literacy and e-learning perception in Cameroon: The case of Yaounde Faculty of Medicine and Biomedical Sciences. *BMC Medical Education*, 13(57). <https://doi.org/10.1186/1472-6920-13-57>

- Blissitt, A. M. (2016). Blended learning versus traditional lecture in introductory nursing pathophysiology courses. *Journal of Nursing Education*, 55(4), 227–230. <https://doi.org/10.3928/01484834-20160316-09>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>
- Bretz, S. L. (2019). Evidence for the importance of laboratory courses. *Journal of Chemical Education*, 96(2), 193-195. <https://doi.org/10.1021/acs.jchemed.8b00874>
- Brew, A. (2010). Imperatives and challenges in integrating teaching and research. *Higher Education Research & Development*, 29(2), 139-150. <https://doi.org/10.1080/07294360903552451>
- Capra, T. (2011). Online education: Promise and problems. *Journal of Online Learning and Teaching*, 7(2), 288-293.
- Chandra, Y. (2020). Online education during COVID-19: Perception of academic stress and emotional intelligence coping strategies among college students. *Asian Education and Development Studies*, 10(2), 229-238. <https://doi.org/10.1108/AEDS-05-2020-0097>
- Christensen, C. M., Horn, M. B., Caldera, L., & Soares, L. (2011). *Disrupting college: How disruptive innovation can deliver quality and affordability to postsecondary education*. Innosight Institute.
- Corlatean, T. (2020). Risks, discrimination and opportunities for education during the times of COVID-19 pandemic. *RAIS Conference Proceedings*, 37-46. <https://doi.org/10.5281/zenodo.3909867>
- Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology*, 11(100). <https://doi.org/10.1186/1471-2288-11-100>
- Dalziel, J., & Peat, M. (1998). *Fostering collaborative learning during student transition to tertiary education: An evaluation of academic and social benefits*. Oxford Centre for Staff and Learning Development.
- De Tantillo, L., & Christopher, R. (2020). Transforming graduate nursing education during an era of social distancing: Tools from the field. *Nurse Education Today*, 92(2020), 104472. <https://doi.org/10.1016/j.nedt.2020.104472>
- Driscoll, A., Jicha, K., Hunt, A. N., Tichavsky, L., & Thompson, G. (2012). Can online courses deliver in-class results?: A comparison of student performance and satisfaction in an online versus a face-to-face introductory sociology course. *Teaching Sociology*, 40, 312-331. <https://doi.org/10.1177/0092055X12446624>
- Durning, B., & Jenkins, A. (2005). Teaching/research relations in departments: the perspectives of built environment academics. *Studies in Higher Education*, 30(4), 407-426. <https://doi.org/10.1080/03075070500160046>
- Dyrbye, L., Cumyn, A., Day, H., & Heflin, M. (2009). A qualitative study of physicians' experiences with online learning in a master's degree program: Benefits, challenges, and proposed solutions. *Med Teach*, 31(2), e40-e46 . <https://doi.org/10.1080/01421590802366129>
- Farooqui, S. (2020, May 1). Education in the time of COVID-19: How institutions and students are coping. *Business Standard*. [https://www.business-standard.com/article/education/education-in-the-time-of-covid-19-how-institutions-andstudents-are-coping-120043001575\\_1.html](https://www.business-standard.com/article/education/education-in-the-time-of-covid-19-how-institutions-andstudents-are-coping-120043001575_1.html)
- Gamage, K. A. A., Wijesuriya, D. I., Ekanayake, S. Y., Rennie, A. E. W., Lambert, C. G., & Gunawardhana, N. (2020). Online delivery of teaching and laboratory practices: Continuity of university programmes during COVID-19 pandemic. *Education Sciences*, 10(10), 291-301. <https://doi.org/10.3390/educsci10100291>
- Goldkuhl, G., Agerfalk, P., & Sjostrom, J. (2017). A design science approach to information systems education. In: Maedche A., vom Brocke J., Hevner A. (eds) *Designing the Digital Transformation. DESRIST 2017*. Lecture Notes in Computer Science, vol 10243. Springer, Cham. [https://doi.org/10.1007/978-3-319-59144-5\\_23](https://doi.org/10.1007/978-3-319-59144-5_23)

- Golladay, R., Prybutok, V., & Huff, R. (2000). Critical success factors for the online learner. *Journal of Computer Information Systems*, 40(4), 69-71. <https://doi.org/10.1080/08874417.2000.11647468>
- Griffiths, R. (2004). Knowledge production and the research-teaching nexus: The case of the built environment disciplines. *Studies in Higher Education*, 29(6), 709-726. <https://doi.org/10.1080/0307507042000287212>
- Hart, C. (2012). Factors associated with student persistence in an online program of study: A review of the literature. *Journal of Interactive Online Learning*, 11(1), 19-42.
- Henderson, D., Woodcock, H., Mehta, J., Khan, N., Shivji, V., Richardson, C., Aya, H., Ziser, S., Pollara, G., & Burns, A. (2020). Keep calm and carry on learning: Using Microsoft Teams to deliver a medical education programme during the COVID-19 pandemic. *Future Healthcare Journal*, 7(3), e67-e70. <https://doi.org/10.7861/fhj.2020-0071>
- Hindocha, J. (2020, October 15). Teachers, students miss physical connect during online classes state problems of connectivity exhaustion. *Hindustan Times*. <https://www.hindustantimes.com/pune-news/teachers-students-miss-physical-connect-during-online-classes-state-problems-of-connectivity-exhaustion/story-R2SnDK4ZlyTpMEDzhRpb0N.html>
- Kang, N. H., & Wallace, C. S. (2005). Secondary science teachers' use of laboratory activities: Linking epistemological beliefs, goals, and practices. *Science Education*, 89(1), 140-165. <https://doi.org/10.1002/sc.20013>
- Khan, M. A., Kamal, T., Illiyan, A., & Asif, M. (2021). School students' perception and challenges towards online classes during COVID-19 pandemic in India: An econometric analysis. *Sustainability*, 13(9), 4786-4801. <https://doi.org/10.3390/su13094786>
- Khan, M., Vivek, V., Nabi, M., Khojah, M., & Tahir, M. (2021). Students' perception towards e-learning during COVID-19 pandemic in India: An empirical study. *Sustainability*, 13(1), 57-71. <https://doi.org/10.3390/su13010057>
- Kim, J. (2020). Learning and teaching online during COVID-19: Experiences of student teachers in an early childhood education practicum. *International Journal of Early Childhood*, 52, 145-158. <https://doi.org/10.1007/s13158-020-00272-6>
- Kulal, A., & Nayak, A. (2020). A study on perception of teachers and students toward online classes in Dakshina Kannada and Udupi District. *Asian Association of Open Universities Journal*, 15(3), 285-296. <https://doi.org/10.1108/AAOUJ-07-2020-0047>
- Laudato, E. E., & Author. (2021). Deleted for peer review. *i-manager's Journal of Educational Technology*, 18(2), 53-62. <https://doi.org/10.26634/jet.18.2.17817>
- Louis, R. (2020). The importance of biochemistry in public health. *Journal of Microbiology and Immunology*, 5(4), 5.
- Morgan, H. (2020). Best practices for implementing remote learning during a pandemic. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 93(3), 135-141. <https://doi.org/10.1080/00098655.2020.1751480>
- Murphy, M. P. (2020). COVID-19 and emergency eLearning: Consequences of the securitization of higher education for post-pandemic pedagogy. *Contemporary Security Policy*, 41(3), 492-505. <https://doi.org/10.1080/13523260.2020.1761749>
- Muthuprasad, T., Aiswarya, S., Aditya, K. S., & Jha, G. K. (2021). Students' perception and preference for online education in India during COVID-19 pandemic. *Social Sciences & Humanities Open*, 3(1). <https://doi.org/10.1016/j.ssaho.2020.100101>
- Nassoura, A. B. (2020). Measuring students' perceptions of online learning in higher education. *International Journal of Scientific and Technology Research*, 9(4), 1965-1970.
- Niebuhr, V., Niebuhr, B., Trumble, J., & Urbani, M. J. (2014). Online faculty development for creating e-learning materials. *Education for Health*, 27(3), 255-261. <https://doi.org/10.4103/1357-6283.152186>

- Palloff, R. M., & Pratt, K. (2007). *Building online learning communities: Effective strategies for the virtual classroom*. John Wiley & Sons.
- Palloff, R. M., & Pratt, K. (2010). *Collaborating online: Learning together in community* (Vol. 32). John Wiley & Sons.
- Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Sage Publications; Thousand Oaks.
- Prata-Linhares, M. M., Cardoso, T. D. S. G., Lopes, D. S. Jr., & Zukowsky-Tavares, C. (2020). Social distancing effects on the teaching systems and teacher education programmes in Brazil: Reinventing without distorting teaching. *Journal of Education for Teaching*, 46(4), 554-564. <https://doi.org/10.1080/02607476.2020.1800406>
- Purdy, E., Thoma, B., Bednarczyk, J., Migneault, D., & Sherbino, J. (2015). The use of free online educational resources by Canadian emergency medicine residents and program directors. *Canadian Journal of Emergency Medicine*, 17(2), 101-106. <https://doi.org/10.1017/cem.2014.73>
- Regmi, K., & Jones, L. (2020). A systematic review of the factors—enablers and barriers—affecting e-learning in health sciences education. *BMC Medical Education*, 20. <https://doi.org/10.1186/s12909-020-02007-6>
- Rice, J. W., Thomas, S. M., & O'Toole, K. (2009). *Tertiary science education in the 21st century*. The Australian Learning and Teaching Council.
- Rodriguez, R. Jr. L. (2021). New normal transition: Senior high school teachers' perception on its ways and challenges. *IOER International Multidisciplinary Research Journal (IIMRJ)*, 3(2), 198-208.
- Sadeghi, R., Sedaghat, M. M., & Sha Ahmadi, F. (2014). Comparison of the effect of lecture and blended teaching methods on students' learning and satisfaction. *Journal of Advances in Medical Education & Professionalism*, 2(4), 146-150.
- Salmon, G. (2013). *E-tivities: The key to active online learning* (2nd ed.). Routledge. <https://doi.org/10.4324/9780203074640>
- Serwatka, J. A. (2003). Assessment in on-line CIS courses. *Journal of Computer Information Systems*, 44(1), 16-20. <https://doi.org/10.1080/08874417.2003.11647547>
- Sharif, S., Sherbino, J., Centofanti, J., & Karachi, T. (2020). Pandemics and innovation: How medical education programs can adapt extraclinical teaching to maintain social distancing. *ATS Scholar*, 1(4), 344-347. <https://doi.org/10.34197/ats-scholar.2020-0084CM>
- Wisanti, Ambawati, R., Putri, E. K., Rahayu, D. A., & Khaleyra, F. (2021). Science online learning during the COVID19 pandemic: Difficulties and challenges. *Journal of Physics: Conference Series*, 1747. <https://doi.org/10.1088/1742-6596/1747/1/012007>
- Yengin, I., Karahoca, D., Karahoca, A., & Yucel, A. (2010). Roles of teachers in e-learning: How to engage students & how to get free e-learning and the future. *Procedia-Social and Behavioral Sciences*, 2, 5775-5787. <https://doi.org/10.1016/j.sbspro.2010.03.942>
- Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Sage Publications Ltd.
- Zhai, G., Wang, Y., & Liu, L. (2012). Design of electrical online laboratory and e-learning. *IERI Procedia*, 2, 325–330. <https://doi.org/10.1016/j.ieri.2012.06.096>