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Biology Students' Attitudes and Perceptions of the Online Learning Process During the COVID-19 Isolation Period

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Abstract

The COVID-19 pandemic significantly disrupted higher education, necessitating a rapid shift to online learning. This study examines the attitudes and perceptions of biology students at the Faculty of Natural Sciences and Mathematics, University of Sarajevo, regarding online education during the pandemic. A survey was conducted among third- and fourth-year undergraduate students and master's students to assess their experiences with digital learning platforms, professor-student interaction, assessment methods, and the impact on their well-being.
Results indicate that while students acknowledged the necessity of online education, the majority expressed a preference for traditional, face-to-face learning. Online learning was perceived as less effective, particularly in terms of engagement, interaction, and knowledge assessment reliability. A significant portion of students reported increased stress levels due to excessive screen time, technical difficulties, and the lack of direct communication. Furthermore, many students felt inadequately

prepared for professional work due to the absence of practical, hands-on experience.
Despite these challenges, the study highlights the role of digital platforms in sustaining education during the crisis and the need for further improvement in online teaching methodologies. The findings suggest that a blended learning approach, integrating both digital and in-person elements, could enhance the effectiveness and accessibility of education in the post-pandemic era.

Keywords: *COVID-19, online learning, student perceptions, digital education, higher education.*

1. Introduction

The coronavirus disease 2019 (COVID-19) was first detected in Wuhan, China, in December 2019. Within a few months, it spread rapidly across the world, leading to a global health crisis. On March 11, 2020, the World Health Organization (WHO) officially declared COVID-19 a pandemic. The unprecedented nature of this outbreak led to widespread disruptions in various sectors, including education. Universities and educational institutions worldwide were compelled to shut down their campuses in early 2020 to curb the spread of the virus. Consequently, higher education institutions had to make an abrupt shift from traditional classroom-based teaching to fully online learning (Bao, 2020).

The transition to online education was highly challenging, as most universities were unprepared for such a significant transformation. Many institutions initially lacked the necessary technological infrastructure, digital tools, and strategic frameworks to facilitate remote learning effectively (Zhang, Wang, Yang, & Wang, 2020). Faculty members, students, and administrative staff had to adapt to new digital learning environments within a short period, often without adequate training or resources. Despite these hurdles, advances in educational technology over the past few decades played a crucial role in supporting this transition (Chatterjee & Chakraborty, 2020; Dhawan, 2020). Various online learning platforms and digital tools became instrumental in enabling remote education, helping institutions sustain academic activities during the crisis (Nash, 2020).

However, mapping traditional educational activities onto a virtual space posed several challenges. Professors had to redesign their curricula, modify teaching methodologies, and incorporate digital assessment techniques to ensure effective learning outcomes. Additionally, both educators and students encountered numerous logistical, technical, financial, and social barriers. Many students faced difficulties in accessing reliable internet connections, digital devices, and quiet study environments, making remote learning an unequal experience (Lassoued, Alhendawi, & Bashitialshaaer, 2020; Peters et al., 2020).

Moreover, the lack of direct face-to-face interaction reduced engagement levels and made it harder for instructors to assess students' understanding and progress.

Beyond academic difficulties, the COVID-19 pandemic and the associated lockdowns had severe consequences for mental health. Prolonged isolation, uncertainty about the future, and increased academic workload led to heightened levels of stress, anxiety, and depression among students (Cao et al., 2020; Islam, Barna, Raihan, Khan, & Hossain, 2020). Many struggled to maintain motivation and focus, while others faced difficulties in balancing personal responsibilities with academic commitments. The psychological distress caused by the pandemic further impeded students' ability to adapt to online education, leading to potential declines in academic performance and overall well-being.

Additionally, the pandemic underscored and exacerbated existing inequalities in access to digital technologies. While some students had access to high-speed internet, personal laptops, and conducive learning environments, others struggled with limited resources and inadequate digital literacy. This digital divide became more pronounced as education shifted online, further widening the gap between privileged and underprivileged students (Jæger & Blaabæk, 2020).

Despite these challenges, the pandemic also highlighted the potential of online education and accelerated the adoption of digital learning tools on a global scale. Many institutions began investing in long-term digital strategies, enhancing their technological infrastructure, and exploring hybrid models of education that blend in-person and online learning. Moving forward, universities are likely to continue integrating digital innovations to make education more flexible, accessible, and resilient against future disruptions.

Research on the effectiveness of student interactions with professors and peers through online tools, as well as the efficiency of online assessment methods, remains limited. Few studies have explored these areas in depth. For instance, Patricia (2020) found that students generally favour face-to-face engagement with their instructors, while Bojovic et al. (2020) highlighted that many professors feel uncertain about the reliability and efficacy of online assessment techniques.

The COVID-19 pandemic drastically transformed the landscape of higher education. While the transition to online learning posed significant challenges, it also prompted a re-evaluation of traditional educational approaches and accelerated the adoption of digital solutions. Addressing issues such as digital inequality, mental health support, and online pedagogical strategies will be crucial in shaping the future of education in the post-pandemic world.

Several studies have examined online education, focusing on student satisfaction, e-learning acceptance, key success factors in distance learning, and learning effectiveness. However,

there is limited research on the factors influencing student satisfaction and success in online education during the COVID-19 pandemic. Since this area remains underexplored, further research is needed to evaluate the effectiveness of online learning during the pandemic.

The aim of this study is to assess the attitudes and opinions of biology students regarding online education at the Faculty of Natural Sciences and Mathematics, University of Sarajevo, during the COVID-19 pandemic.

2. Respondents and Methods

The research covered in this study was conducted in May 2023 using the survey method. The research instrument was a questionnaire designed for students of the first and second cycles of the Department of Biology at the Faculty of Science, University of Sarajevo. Regardless of the study cycle, all students who participated in the survey attended courses according to their chosen field of study: microbiology, biochemistry and physiology, genetics, ecology, or the teaching program. The questionnaire was anonymous, allowing students to express their honest opinions. To assess students' perspectives on online education during the COVID-19 pandemic, we used modified questionnaire (Chakraborty et al., 2021) consisting of 20 statements and 7 questions related to online education during the COVID-19 pandemic (Table 1.).

The survey was conducted in classrooms at the Faculty of Science, University of Sarajevo. The questionnaire was structured into several thematic sections, or categories of questions. The first part of the survey covered general information, including gender, year of study, and field of study. The main part of the questionnaire was divided into five categories:

- General conditions and experience of studying through online platforms (GI),
- Professor-student interaction (Int),
- Knowledge assessment (As),
- Health issues (HI), and
- General evaluation of learning outcomes (GE).

The questionnaire was designed for anonymous responses using a Likert scale. The Likert scale measures attitudes by asking respondents to indicate the extent to which they agree or disagree with a series of statements on a particular topic. Each respondent had the opportunity to answer each statement and question on a 5-point Likert scale, where "1" represented "Strongly disagree" and "5" represented "Strongly agree."

For data processing, we used Microsoft Excel 2010. The results were presented as percentages in tables or graphs. Descriptive statistics were applied to analyse the questions related to learning outcome assessment. The results were expressed as the arithmetic mean (Mean), standard deviation (STDEV), and minimum (MIN) and maximum (MAX) values.

Table 1. Questionnaire used in this study.

Indicator	Statement
	General Issues
GI1	Teaching is conducted more effectively through online platforms than in classrooms.
GI2	Professors have made the literature needed for mastering the material available through online platforms.
GI3	Numerous learning materials related to the covered lessons can be found on the internet as a suitable replacement and supplement.
GI4	Professors have improved their online teaching skills since the beginning of the COVID-19 pandemic.
GI5	Students have sufficiently developed IT skills.
	Interaction
Int1	The interaction between professors and students is of higher quality in classrooms than on online platforms.
Int2	If the professor and students show their faces (use cameras), the lecture becomes more interactive.
Int3	Professors show understanding of the challenges students face during online classes.
Int4	Students freely express their opinions and initiate discussions during online classes.
Int5	Students are provided with consultations at scheduled/agreed-upon times via online platforms.
	Assessment
As1	Online tests and quizzes are an objective indicator of students' acquired knowledge.
As2	It is easier to pass tests and quizzes via online platforms than in the classroom.
As3	The use of unauthorized resources is more frequent during online quizzes and tests.
As4	The allocated time for taking online quizzes and tests is adjusted to the difficulty and number of questions.
As5	Oral examinations of students within online classes have been reduced to a minimum.
	Health Issues
HI1	Excessive use of computers during online classes causes stress and affects sleep.
HI2	Excessive computer use leads to decreased concentration.
HI3	During online classes, a large number of students experience a fear of losing their internet connection.
HI4	During online classes, gastrointestinal issues are more frequent among a larger number of students.
HI5	Online grading creates more anxiety than traditional forms of assessment.
	General Perspective
GE1	To what extent has online learning met your expectations?
GE2	To what extent has online learning prepared you for continuing your education (returning to the classroom)?
GE3	To what extent has online learning equipped you for working in your profession?
GE4	How satisfied are you with the overall implementation of online learning?
GE5	How difficult and demanding was online studying in general?
GE6	How useful was online learning for you?
GE7	What overall rating would you give to this method of studying (online education)?

3. Results and Disscusion

This study utilized a survey method and included a total of 101 respondents. In the initial section of the questionnaire, participants were asked to provide basic demographic information, such as gender, year of study, and academic program. The gender distribution analysis revealed that the majority of respondents, 90 (89.10%), were female, while 11 (10.90%) were male.

Regarding the academic level of the participants, 36 (35.64%) were third-year students from the first study cycle, while 42 (41.58%) were in their fourth year. Additionally, 23 students (22.77%) were enrolled in the second study cycle.

In terms of study programs within the Department of Biology, the highest number of respondents, 39 (38.61%), were from the Microbiology program. A total of 23 students (22.77%) indicated they were studying Biochemistry and Physiology. The Ecology program had 18 respondents (17.82%), while 14 students (13.86%) were from the Teaching program. The Genetics program had the fewest participants, with only 7 students (6.93%).

Most students (46.53%) strongly disagreed that online learning is of higher quality than classroom instruction (GI1), citing difficulties in focusing due to pandemic-related concerns or technological limitations. Regarding the availability of course materials (GI2), the majority of students had a positive view, with 37.62% partially agreeing and 29.70% fully agreeing that professors provided resources through online platforms. A significant number of students recognized online resources as valuable learning tools (GI3), with 42 students partially agreeing and 21.78% fully agreeing that the internet offers useful supplementary materials. Opinions on whether professors improved their online teaching skills (GI4) were mixed, with 40.59% of students partially agreeing, 29.70% remaining neutral, and a smaller percentage expressing strong agreement or disagreement. When evaluating their IT skills (GI5), 31.68% of students partially agreed they were well-developed, while 27.72% remained neutral, and smaller groups either fully agreed or disagreed.

The majority of students (57.42%) fully agreed that professor-student interaction is of higher quality in classrooms than on online platforms (Int1), with a smaller percentage expressing neutrality or disagreement. Regarding the use of cameras in online lectures (Int2), opinions varied, with 27.72% fully agreeing that it enhances interactivity, while 13.86% completely disagreed. A comparative study from India showed similar findings, with over 50% of students agreeing that in-person interaction is superior, and slight differences observed in views on camera use (Chakraborty et al., 2021). The importance of cameras in online teaching was highlighted, as Indian students showed a more neutral stance, whereas students in this study largely agreed that cameras improve engagement. Student opinions on whether professors understand their challenges in online learning were mixed (Int3), with 32.67% remaining neutral and equal proportions (25.74%) either partially agreeing or

disagreeing. A significant number of students (34.65%) disagreed that they could freely express opinions and engage in discussions during online classes (Int4), attributing this to the lecture format. Regarding online consultations (Int5), 31.68% of students partially agreed that professors provided scheduled consultations, while 20.79% fully agreed, indicating overall accessibility for students.

A significant portion of students (32.67%) completely disagreed that online tests and quizzes are objective measures of knowledge (As1), while only 4.95% fully agreed with this statement. Most students (76.23%) believed that passing exams is easier on online platforms (As2), with 39.60% partially agreeing and 36.63% fully agreeing with this claim. Concerns about cheating during online exams were prevalent (As3), as 42.57% of students fully agreed that unauthorized resources are used more frequently in online assessments. A study in Croatia found that 69.5% of professors viewed online exams as unreliable, aligning with the scepticism expressed by biology students in this research (Vražić et al., 2022). The majority of students (63.36%) disagreed that the allocated time for online quizzes and tests (As4) was appropriate, indicating dissatisfaction with the exam duration. Most students (68.31%) agreed that oral examinations during online learning were minimized (As5), with 39.60% fully supporting this observation.

A majority of students (67.32%) agreed that excessive computer use during online classes causes stress and affects sleep (HI1), with 36.63% fully agreeing and 30.69% partially agreeing. Similarly, 75.24% of students believed that excessive screen time reduces concentration (HI2), with 38.61% fully agreeing and 36.63% partially agreeing. Concerns about internet connection loss were prominent (HI3), as 52.47% of students fully agreed with having a fear of disconnection. A study from Croatia found that most students did not experience high stress levels during online learning, contrasting with the findings of this research (Vražić et al., 2022). 40.59% of students were neutral regarding the increased occurrence of gastrointestinal issues during online learning (HI4), but 48.51% acknowledged experiencing them to some extent. More than half of the students (46.53%) felt that online assessments caused more anxiety than traditional methods (HI5), while 26.73% remained neutral on the matter.

Student satisfaction with online learning is based on multiple factors, the most significant of which include the format of online instruction, the functioning of the overall support system, the syllabus or curriculum, instructor competencies and student support during instruction, as well as the speed of feedback (Wei & Chou, 2020). Therefore, student satisfaction is a key indicator that directly impacts learning outcomes.

The survey results indicate that most students had moderate expectations of online learning (GE1), with 53.46% selecting “moderate” as their response. However, 26.73% expressed dissatisfaction, while only 13.86% stated that online learning met their expectations.

Regarding preparation for returning to in-person education (GE2), 59.4% of students felt unprepared, with only 1.98% believing online learning fully prepared them. Similarly, when asked about readiness for professional work (GE3), 75.24% reported inadequate training through online education. A Croatian study by Vražić et al. (2022) aligns with these findings, showing that 70.8% of dental students felt unprepared for clinical work due to a lack of practical experience. When assessing overall satisfaction with online learning (GE4), 45.54% of students reported moderate satisfaction, while 34.65% were dissatisfied to some extent. The study also found that 46.53% perceived online education as moderately challenging, while 20.79% found it highly demanding (GE5). In terms of usefulness (GE6), 58.41% found online learning moderately beneficial, but 8.91% deemed it entirely unhelpful. Finally, when rating online education on a scale from 1 to 5 (GE7), the average score was 2.84, indicating that students generally found it suboptimal. The lowest satisfaction was related to professional training (mean score: 1.94), underscoring the limitations of online learning in skill acquisition (Table 2.).

Table 2. Descriptive statistics on given responses.

Indicator	Percentages					Mean score	
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	SD
GI1	47	24	15	11	4	2.02	1.19
GI2	6	11	16	38	30	3.74	1.17
GI3	13	8	30	41	9	3.56	1.17
GI4	13	8	30	41	9	3.25	1.14
GI5	7	20	28	32	14	3.26	1.13
Int1	7	6	10	20	58	4.15	1.23
Int2	14	13	21	25	28	3.40	1.38
Int3	11	26	33	26	5	2.88	1.07
Int4	16	35	26	15	9	2.66	1.17
Int5	5	13	30	32	21	3.50	1.11
As1	33	18	28	17	5	2.43	1.24
AS2	10	3	11	40	37	3.90	1.22
As3	2	5	18	33	43	4.08	0.99
As4	27	37	17	16	4	2.33	1.15
As5	6	9	17	29	40	3.87	1.20
HI1	4	9	20	31	37	3.87	1.12
HI2	6	5	14	37	39	3.97	1.12
HI3	8	5	7	28	53	4.11	1.22
HI4	8	3	41	26	23	3.52	1.11
HI5	15	12	27	19	28	3.32	1.38
GE1	9	18	54	14	6	2.90	0.95
GE2	26	34	32	7	2	2.25	0.98
GE3	37	39	20	4	1	1.94	0.90
GE4	8	27	46	17	3	2.80	0.91
GE5	12	15	47	21	6	2.94	1.03
GE6	9	15	59	15	3	2.88	0.87
GE7	9	20	55	12	5	2.84	0.92

Over time, educational technologies have significantly advanced, leading to the development of sophisticated online learning platforms and specialized resources tailored to various courses. Additionally, some online tools promote collaborative learning (Adhikary, Gupta, Singh, & Singh, 2010). However, student self-reflection remains crucial in online education. Research indicates that students recognize the importance of periodic assessments to maintain the effectiveness of the teaching-learning process, and professors can utilize innovative tools to facilitate this. Studies have also shown that the pandemic has led to increased stress and anxiety among students (Arora et al., 2021; Islam et al., 2020). To address this, educators should consider offering greater flexibility in online courses (Mahmood, 2021). Moreover, limited access to digital devices in some households, where multiple individuals need to share them, highlights a new aspect of the digital divide. Various factors influence the social issues associated with online education (Chakraborty et al., 2021). Therefore, it is essential to examine the social impact of online learning in greater depth (Toquero & Talidong, 2020).

4. Conclusions

The emergence of COVID-19 in 2020 led to a significant shift in education, making online learning the primary mode of instruction. Universities and educational institutions transitioned to digital platforms, presenting both students and professors with challenges and limitations. This shift sparked diverse perceptions and attitudes toward online education.

In Bosnia and Herzegovina, online learning was previously marginal but became mainstream during the pandemic, highlighting the need to assess students' perspectives on its various aspects. Student satisfaction served as a valuable tool for evaluating the quality of education during this period.

Key findings from the study include:

- Online learning had a significant impact on education.
- While students viewed online education as a viable alternative during the pandemic, they preferred traditional in-person teaching.
- Professors improved their online teaching skills in response to the challenge.
- A lack of direct communication (both student-professor and student-student) contributed to negative perceptions of online learning.
- Students perceived online assessments as unreliable indicators of acquired knowledge and noted an increase in academic dishonesty.

- Some students experienced health-related stress, such as anxiety over internet connectivity issues.
- Online education for biology students received an average rating.
- The study suggests further research and new teaching techniques are necessary to improve online education.

Collected data provide a foundation for enhancing online learning, emphasizing the need for ongoing investigation to refine methods and improve student experience.

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