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Islamic University of Technology (IUT)
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Investigating Engineering Students' Learning Experiences and Satisfaction
with Online Classes Amidst COVID-19 Pandemic

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Dedication

This research work is dedicated to my beloved parents **Dr. Abdu Abubakar Charanchi** and **Hajjia Hurairat Abdu Charanchi**. May Almighty Allah Ta'ala reward them with Jannatul Firdous, Ameen.

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Declaration of the author

I hereby declare that the work presented in this thesis is an original work of me, **Abdulaziz Abdullahi**, a student of the Department of Technical and Vocational Education (TVE), Islamic University of Technology (IUT), the Organization of Islamic Cooperation (OIC), Dhaka, Bangladesh. All the information in this document has been obtained and presented in accordance with the academic rules and ethical conduct of the host institution. I also declare that this work has not been submitted to any other institution for any other degree.

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Abstract

Online learning is increasingly becoming the part of the student learning experiences, especially during the ongoing global crisis of the COVID-19 pandemic that resulted in social restriction and lockdown across the affected countries. Many institutions around the world have no choice but to transform to a fully online mode of delivery to ensure learning continuity. This study investigates the learning experience and satisfaction with online classes of engineering university students during the COVID-19 pandemic.

In this study, several constructs relating to students' learning experiences were examined. A total of 217 respondents participated in the study. A cross sectional survey method has been employed and the obtained data were analyzed quantitatively using the research software SPSS. The study reveals that students confront negative experiences towards online classes due to the immediate transition from the traditional learning environment. They also showed less satisfaction with the online classes. The result further indicated that technical issue was found to be an important factor in determining student satisfaction with online learning. Similarly, constructs such as perception of online learning and approaches to online learning were found to have a significant effect on students' online learning satisfaction. The result also shows a direct correlation between satisfaction level and students' learning experiences.

Keywords: Online learning, engineering students, learning experiences, learning approaches, learning satisfaction, perceptions, COVID-19.

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Abbreviations

IUT = Islamic University of Technology

OIC = The organization of Islamic Cooperation

Covid-19 = Corona Virus 2019

H = Hypothesis

TVE = Technical and Vocational Education

MCE = Mechanical and Chemical Engineering

CSE = Computer Science and Engineering

BTM = Bachelor of technology management

CEE = Civil and Environmental Engineering

EEE = Electrical and Electronics Engineering

F-F = face to face

HE = Higher Education

E-learning = Electronic learning

-POL = Negative perception of online learning

+POL = Positive perception of online learning

AOLT= Approaches to online learning technology

AOL = Approaches to online learning

SOL = Satisfaction with online learning

Chapter 1 Introduction

1.1 Background of the problem

The World Health Organization (WHO) declared COVID-19 as a global public health emergency on 30th January 2020 as well as a pandemic on 11th March 2020 (Bestiantono et al, 2020). Since then, a lot has been changed in global education by this sudden disaster that disrupted the academic system of many institutions resulting in experiencing a different learning style by millions of students. Indeed, COVID-19 has had a serious impact on learners, teachers and educational organizations around the world(Mailizar et al., 2020). The COVID-19 outbreak has necessitated the need for capitalizing on online learning by many institutions resulting in an emergent transition from face-to-face to distance learning mode as a precautionary measure to minimize physical gathering at the campus(Al Mamun, Hossain, et al., 2022). This COVID-19 has caused a great impact on the conventional learning method of tertiary and academic institutions across the globe. The management of schools, colleges, and universities have no choice but to opted for online lectures/classes as an alternative way for continuity of education (Bestiantono et al., 2020).

Like many affected countries, Bangladesh has confirmed its case in early March 2020 (IEDCR). On 15 April 2020, the number of confirmed COVID-19 cases in Bangladesh reached more than 500 cases (WHO, 2020). Since then, the nationwide lockdown has been enforced to protect the lives of the citizens. This total lockdown causes class suspensions resulting in the need for online learning in the country. The decision led students and teachers to learn and work from home. This swift replacement of face-to-face learning in classroom settings with an online learning environment has brought a lot of challenges for both students and teachers due to a lack of readiness, digital literacy, capacity, and other factors that do not exist in previous traditional systems(Al Mamun, Hossain, et al., 2022).

However, despite the challenges with the implementation of e-Learning, During the COVID-19 outbreak, many schools and universities have rapidly implemented online learning for the delivery of distance instruction. Therefore, schools that have limited or no experience with

eLearning and schools that have not prepared online learning resources at hand experience difficulties, especially, when teachers do not understand how to use online learning platforms(Rahiem, 2020; Saidu & Al Mamun, 2022).

In this new learning environment, technologies have dramatically multiplied and diversified the complexity of the learning specifically in the way students are experiencing and interacting with the educators, teachers, and peers. Eventually, students need to have email, chat, exchange learning materials, or video conversations with teachers and peers to create a feeling of a community in an online environment. At the individual cognitive level, they need to use online course-management systems to organize resources to have better learning experiences. Students are now forced to use software programs, applications, and educational technologies to learn, and sometimes on their own time without instruction or supervision from teachers. With the rapid advancement of technology and the quick expansion of Internet connection around the world, education demand and supply are changing faster than ever. In some situations, demographic shifts leading in growing populations provide issues for Higher Education (HE) in terms of demand and supply of education, particularly during the global pandemic of COVID-19(Ananga, 2020). These changes create a new dimension of pedagogical shift and learning experiences from that of the traditional learning environment.

These pedagogical and technological shifts and the new learning experience that emerged from them need to be studied carefully to tailor the online learning environment for effective learning. Thus, constant investigation and exploration are required to offer a more meaningful learning experience to students. This study attempts to investigate the online learning experience of the engineering students, their perception and satisfaction with the online environment in Bangladesh in order to achieve a better understanding of the ways students make sense of their online learning and thus help in designing effective teaching and learning pedagogy that promote successful online education.

1.2 Problem statement

More than ever before, the growing use of online learning technologies has taken a new dimension in academia and the online environment is becoming a ubiquitous part of students' experience in higher education (Al Mamun et al., 2020; Al Mamun, Lawrie, et al., 2022), especially at a time when COVID-19 continues to hit most of the educational sectors. The dilemma of this sudden transition from traditional face-to-face settings to an online environment has resulted in a completely new learning experience for the students. Higher education institutions are exploring and adopting new digitalized instructional modes to manage the rapid changing demands of education as they deal with various challenges, especially due to the recent COVID-19 outbreak. eLearning is one of such modes that offer a chance of transforming student learning to be innovative and digitally framed using computer technologies, but there are challenges that come along with this technological implementation. These problems include but are not limited to the nature of online learning, theory and pedagogical challenges, difficulties in the lab and practical courses, connectivity problems, challenges with the digital devices, household production, distraction, overall perception of online learning, etc. This study, therefore, seeks to find the student's approaches to online learning and their experiences and satisfaction with the online environment amid COVID-19.

1.3 Research Objectives

The objective of the study is to investigate engineering students' learning experiences and satisfaction with online learning and online technologies during the COVID-19 situation. Under this broad objective, this study further attempts to investigate the following specific objectives-

- i. To investigate students' perception of online classes
- ii. To examine students' approaches to learning in online classes
- iii. To analyze students' approaches to online learning technologies
- iv. To find out the students' satisfaction about the online classes

1.4 Research questions

To address the research objectives described above, the following research questions are going to be investigated about the online classes during the COVID-19 pandemic-

RQ1. What perception do the students hold about the online classes?

RQ2. What learning approaches do the students demonstrate during online classes?

RQ3. What approaches do the students demonstrate about the online learning technologies?

RQ4. To what extent the perception, learning approaches and approaches to online technologies predict the student learning satisfaction?

RQ5. How does the demographic variables influence students' online learning satisfaction?

1.5 Significance of the study

The goal of every institution of learning is to achieve academic excellence and that can only be possible if the students of those institutions are motivated toward achieving a maximum academic outcome. Hence, a good outcome is tied to a positive learning experience and students' satisfaction with learning. Student learning experience is the key element to determining their satisfaction and ultimately assessing their performance of learning.

The impact of COVID-19 on conventional learning is continuing to dominate the academic institutions across the world. However, managements of schools, colleges and universities have long been adopted online lectures/classes as an alternative way to ensure learning continuity. In this regard, during the COVID-19 pandemic, online learning is continued to prove helpful in safeguarding students' learning and faculty's teaching delivery (Bestiantono et al., 2020).

Few studies have been carried out in some higher learning institutions to investigate the students' learning experience and satisfaction with online learning amidst COVID-19 pandemic. Some have found that students have a positive and negative perception about the implementation of full scale online learning in a low-tech environment (Tanjung & Utomo, 2021). Therefore, it could be noted that online learning can produce a positive experience and yield lasting satisfaction to the students especially in the context of COVID-19 where the opportunity to experience social interaction at schools is often limited, but with the advancement of digital learning students won't missed out

much. It can also have a negative perception to the students in a low-tech environment where access to internet connectivity and the electronic device is often limited. Some findings revealed that online learning was a terrific idea for keeping teaching and learning going while staying at home. However, there were reviews that shows due to the numerous challenges associated with online learning, it should be implemented with utmost support from all the possible areas (Andoh, R. & Henaku, 2020).

1.6 Conclusion

This chapter described the problem under study from the onset of COVID-19 pandemic. The objectives of this research are stated, and research questions were formulated and enumerated in conformity with the research objectives. As highlighted in this chapter, the experience and satisfaction of online learning of engineering students during Covid-19 were studied and the literature gap was established which the current study tries to fill. The chapter further discussed the significance of the use of online learning technologies amid COVID-19 and how it can be effectively utilized in an online environment in order to enable a continuous study atmosphere for the students in a distance mode. To develop a more meaningful online learning pedagogy it is imperative to study and understand how students perceive online learning and learning technologies, how they make the use of these tools, and the experience they acquired during the learning process. The subsequent chapter of this book which is the literature review (chapter two) will highlight different studies that have been carried out along with their findings related to the students' online learning experience in the context of COVID-19 pandemic.

Chapter 2 Literature Review

2.1 Introduction

This chapter highlights different scholarly literature relating to the students' learning experience with online learning as well as their satisfaction about online classes during COVID-19 with key findings and arguments as it relates to the current study.

2.2 Student learning experiences

The totality of the activities that occur during the learning process is what gives birth to learning experiences. According to Edglossary(2013), learning experience is referred to any interactions, program, course, or other activity in which learning takes place, be it in traditional academic settings (schools campus/classrooms) or in conventional settings (off-campus locations/outdoor environments), or whether it includes interactions of traditional education (students learning directly from teachers or professors) or nontraditional interactions (students learning through learning management software or application). Thus, experiences may differ according to the environments and mechanisms through which learning has been delivered to students. Although the environment and tools may vary either in traditional settings or nontraditional settings.

2.3 Students' online learning experiences

Shifting towards online learning is not a new phenomenon, it has been accompanying higher education institutions for some years now (Adedoyin & Soykan, 2020). This digital transformation of tertiary or higher education institutions is becoming a key issue to a point that several stakeholders of education have expressed their concerns about and the abilities to apply ICT in every sphere of education. Thus, universities must be up to the task of preparing potential teachers that are digitally literate in order to be able to respond the challenges raised in the virtual environment and provide solutions to that (Nicolaou et al., 2019). COVID19 has tested the readiness of many education institutions, forcing them to provide quick alternative and system that is sufficient for the teachers and learners. Although, a situation like COVID-19 outbreak accelerates a long-standing issue of digital inequality among the students in education (Al Mamun, Hossain, et al., 2022). However, despite the challenges, many institutions have adopted online education and will continue to practice it for good.

This study focused on understanding how online learning during COVID-19 pandemic has been conducted in engineering institution by analyzing university students' perception and experiences about it. Till date, very limited study has been conducted in Bangladesh in the midst of the COVID-19 pandemic. Though there were some studies conducted in Bangladesh, most of them do not focus on engineering students.

In the context of online learning, a number of studies have looked into the students' learning experiences with online learning technologies and e-learning environments during COVID-19. To mention some, Tanjung and Utomo (2021) and Paechter and Maier (2010) investigate students' perspectives on the implementation of full-online learning mode in an English classroom with a low-tech environment. They found that (1) most of the respondents have had a level of familiarity using a Google search engine, e-resources, social media and learning applications that enable them to access and comprehend the learning content; (2) the use of social media, online resources and learning applications resulted in a different impact on respondents' perception on learning effectiveness; (3) the respondents are more digitally-literate in using online-based platforms or other learning application and enable to autonomously learn the course materials as well as improve their knowledge and skills; (4) support system needs to be incorporated in the system to engage students in teaching and learning activities; (5) the findings also revealed that there is a requirement of feedback and consistency in determining course schedule and timeline for class work and exam submission.

Student learning experiences can be as a result of students' perception and approaches to the learning environment as well as learning satisfaction. Thus, the conceptualized model of this study discussed in the method section highlights the attributes that lead to the learning experiences of the students based on the three factors summarized from the theoretical framework; (a) learning perception which relates the degree to which students thought about online learning (Prosser & Trigwell, 2017); (b) learning approaches which refer to how students engaged in online learning (Nicolaou et al., 2019); and (c) learning satisfaction which indicates the attainment of learning acquired by the students (Ellis et al., 2007). These three attributes were extracted and adopted from the model of the literature developed by (Han & Ellis, 2020) and

named it as *3P Model*, which stands for presage, process and product of the learning environment.

The *3P model* described the correlation of the key aspects of students' learning experience and outcomes. Thus, the *first P* which is presage is associated with personal attributes of the students and situational characteristics of learning environment, the *second P* which is process related to students' perception of learning environment as well as students' approaches to learning, the *last P* which stands for product consist of attributes related to students' leaning outcomes. In this present study we adopted the attributes related to two last items (Process and product) to find out the interrelatedness to the learning experience in the context of online learning amidst COVID-19 pandemic. More details about it will be discussed in the chapter 3- methodology.

In a study conducted by Bestiantono et al. (2020) on the attitudes of Pakistani higher education students towards compulsory digital and distance learning during COVID-19, revealed that online learning cannot produce desired results in underdeveloped countries like Pakistan, where most of the students have no means or access to internet due to technical as well as monetary issues. There is lack of face-to-face interaction with the teacher, response time, and absence of traditional classroom activity which were among some critical issues highlighted by the respondents.

Andoh, R. and Henaku (2020) in their study interviewed ten college students from four colleges of education about their perception of online learning in Ghana. The findings showed that students experience the issues like internet connection problems, financial difficulty due to the high cost of internet bundles, lack of electronic devices, and disruption at home as a result of the need to assist in household production. The college students then suggest that online learning should be suspended due to the number of problems associated with online learning such as the inconveniences they struggle as described above.

Another study by Han and Ellis (2020) proposed an initial development and validation of perceptions of the Blended Learning Environment Questionnaire (PBLEQ). The study analyzes two cohorts of students enrolled in courses either from social sciences disciplines /humanities or from sciences/engineering disciplines. The evidence revealed that the PBLEQ has the potential

to help unravel students' perceptions of the blended learning environment in a diverse educational field. Thus, the invariance tests among the two cohorts group validated that the PBLEQ had invariant factor loading, factor structure, and intercepts.

Another study indicates that there are consistent and different patterns of associations with the learning experiences that reveal the role of online learning technologies in the learning experiences of the students. The findings are however shows that qualitative differences in how students use online learning technologies and differences in how they perceive online learning technologies are logically connected to the quality of learning outcomes(Ellis & Bliuc, 2019).

Bali andLiu (2018) examined the issues of student perception on online learning and traditional face-to-face learning in the context of social interaction, social presence, and satisfaction in Indonesia Open University. The comparison of the online learning group and the face-to-face learning group was conducted to explore student-learning perceptions regardless of the course delivery method and the online environment. The result of their study indicates that the perception of face-to-face learning was higher than the perception of online learning in terms of social presence, social interaction, and satisfaction. They however added that there is no statistically significant difference in learning preference found among the level of the students. Meanwhile, some respondents were very comfortable with online learning since it led them to the chance of being innovative by using computer technology.

According to Ellis et al. (2007)there is a significant association among students' concepts of discussions, approaches, and levels of achievement. However, the results suggest that students who do not understand how discussions can help them to interrogate, reflect on and revise their ideas tended not to improve their understanding of their levels of achievement. This type of insight is critical for teachers and courses designers wishing to create university experiences in which learning discussion is used to promote successful education.

2.4 Online learning satisfaction

Learning satisfaction has been defined as the level of joy one feels when learning, it is seen in terms of affect, as a superior emotional complex(Rahman et al., 2021).

Learning satisfaction represents learners' feelings and attitudes toward the learning process, or the perceived level of fulfillment attached to learning. This satisfaction is simply the attainment of the learning that students obtained.

Student satisfaction plays a vital role in achieving the vision and mission of any school or university (Rahman et al., 2021). Students' satisfaction has also been defined as the feeling or outlook of students towards their instructional or educational activities. Hence, the attitude of students towards their learning experience is reflected by the level of satisfaction about their learning (Alqurashi, 2016).

Student satisfaction with online learning is considered to be one of the very important components for identifying the attributes of online learning (Soffer & Nachmias, 2018). Several factors, such as knowledge, attitudes, motivation, process and facilities, learning environment, and learning outcomes, have been found to have an impact on learning satisfaction (Muhsin et al., 2020). Additionally, the performance of the teacher, course appraisal have an important influence on students' learning satisfaction (Bliuc et al., 2010).

2.5 Conclusion

This chapter reviewed the literature related to students' learning experience with online learning amidst COVID-19 pandemic, online learning satisfaction and approaches to learning. It begins with an explanation of the learning experience then students' learning experience with online learning and the findings related to students' experience of learning. It then explains online learning in the present day. Relevant studies on how students are experiencing learning in traditional face-face and online environments are also reviewed alongside the student learning satisfaction.

Chapter 3 Methodology

3.1 Introduction

This study investigates the students' perception and the approaches to learning that influence the learning experiences with online classes during COVID-19. Also, a research model has been developed which described the learning experience as the product of learning perception, learning approaches as well as learning satisfaction of the students in the context of an emergent online education in Bangladesh.

In order to address the problem, a quantitative research methodology was employed for the collection of required data from students of IUT. The data obtained was analyzed using software called *statistical package for social science* (SPSS 23). The results obtained from the analysis were presented in chapter 4.

3.2 Theoretical framework

The study adopted the **3P model**, discussed in chapter 2, which is a conceptualized model that outlines the presage, process, and product of student learning. The model has components of learning attributes, learning perception, learning approach, and learning outcome. Thus, the theory proposed that student learning experiences can be as the result of students' perception about learning and their approaches to learning environment as well as learning satisfaction (Han & Ellis, 2020). This model further implies that students learning experience is tied with the outcome of learning which stand as product, having been influence by the way students approach to the online learning and how their perception to the learning environment has been developed.

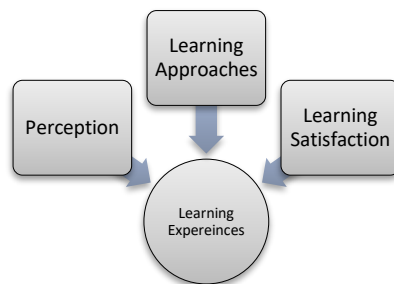


Figure 3-1Theoretical framework of the current study

The figure 3-1 shows that learning experience is the product of learning perception, learning approaches, and learning satisfaction of the students in the context of distance learning. Ellis and Bliuc (2019) found that there are regular and distinct patterns of correlations between various parts of the learning experience that demonstrate the function of online learning technology in the student learning experience. The findings also imply that qualitative differences in how students utilize and perceive online learning technology are logically related to the quality of outcomes. However, despite the correlation between the students' perception of online learning technologies and approaches to those technological means, online learning continues to be everyday matter of discussion when it comes to its perception in specific.

A study indicates that the perception of face-to-face learning was more positive than online learning in terms of social presence, social interaction, and satisfaction (Bali & Liu, 2018). This shows that online learning has less positive perception as the social presence is limited in this form of learning, especially, in the midst of COVID-19 when everyone is confined at home with lockdown and some psychological stress. Ananga (202) stated that online learning should be an optional for higher education delivery because of the fact that the contribution of online learning is a spotlight on learners' needs only as they are the focus of all educational processes.

3.3 Conceptual framework/ Research model of the current study

This study analyzes the factors that influence the student learning experiences, such as technological innovations that are associated to successful student learning or satisfaction (Ellis & Bliuc, 2019). COVID-19 demands more necessity and growth of online learning technologies (Ananga, 2020). For this study, the researcher used three components of the model to predict students' online learning experience during COVID-19: learning perception, learning approaches, and learning satisfaction.

3.3.1 Learning perceptions

Learning perception refers to a degree to which students perceived understanding about learning (Prosser & Trigwell, 2017). In the context of online learning, students' perception might be different than in face-to-face learning, depends on the motivational beliefs and achievement emotions. Online learning has a reputation for being less interactive than face-to-face learning. It is mostly caused by a lack of social presence, social engagement, and student pleasure (Bali

&Liu, 2018). The online learning perception form a motivational belief of whether the online learning and learning technology meets the academic needs and interest or not,dependingon the students' experience with the learning process or a prior factor towards learning. Thus, perception is the driven tool towards motivational belief. Regardless, whether the perception is positive or negative, online learning perception remains a phenomenon of discussion especially when considering the emergent online classes' transition during COVID-19. As many students perceived the learning more negatively due to many factors related to the rapid transition from face to face to online learning, both positive perception of online learning (POL+) or negative perception of online learning (POL-) may be formed.

3.3.2 *Learning approaches*

Learning approach refers to the degree on how students engaged in learning processes(Topala & Tomozii, 2014).Student approaches to learning is also defined as the way that students observe their learning in a uniquely different approach, depending upon the perceived objectives of the course they are studying. This is the second action after the learning perception. In an online environment, the learning approaches are simply regarded as a student's behavior and skills demonstrated during the online learning. It could be from the way they make sense with online learning technology to conduct learning. There are two types learning approaches mainly the students can demonstrate during the learning process- surface approaches to learning (Surf AOL) and deep approaches to learning (Deep AOL). Similarly, students can also demonstrate surface approaches to use the online learning technologies (Surf AOLT) and deep approaches to use the online learning technologies (Deep AOLT).

3.3.3 *Learning Satisfaction*

Learning satisfaction is the last construct examined in this research. The learning satisfaction is regarded as the attainment achieved by the learners in the learning process. This attainment serves as the outcomes of learning. In the context of online learning, several scholars have identified student satisfaction as an important outcome in online settings (Topala & Tomozii, 2014). In particular, course satisfaction has been found to relate to course attribution, as well as students' intentions to enroll in future online courses (Mansour & Davison M. Mupinga, 2004). What is more, student satisfaction is often considered as an essential outcome in job-related learning contexts (Artino, 2010).Course satisfaction is a crucial aspect of learning. Many

researchers have claimed that when comparing satisfaction with online and face-to-face courses, learners prefer face-to-face interactions(Bali & Liu, 2018).

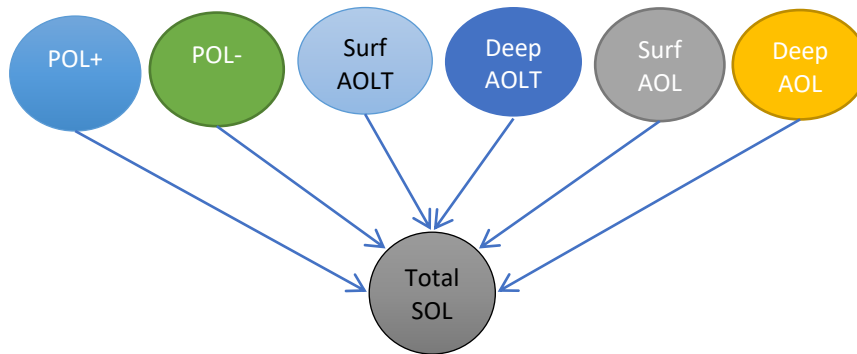


Figure 3-2 The conceptual model of students' learning experiences

This study conceptualized that all the constructs discussed above such as POL+, POL-, Surf AOL, Deep AOL, Surf AOLT, Deep AOLT can contribute to predicting the total satisfaction on online learning (Total SOL) (Fig. 3-2).

3.4 Methods

3.4.1 Research context

Digital media has enriched teaching and learning experiences in recent years and has become commonplace among university students and teachers. E-learning has become increasingly popular in recent years, i.e., the application of digital media for teaching and learning such as zoom, Google meet and other learning management systems apps. The outbreak of the COVID-19 pandemic has resulted in schools, colleges and universities to immediately switch to digital learning for the continuity of global education(Andoh, R. & Henaku, 2020).

This swift transition to online learning has received considerable attention by various stakeholders, although online learning is not a new thing. Scholars have questioned whether schools, colleges, and universities are ready to move to online learning(Esani, 2010). Many universities in industrialized countries, however, have made the move successfully (Hero, 2019). In digitally evolved countries, online learning can be beneficial (Raju, 2020). A study findings highlighted that “online learning cannot produce desired results in underdeveloped countries like Bangladesh, where a vast majority of students are unable to access the internet due to technical

as well as monetary issues”(Bestiantono et al., 2020). This study is therefore seeking to explore the online learning amid COVID-19 in the context on Bangladesh.

3.4.2 Population and sample

The target population for this study is the students at Islamic University of Technology, a reputed international engineering university in Bangladesh. The institution represents fifty-seven Islamic member countries from Asia, Africa, Europe, and Middle East to develop human resources in the member countries of the OIC in the fields of engineering and technology as well as technical education and management. IUT basically is higher educational and research institution that offers a wide range program both at undergraduate and postgraduate levels in the fields of Engineering and Technical Education. However, this study focused on undergraduate and postgraduate students enrolled in the engineering disciplines only.

Sampling is an important part in research, it is based on the samples that conclusions are drawn which are extended to the population. Therefore, a stratified sampling technique was first used to select six departments of IUT. The departments are namely Technical and Vocational Education (TVE), Mechanical and Production Engineering (MPE), Computer Science and Engineering (CSE), Civil and Environmental Engineering (CEE), Electrical and Electronics Engineering (EEE) and Business and Technology Management (BTM).

The method further divided the population into different homogenous segments such as, student type, gender, program, and year of study. Convenience sampling technique was then used to select the individual respondents. The distribution of samples is represented in Table3-4. A total of 220 students participated in the survey out of which 3 were removed for poor responses. That reduced the number to 217 which is the actual data of participants analyzed. Table 3-4shows the distribution of students with their respective departments across all levels of study.

Table 3-1 Distribution of participants across IUT Departments:

Departments	No. of participants	Percentage
Technical and Vocational Education	22	10.1%
Mechanical and production Engineering	24	11.1%
Computer science and Engineering	47	21.7%
Civil and Environmental Engineering	36	16.6%
Business Technology and management	6	2.8%
Electrical and Electronics Engineering	82	37.8%
Total	217	100%

3.4.3 Data Instrument

A survey questionnaire was developed to get the required data from the respondents, The items in the questionnaire were adopted from relevant works by Han and Ellis (2020) and Ellis and Bliuc (2019) with some modifications. The survey instrument was validated by 3 experts in the relevant field. The questionnaire is divided into (3) parts- A, B and C and contains a total of (40) items initially. Part A contains the demographic information as Gender, Academic level, Student type, Department and Year of Study making a total of 5 items. Part B sought students' perception of online learning environment (**POL**) with 13 items initially before 3 items were removed leaving a total of 9 items, while items in part C sought to measure the students' approaches to Online Learning Technologies (**SAOLT**) with 11 items, part D was also sought to analyze the approaches to Online Learning (**AOL**) with 9 items and the last part which is part E sought to measure the students' learning satisfaction about the online classes (**SOL**) with 6 items all on a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree". The final questionnaire items for the study were 40. See Appendix B for the complete questionnaire.

3.4.4 Reliability and validity of the questionnaire

Bhattacharjee (2012) states that "reliability is the degree to which the measure of a construct is consistent or dependable" (Bhattacharjee, 2012 p.3-6). The reliability of the construct were very important and equally ensured in this study. The reliability results are shown in the next chapter in the results section.

3.4.5 Data collection procedure

An online questionnaire was designed using Google forms for the data collection. The form was used to collect the required data through a shared link to the students of the selected IUT Departments. Permission was sought and granted by the respective class representatives who facilitated in sharing the link to their batch mates. Most of the class representatives were contacted through Facebook and WhatsApp. A message was sent to all of them with the URL of the survey questionnaire soliciting their assistance in sharing with their respective batch mates through their usual Facebook or WhatsApp group. Based on the nature of the online form, all responses were received in real time on completion by the respondents. A reminder was given two to three times to the respondents in order to complete the survey.

3.4.6 Data analysis

The data was analyzed using several statistical techniques involving descriptive statistic, regression analysis and MANOVA. The analysis was performed through software for statistical package for social science (IBM SPSS)

Descriptive analysis refers to statistically describing, aggregating, and presenting the constructs of interest or associations between these constructs(Bhattacharjee, 2012).To describe the profile of the respondents in this study, descriptive statistic was firstly used on the respondents' demographic data. The descriptive statistic is used to summarize and display data in succinct manner (Bulman & Osborn, 1989).

Regression Analysis is the process of estimating regression coefficients. The multiple regression is employed to analyze the predicting relationships between the dependent and independent variables. This regression analysis is a tool for the investigation of relationships between variables(Sykes,1993).

MANOVA (multivariate analysis of variance) is used to examine the difference between groups. More precisely MANOVA examines the group differences stemming from the demographic data across multiple dependent variables simultaneously(Bhattacharjee, 2012p115). As part of this study, this analysis aims to specify the effect or influence of certain demographic parameters such as gender, age, year of study, education level and so on. The result of this analysis and all others were reported in chapter four.

3.5 Ethical consideration

Ethical provisions guide the conduct of every research, as such the research followed the ethical guidelines by respecting the participants, protecting their autonomy, and ensuring well-informed voluntary participation. A fair distribution of risk and benefits was equally considered. Students at Islamic University of Technology are the participants in the study; their full consent was sought in getting the required information or data for the research. The identities and personal information of the participants was well protected. It should be noted however, that all the data was obtained through a virtual means (online Google form) due to the current global health pandemic of Covid-19.

3.6 Conclusion

The objective of this study was to investigate the online learning experience and satisfaction of engineering students of Bangladesh during the COVID-19 pandemic. Therefore, all the tools and instruments as well as relevant literature were carefully chosen in order to achieve the desired objective of the study. There is no doubt that online learning technologies have brought a lot of solutions especially at this very time of need for the continuity of education while observing stay at home policy. Most of the academic institutions have enjoyed the fruit of e-learning during this global pandemic. It is evident from the available literature despite the fact that online education stands a chance of transforming students to be innovative and digitally literate using computer technologies, but this emergent remote learning remains a topic of concern as it has a positive and negative effect to students' learning experience in higher institution.

Chapter 4 Data Analysis and Results

4.1 Introduction

The purpose of the study was to evaluate the perception and learning experience of engineering university students about online classes. The study used quantitative research method to analyze the data. A cross sectional survey research method has been utilized to collect the data. The details of the findings are described in the section below.

4.2 Description of the demographic information

The participants of this study were students from the six different departments of IUT. The distribution of the students in terms of the demographic variables is shown in table 4-1.

Table 4-1 Summary of the demographics of the participants

Demography	Category	Frequency (n=217)	Percentage
Gender	Male	168	77.4 (168)
	Female	49	22.6 (49)
Student category	International	86	39.6
	Domestic	131	60.4
Educational level	Undergraduate	193	88.9
	Postgraduate	24	11.1
Year	First year	69	31.8
	Second year	59	27.2
	Third year	41	18.9
	Fourth year	48	22.1
Department	MPE	24	11.1
	EEE	82	37.8
	TVE	22	10.1
	BTM	6	2.8
	CSE	47	21.7
	CEE	36	16.6

As illustrated in the table, the male participants (77.4%) were the dominant participants while considering gender as variant. However, undergraduate students (88.9%) and domestic students (60.4%) were the major segments in 'education level' and 'student category' respectively. Furthermore, the data on other variants are maintaining a balanced ratio.

4.3 Percentage and frequency of the individual

Perception related to online learning (POL): From the table 4-2 below it is found that, overall, the negative perception of online learning is higher than the positive perception. Specifically, in POL7 maximum number of students (55.8%) strongly agreed with the statement that *technical issues disrupt the flow and pace of online classes* while 21.2% also agreed with the same statement. Only 2.8% respondents are strongly disagreed with it and 12.9% found neutral with this issue. **Table 4-2** shows that 33.2% respondents strongly agreed that *online classes save time* (POL6) during the learning process and at the same time 29.5% respondents are agreed with it. Again, only 9.7% disagreed with this statement. Students also reported that the workload for the online activities was too heavy (POL9) for their learning.

Table 4-2 Perception of online learning (POL)

Construct	Items	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
POL1	Online classes are more effective than face-to-face classroom	9.2(20)	14.7(32)	21.7(47)	28.6(62)	25.8(56)
POL2	Online classes are more convenient than traditional classes	16.1(35)	24.4(53)	22.6(49)	22.1(48)	14.7(32)
POL3	Quality of discussion is low in online classes compared to face-to-face	22.1(48)	30.4(66)	20.7(45)	17.1(37)	9.7(21)
POL4	Learning and knowledge transfer happens more in online classes	9.2(20)	12.9(28)	26.7(58)	31.3(68)	19.8(43)
POL5	Online classes are less structured than classroom mode	11.5(25)	19.8(43)	24.4(53)	26.3(26.3)	18.0(39)
POL6	Online classes save time	33.2(72)	29.5(64)	15.7(34)	9.7(21)	12.0(26)
POL7	Technical issues disrupt the flow and pace of online classes	55.8(121)	21.2(46)	12.9(28)	7.4(16)	2.8(6)
POL8	It is difficult to clarify doubts in online classes compared to classroom mode	24.0(52)	28.1(61)	24.9(54)	16.1(35)	6.9(15)
POL9	The workload for the online activities was too heavy	32.2(72)	28.1(61)	20.7(45)	11.5(25)	6.5(14)

Approaches related to online learning technology (AOLT): From the **table 4-3** below we found that average students found online learning technologies as a helpful tool to achieving their courses objectives. For example, in AOLT1 37.3% of students believes that the statement “*I find I use the online learning technologies in this course to further my research into a topic*” is almost always true, while 0.5% were not true at all with the same statement. Similarly, in

AOLT8 18.9% believes that the statement “I restrict my use of online learning technologies in this course to do as little as possible” is not at all true.

Table 4-3 *Approaches to Online Learning Technologies (AOLT)*

Construct	Items	Almost always true	Usually true	Often true	Rarely true	Not all true
Percentage (frequency)						
AOLT1	In this course, I find that I use the online learning technologies to expand my research on a topic.	37.3(81)	37.8(82)	18.0(39)	6.5(14)	0.5(1)
AOLT2	I spend time using the online learning technologies in this course to expand my understanding on crucial topics	31.3(68)	38.7(84)	18.0(39)	8.3(18)	3.7(8)
AOLT3	I strive to make advantage of online learning technologies in this course to gain a better knowledge of fundamental concepts.	35.9(78)	35.0(76)	18.9(41)	7.8(17)	2.3(5)
AOLT4	I found that connecting with online learning technologies helps me understand essential concepts better in this course.	27.6(60)	25.8(56)	29.5(64)	12.0(26)	5.1(11)
AOLT5	I try to communicate with other students via online learning technology in order to test my ideas in this course.	25.3(55)	28.1(61)	28.6(62)	15.2(33)	2.8(6)
AOLT6	I find using the online learning technologies in this course help me to develop my critical thinking abilities	20.7(45)	29.0(63)	29.0(63)	14.3(31)	6.9(15)
AOLT7	I use online learning technologies in this course mainly to download files	25.3(55)	18.9(41)	24.9(54)	19.4(42)	11.5(25)
AOLT8	I restrict my use of online learning technologies to do as little as possible in this course	6.9(15)	13.8(30)	33.6(73)	26.7(58)	18.9(41)
AOLT9	I do not use the online learning technologies in this course to enable me achieve my aim	25.3(55)	37.3(81)	28.1(61)	6.5(14)	2.8(6)
AOLT10	I only use the online learning technologies in this course to fulfill course requirements	16.1(35)	22.6(49)	27.6(60)	22.6(49)	11.1(24)
AOLT11	I do not find using online technologies helps me to understand things more deeply in this course	14.3(31)	17.1(37)	21.7(47)	22.6(49)	24.4(53)

Approaches related to online learning (AOL): From the **table4-4** we found that average students were only researching about the class topics simply because they have to do it to pass the course. Thus, in AOL6, 37.3% of students believe that the statement “I research in this course mainly because I have to” is almost always true, while 21.1% were usually true with the same statement. Although 24.9% were considered it is often true.

Table 4-4 Approaches to Online Learning (AOL)

Construct	Items	Almost always true	Usually true	Often true	Rarely true	Not all true
		Percentage (frequency)				
AOL1	I try to think about revealing questions when I am researching	9.7(21)	27.6(60)	39.2(85)	14.7(32)	8.8(19)
AOL2	I often take the initiative when pursuing a line of questioning in research	11.5(25)	19.8(43)	26.3(57)	26.7(58)	15.7(34)
AOL3	Formulating just the right question in my mind helps me to research effectively	8.3(18)	22.6(49)	34.6(75)	22.6(49)	12.0(26)
AOL4	I find I research most effectively when I am proactive about it	11.1(24)	25.3(55)	35.5(77)	19.4(42)	8.8(19)
AOL5	I spend a long time thinking about just the right question to ask when researching something	19.4(42)	33.2(72)	25.3(55)	16.6(36)	5.5(12)
AOL6	I research in this course mainly because I have to	37.3(81)	21.2(46)	24.9(54)	10.6(23)	6.0(13)
AOL7	Researching something is just looking for what others have found out before	24.4(53)	23.5(51)	26.7(58)	14.3(31)	11.1(24)
AOL8	When I research something, I like others to tell me where to find the answer	16.1(35)	16.6(36)	28.6(62)	22.1(48)	16.6(36)
AOL9	When I research something, it is just like following a formula	8.8(19)	16.1(35)	27.2(59)	24.4(53)	23.5(51)

Satisfaction with online learning (SOL): The table 4-5 revealed that 19.8% were strongly not satisfied with the overall online classes during COVID-19, while 17.1% were fully satisfied. Although 26.3% are undecided with the overall satisfaction. However, 28.1% agreed to satisfied with the learning contents and course structure designed for online classes during Covid-19.

Table 4-5 Satisfaction of online learning (SOL)

Construct	Items	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
		Percentage(frequency)				
SOL1	I am satisfied with the online instructional styles of the instructors during Covid-19	9.2(20)	23.5(51)	25.3(55)	23.5(51)	18.4(40)
SOL2	I am satisfied with the learning contents and course structure designed for online classes during Covid-19	10.6(23)	28.1(61)	27.2(59)	18.0(39)	16.1(35)
SOL3	I am satisfied with the instructors and teaching assistants (if any)	20.3(44)	24.9(54)	25.3(55)	16.6(36)	12.9(28)
SOL4	I am satisfied with the use of	11.5(25)	22.1(48)	31.3(68)	14.7(32)	20.3(44)

	online discussion forum during Covid-19						
SOL5	I am satisfied with the exams conducted online during Covid-19	16.6(36)	14.7(2)	22.6(49)		22.1(48)	24.0(52)
SOL6	Overall, I am satisfied with online classes during Covid-19	17.1(37)	19.4(42)	26.3(57)		17.5(38)	19.8(43)

4.4 Descriptive statistic of the individual items

The constructs examined in this study were illustrated alongside their respective codes, mean, mode and standard deviation. Also, skewness and kurtosis were analyzed. There are four major construct of online learning experience with their respective observed variables. However, three of the constructs were sub-divided into six group making total of seven constructs; perception of online learning was represented with code POL. This POL divided into two, positive perception and negative perception, then the serial number of the observed variables that measures it example, POL1, POL2...and so on. The same applies to the observed variables under the remaining constructs as follows AOLT (Deep & surface), AOL (Deep & Surface), and SOL (Learning satisfaction). N indicated the total number of participants in the study which is 217.

Table 4-6 Descriptive statistic of the individual items

Construct	Items	Mean	Mode	Std. dev	Skewness	Kurtosis
Perceived online learning (POL)	POL1	2.53	2	1.273	0.449	-0.853
	POL2	3.05	4	1.306	-0.057	-1.123
	POL3	3.38	4	1.268	-0.380	-0.922
	POL4	2.60	2	1.206	0.434	-0.651
	POL5	2.81	2	1.269	0.177	-1.013
	POL6	3.62	5	1.349	-0.713	-0.684
	POL7	4.20	5	1.094	-1.258	0.644
	POL8	3.46	4	1.213	-0.363	-.825
	POL9	3.70	5	1.224	-0.649	-0.559
Approach to online learning technology (AOLT)	AOLT1	4.05	4	924	-0.741	-0.121
	AOLT2	3.86	4	1.068	-0.861	0.188
	AOLT3	3.94	5	1.035	-0.826	0.064
	AOLT4	3.59	3	1.160	-0.049	-0.654
	AOLT5	3.58	3	1.107	-0.288	-0.812
	AOLT6	3.42	3 [^]	1.169	-0.351	-0.664
	AOLT7	3.27	5	1.338	-0.158	-1.146
	AOLT8	2.63	3	1.144	0.273	-0.598
	AOLT9	3.76	4	0.994	-0.587	0-042
	AOLT10	3.10	5	1.239	-0.032	-0.970
	AOLT11	2.74	1	1.374	0.237	-1.168
Approach to online learning (AOL)	AOL1	3.15	3	1.070	-0.252	-0.360
	AOL2	2.85	2	1.240	0.160	-0.949

Learning Satisfaction (SOL)	AOL3	2.93	3	1.124	-0.012	-0.679
	AOL4	3.11	3	1.111	-0.109	-0.602
	AOL5	3.44	4	1.142	-0.366	-0.691
	AOL6	3.73	5	1.233	-0.599	-0.661
	AOL7	3.36	3	1.295	-0.320	-0.935
	AOL8	2.94	3	1.304	0.108	-1.025
	AOL9	2.62	3	1.249	0.287	-0.899
	SOL1	2.82	3	1.245	0.064	-1.033
	SOL2	2.99	4	1.240	-0.159	-0.976
	SOL3	3.23	3	1.303	-0.233	-1.015
	SOL4	2.90	3	1.280	-0.063	-1.000
	SOL5	2.78	1	1.397	0.237	-1.184
	SOL6	2.96	3	1.360	0.000	-1.156

The findings in the table 4-6 show that the kurtosis and skewness values of all the items are within the threshold of normality and hence are eligible for further analysis.

4.4.1 Reliability and descriptive statistic of the theoretical constructs

The reliability of the constructs was evaluated using the Cronbach's alpha (α) (see table 4-7). While conducting the reliability test we found that POL5 AND AOLT9 were problematic because the individual Cronbach alpha was below 0.7 (Kopalle & Lehmann, 1997). So, to improve the reliability value for the particular construct we remove the POL5 as well as AOLT9. However, there are other three constructs (negative POL, surface AOLT and surface AOL) whose overall reliability values remain <0.7 ; as the items elimination does not make significant change no items were eliminated from this construct.

Table 4-7 Reliability and descriptive statistic of the theoretical constructs

Constructs	N	Mean	5% Trimmed Mean	Min.	Max.	Std. Dev.	Skewness	Kurtosis	Reliability (α)
Positive POL		11.806	11.790	4	20	4.083	0.103	-0.632	0.806
Negative POL		17.548	17.670	8	24	3.056	-0.537	0.178	0.613
Deep AOLT		22.447	22.6290	6	30	4.846	-0.368	-0.148	0.842
Surface AOLT		15.506	15.457	5	25	3.713	0.257	0.042	0.667
Deep AOL		15.470	15.460	6	25	4.127	-0.030	-0.232	0.774
Surface AOL		12.649	12.676	4	20	3.576	-0.107	-0.624	0.660
Total SOL		17.677	17.676	6	30	6.391	-0.041	-0.613	0.900

4.5 Assessing the normality of the data and outliers

Table 4-8 Tests of normality

Constructs	Kolmogorov-Smirnov			Shapiro-wilk		
	statistic	df	Sig.	Statistic	df	Sig.
PositivePOL	0.071	217	0.010	0.977	217	0.002
NegativePOL	0.103	217	0.000	0.971	217	0.000
DeepAOLT	0.082	217	0.001	0.971	217	0.000
SurfAOLT	0.093	217	0.000	0.984	217	0.016
DeepAOL	0.072	217	0.009	0.987	217	0.043
SurfAOL	0.084	217	0.001	0.982	217	0.006
TotalSOL	0.061	217	0.045	0.973	217	0.000

a. Lilliefors significance correction

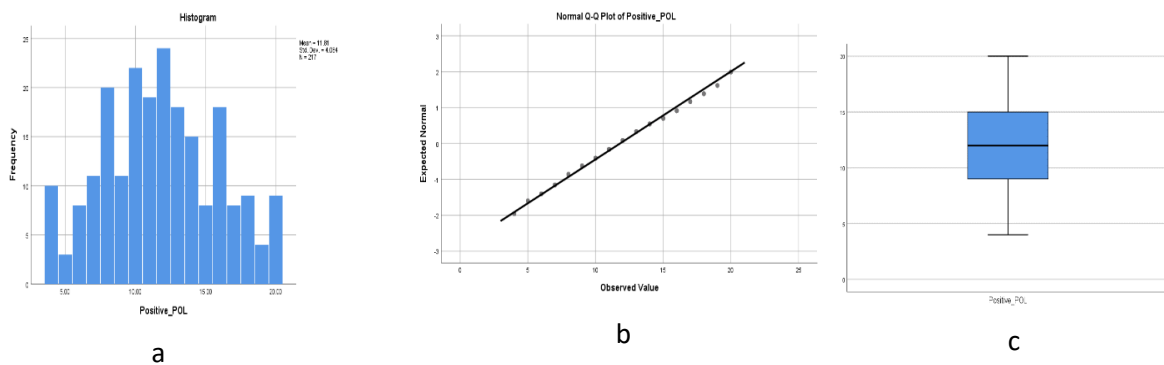


Fig. 4-1 Positive POL (a) histogram, (b) Normal Q-Q Plot, (c) boxplot

Figure 4-1 shows (a) histogram (b) Normal Q-Q Plot and (c) boxplot of students' positive perception of online learning. By looking at a Kolmogorov-Smirnov and Shapiro-Wilk values it was found that the data for positive POL did not violate the normality, as the $p < 0.05$, also this is supported by inspection of the normal probability plot (the histogram and Q-Q plot, Fig. 4-1). The boxplot also confirmed that no outliers are existed in the data.

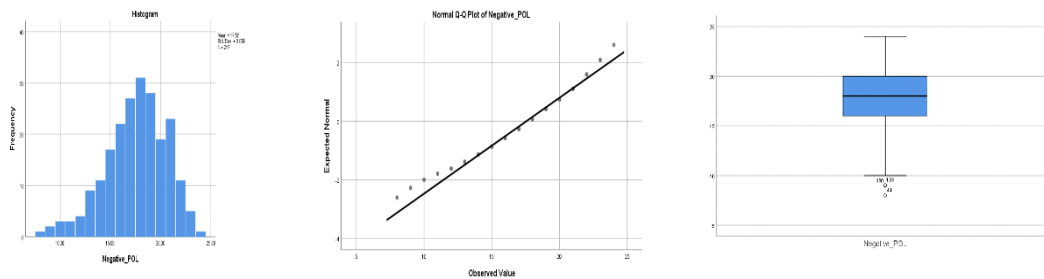


Fig 4-2: Negative POL (a) histogram, (b) Normal Q-Q Plot, (c) boxplot

Fig 4-2 shows (a) histogram (b) Normal Q-Q Plot and (c) boxplot of students' negative perception of online learning. The actual shape of the histogram appears to be reasonably normally distributed. This is also supported by the inspection of the normal probability plots (labeled normal Q-Q plot). In this plot, the observed value for each score is plotted against the expected value of the normal distribution. A reasonably straight line suggests a normal distribution in the Q-Q plot. However, in the case of boxplot, there are five outliers, but since the trimmed mean and mean value are closely similar (17.670) and (17.548) respectively, noelimination of the data is required.

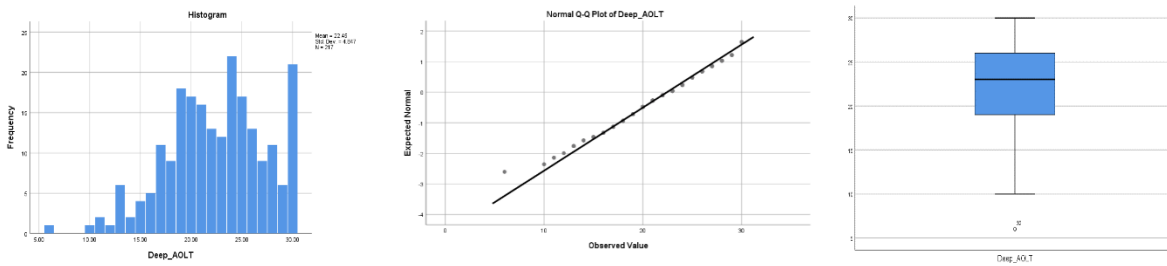


Fig 4-3: *Deep AOLT* (a) histogram,(b) Normal Q-Q Plot,(c) boxplot

The above figure 4-3 shows (a) Histogram (b) Normal Q-Q plot and (c) Boxplot of the deep approach to online learning technology. The values from the Kolmogoruv-Smirnov and Shapiro-Wilk shows that the scores for deep AOLT are in normal distribution, as the $p < 0.05$. This is also supported by inspection of the normal probability plot(the histogram and Q-Q plot) in which all appeared to be normally distributed. But in case of boxplot,there are two outliers. However, since the trimmed mean and mean value are closely similar (22.6290) and (22.447) respectively, there is no need to eliminate the outliers from the data set.

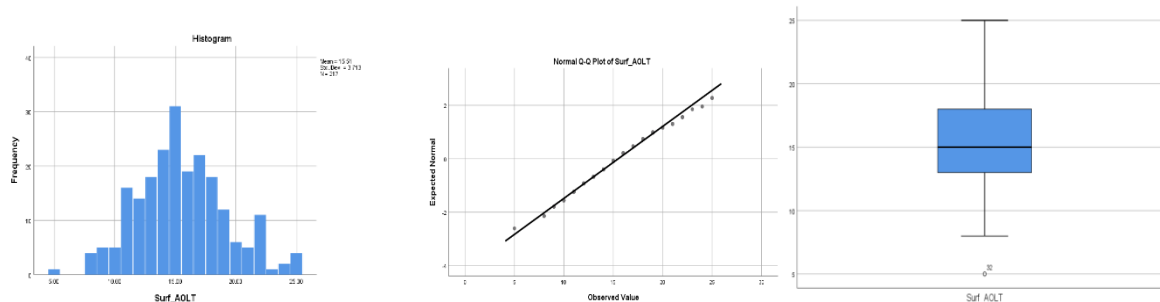


Fig4-4: *Surface AOLT* (a) histogram,(b) Normal Q-Q Plot,(c) boxplot

Fig 4-4 shows (a) histogram (b) Normal Q-Q Plot and (c) boxplot of students' surface approach to online learning technology. By looking at a Kolmogorov-Smirnov and Shapiro-Wilk values we can see that the data for surface AOLT are in normal distribution, as the $p < 0.05$. The actual shape of the histogram appears to be reasonably normally distributed. This is also supported by the inspection of the normal probability plots (labeled normal Q-Q plot). A reasonably straight line suggests a normal distribution in the Q-Q plot. But, in the case of boxplot, there are only two outliers. However, the mean value (15.506) and trimmed value (15.457) appears to be very closer, hence there is no need to remove the outliers from the data.

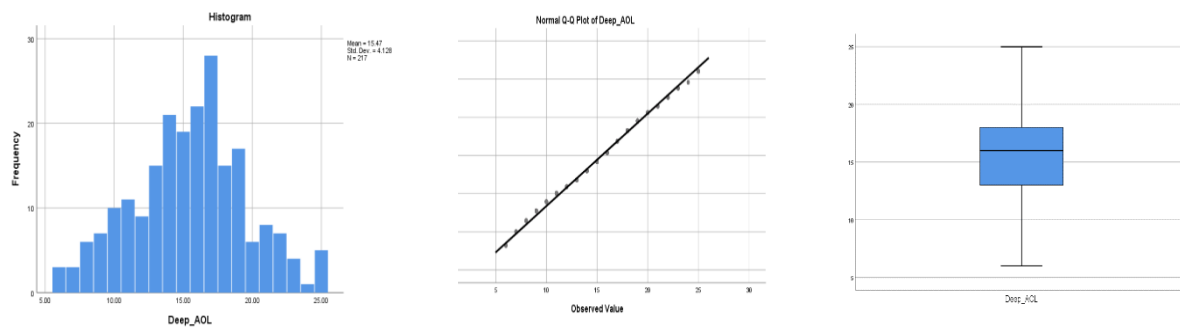


Fig 4-5: *Deep AOL* (a) histogram, (b) Normal Q-Q Plot, (c) boxplot

Figure 4-5 shows (a) histogram (b) Normal Q-Q Plot and (c) boxplot of students' deep approach to online learning. By looking at a Kolmogorov-Smirnov and Shapiro-Wilk values we can see that our data for the deep AOL are in normal distribution, as the $p < 0.05$, also this is supported by inspection of the normal probability plot (the histogram appears to be normally distributed and Q-Q plot is in form of straight line with the observed values). The boxplot also confirmed that it is significant as there are no outliers in the data set.

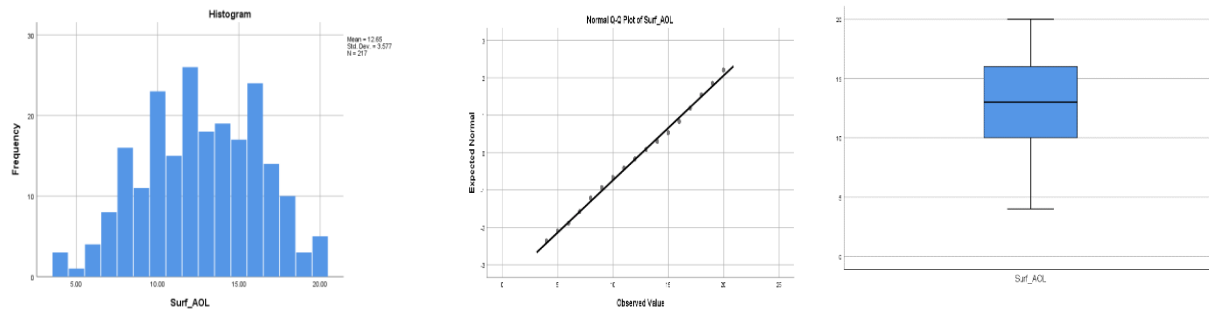


Fig 4-6: *Surface AOL* (a) histogram, (b) Normal Q-Q Plot, (c) boxplot

Fig 4-6 shows (a) histogram (b) Normal Q-Q Plot and (c) boxplot of students' surface approach to online learning. The actual shape of the histogram appears to be reasonably

normally distributed. It is also supported by the inspection of the Q-Q plot in which the observed values were plotted against the expected values and a reasonably straight line suggests a normal distribution in the Q-Q plot. The boxplot also confirmed that it is significant as there are no outliers in the data set.

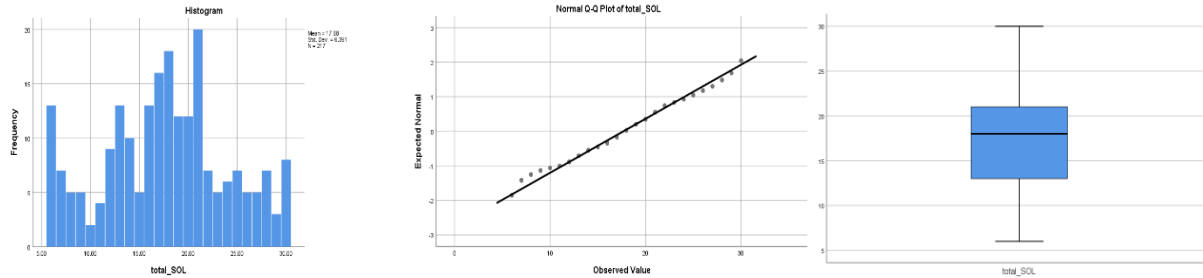


Fig 4-7: Total SOL (a) histogram, (b) Normal Q-Q Plot, (c) boxplot

Fig 4-7 shows (a) histogram (b) Normal Q-Q Plot and (c) boxplot of students' learning satisfaction. By looking at a Kolmogorov-Smirnov and Shapiro-Wilk values, it is confirmed that the data for total SOL are normally distributed, as the $p < 0.05$. Also, this is supported by inspection of the normal probability plot (the histogram appears to be normally distributed and Q-Q plot is in form of straight line with the observed values). The boxplot also confirmed it is significant as there are no outliers exist in the dataset.

4.6 Multiple Regression Analysis

Table 4-9 Correlations

		Correlations						
		Total SOL	Positive POL	Negative POL	Deep AOLT	Surf AOLT	Deep AOL	Surf AOL
Pearson Correlation	Total SOL	1.000						
	Positive POL	.671	1.000					
	Negative POL	-.277	-.258	1.000				
	Deep AOLT	.386	.430	-.083	1.000			
	Surf AOLT	-.005	-.017	.090	.004	1.000		
	Deep AOL	.587	.504	-.203	.440	.084	1.000	
	Surf AOL	-.178	-.108	.216	-.094	.321	-.200	1.000

Table 4-9 shows correlation of six independent variables with one dependent variable.

Table 4-10 Model Summary

Model Summary					
Model	R	R Square	Adjusted R Square	Square	Std. Error of the Estimate
1	0.737 ^a	0.543	0.530		4.38278

a. Predictors: (Constant), SurfAOL, DeepAOLT, NegativePOL, SurfAOLT, PositivePOL, DeepAOL

b. Dependent Variable: totalSOL

From the above table of model summary, it can be seen that the R-Square is 0.0543, this shows that the predictor or independents variables (Surf AOL, Deep AOLT, Negative POL, Surf AOLT, Positive POL, Deep AOL) have 54% predictive ability to the dependent variable (totalSOL).

Table 4-11 ANOVA results

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4789.580	6	798.263	41.557	.000 ^b
	Residual	4033.839	210	19.209		
	Total	8823.419	216			

a. Dependent Variable: total_SOL

b. Predictors: (Constant), Surf_AOL, Deep_AOLT, Negative_POL, Surf_AOLT, Positive_POL, Deep_AOL

ANOVA results in table 4-11 reveals that the there is significant correlation between independent variable and dependents variable $F(798.263, 6) = 41.557, p < .05$.

Table 4-12 Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
Positive_POL	.744	.090	.476	8.304	.000	.568	.921	.664	1.506
Negative_POL	-.167	.103	-.080	-1.613	.108	-.371	.037	.890	1.123
Deep_AOLT	.047	.071	.035	.656	.512	-.094	.187	.745	1.343
Surf_AOLT	-.003	.086	-.002	-.033	.974	-.173	.167	.868	1.152
Deep_AOL	.475	.090	.307	5.274	.000	.297	.653	.643	1.554
Surf_AOL	-.080	.092	-.045	-0.870	.385	-.261	.101	.823	1.215

The above table shows a summary of the unstandardized and standardized coefficients for the direct effects, according to the level of significance presented in the table, there is no p-value greater than critical value alpha (0.5) in all the independent variables except in two variablesnamely, positive POL and Deep AOL. The shows that the two independent variables are

statistically significant on dependent variable (total SOL). The confidence level was also observed between lower and upper range of the interval

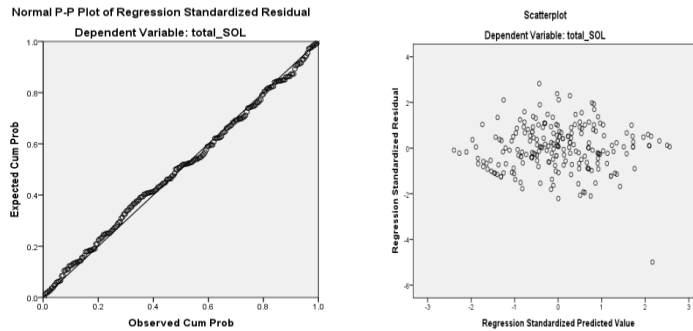


Fig 4-8 (a) normal P-P Plot (b) scatplot

The regression standardized residual found to be normally distributed whereby the observed and expected values were found along the line, without any significant departures from it. According to the normal probability plot of standardized residuals and the scatterplot of standardized residuals against standardized predicted values, the assumptions of normality, linearity, and homoscedasticity of residuals were met. Furthermore, the variance of residuals is considered to be equal or same for all predicted value of dependent variable which provided support of homoscedasticity. Therefore, the assumptions of linearity and homoscedasticity in the multivariate analyses have been fulfilled.

4.7 MANOVA

The researcher conducted multivariate analysis of variance (MANOVA) to examine the effect of gender, category of students, education level, and students learning experience with online learning during COVID-19 (i.e., perception, approach and satisfaction). All the assumptions for MANOVA have been tested to verify the sample distribution, linearity, normality, multicollinearity, univariate and multivariate outliers, and homogeneity of variance-covariance. No significant violation of any assumption has been found in the data. Table 4-12 shows the MANOVA result on the impact demographic variables.

Table 4-13 *Multivariate analysis of variance (MANOVA)*

Demographic variables	Wilk's lambda	F	Hypothesis df	Error df	P	Partial eta squared
Gender	0.959	1.278	7.0	209.0	0.263	0.041
StudentCategory	0.784	8.238	7.0	209.0	0.000	0.216
Educationallevel	0.879	4.093	7.0	209.0	0.000	0.121
Year	0.899	1.065	21.0	594.9	0.382	0.035
Department	0.753	1.721	35.0	864.7	0.006	0.055

Significant at $p > 0.5$

The result of the MANOVA analysis suggest a statistically significant effect for three demographic variables on students learning experience with online learning except in two demographic variables (year and gender). Separate analysis of variance was also run (ANOVA) to examine the statistical significance of the demographic variable for each of the result of the dependent variable (i.e., Perception, Approaches and satisfaction). For details see the discussions in the following sections.

4.8 ANOVA

The result indicates statistically significant impact of student category on negative POL, surface AOLT, deep AOLT, and total SOL.

Table 4-14 *ANOVA test for students' category*

Demographic variables	Online learning experience	category	M	SD	df	Error	F	P	Partial eta squared
Student Category	Positive POL	International student	11.93	3.80	1	215	0.130	0.718	0.001
		Domestic student	11.72	4.27					
	Negative POL	International student	16.82	2.59	1	215	8.234	0.005	0.037
		Domestic student	18.02	3.24					
	Deep AOLT	International student	22.08	4.53	1	215	0.810	0.369	0.004
		Domestic student	22.68	5.01					
	Surf AOLT	International student	16.66	3.30	1	215	14.68	0.000	0.064
		Domestic student	14.74	3.77					
	Deep AOL	International student	16.38	3.57	1	215	7.180	0.008	0.032
		Domestic student	14.87	4.36					
	Surf AOL	International	12.12	3.24	1	215	3.062	0.082	0.014

	student								
	Domestic	12.99	3.75						
Total SOL	International	19.48	5.47	1	215	12.02	0.001	0.053	
	Domestic	16.48	6.68						

Students' category showed statistically significant impact on the following students' experiences-

- $F(1,215) = 8.234$, $p = 0.005$, partial eta squared = 0.037, with the domestic student (M=18.02) scoring higher than the international student (M=16.82) in negative POL
- $F(1,215) = 14.68$, $p = 0.000$, partial eta squared = 0.064, with the international students (M=16.66) scoring higher than the domestic students (M=14.74) in surface AOLT
- $F(1,215) = 7.180$, $p = 0.008$, partial eta squared = 0.032, with the international students (M=16.38) scoring higher than the domestic students (M=14.87) in deep AOL
- $F(1,215) = 12.02$, $p = 0.001$, partial eta squared = 0.053, with the international students (M=19.48) scoring higher than the domestic students (M=16.48) in SOL.

Table 4-15 ANOVA test for education level

Demographic variables	Online learning experience	category	M	SD	df	Error	F	P	Partial eta squared
Education Level	Positive POL	Undergraduate	11.60	4.01	1	215	4.487	0.035	0.020
		Postgraduate	13.45	4.36					
	Negative POL	Undergraduate	17.78	2.98	1	215	10.687	0.001	0.047
		Postgraduate	15.66	3.03					
	Deep AOLT	Undergraduate	22.45	4.77	1	215	0.001	0.974	0.000
		Postgraduate	22.41	5.50					
	Surf AOLT	Undergraduate	15.63	3.75	1	215	2.163	0.143	0.010
		Postgraduate	14.45	3.32					
	Deep AOL	Undergraduate	15.19	4.05	1	215	8.199	0.005	0.037
		Postgraduate	17.70	4.06					
	Surf AOL	Undergraduate	12.74	3.59	1	215	1.268	0.261	0.006
		Postgraduate	11.87	3.37					
	Total SOL	Undergraduate	17.08	6.22	1	215	15.858	0.000	0.069
		Postgraduate	22.41	5.80					

Education level showed statistically significant impact on students learning experience with online mode-

- $F(1,215) = 4.487$, $p = 0.035$, partial eta squared = 0.020, with the postgraduate students ($M=13.45$) scoring higher than the undergraduate students ($M=11.60$) in positive POL
- $F(1,215) = 10.68$, $p = 0.001$, partial eta squared = 0.047, with the undergraduate students ($M=17.78$) scoring higher than the postgraduate students ($M=15.66$) in negative POL
- $F(1,215) = 8.199$, $p = 0.005$, partial eta squared = 0.037, with the postgraduate students ($M=17.70$) scoring higher than the undergraduate students ($M=15.19$) in deep AOL
- $F(1,215) = 15.85$, $p = 0.000$, partial eta squared = 0.069, with the postgraduate students ($M=22.41$) scoring higher than the undergraduate students ($M=17.08$) in SOL.

Table 4-16 ANOVA test for departments

Demographic variables	Online learning experience	category	M	SD	df	Error	F	P	Partial eta squared
Department	PositivePOL	MPE	10.95	4.12	5	211	1.753	0.124	0.040
		EEE	12.48	4.41					
		TVE	12.77	3.57					
		BTM	13.33	2.33					
		CSE	11.12	4.09					
	NegativePOL	MPE	19.16	2.80	5	211	3.013	0.012	0.067
		EEE	17.35	3.14					
		TVE	15.95	2.80					
		BTM	16.66	1.03					
		CSE	17.95	2.52					
	Deep AOL	MPE	22.16	4.82	5	211	0.106	0.991	0.003
		EEE	22.32	5.47					
		TVE	22.90	5.06					
		BTM	23.33	2.80					
		CSE	22.51	4.23					
	Surf AOL	MPE	16.00	3.53	5	211	1.231	0.296	0.028
		EEE	15.95	4.05					
		TVE	15.63	3.18					
		BTM	12.00	3.34					
		CSE	15.46	3.59					
	Deep AOL	MPE	14.04	4.36	5	211	1.062	0.382	0.025
		EEE	15.54	4.77					
		TVE	16.63	2.76					
		BTM	16.33	4.03					
		CSE	15.19	3.26					
	Surf AOL	MPE	12.83	3.25	5	211	1.339	0.249	0.031
		EEE	13.28	3.73					
		TVE	11.81	3.56					
		BTM	11.00	4.18					
		CSE	12.00	3.72					
		CEE	12.72	3.50					

	MPE	14.58	5.57	5	211	4.309	0.001	0.093
	EEE	17.59	6.91					
Total SOL	TVE	22.59	5.03					
	BTM	18.33	4.84					
	CSE	16.68	5.30					
	CEE	18.11	6.48					

Departments showed statistically significant impact on students learning experience with online mode-

- $F(5,211) = 3.013$, $p = 0.012$, partial eta squared = 0.067, with the MPE department (M=19.16) scoring higher than the EEE, TVE, BTM, CSE and CEE department (M=17.35), (M=15.95), (M=16.66), (M=17.95), (M=17.50) respectively in negative POL
- $F(5,211) = 4.309$, $p = 0.001$, partial eta squared = 0.093, with the TVE department (M=22.59) scoring higher than the MPE, EEE, BTM, CSE and CEE department (M=14.58), (M=17.59), (M=18.33), (M=16.68), (M=18.11) respectively in SOL.

No statistically significant differences were found for department in Positive POL, Deep AOLT, Surface AOLT, Deep AOL and Surface AOL.

Chapter 5 Discussion and Conclusion

5.1 Introduction

This chapter highlights the findings of this study and explains relevant argument from the extant literature relating to the online learning experience and satisfaction of engineering students amidst Covid-19 pandemic. Subsequently the implication and limitation of the study have been discussed with a conclusion and future research direction has been suggested in this chapter.

5.2 Discussion

Online learning and classes are becoming an increasingly important aspect of the global education system. Education has become more convenient and accessible to all types of students because of the advancement of learning technologies(Nambiar, 2020). Education sector in Bangladesh has been an ever-growing entity. Bangladesh has been among the largest sectors in the world when it comes to higher education(Rahman et al., 2021). Though online and distance courses have been there from a long time. However, only in the last few years has the online form of taking classes been recognized as an alternative to the traditional face-to-face classroom approach at universities and colleges in Bangladesh.

In Bangladesh educational system, the face-to-face classroom method has always been the most popular. Traditional techniques' familiarity and convenience of use, as well as a lack of demand for online teaching channels, have been important impediments to online education uptake (Sarkar et al., 2021). However, in the wake of current COVID-19 pandemic situation the educational boards have made it essential to conduct online classes at the college and university level.

Not only in Bangladesh, but throughout the world, Covid-19 has brought about a significant revolution in the educational system(Islam et al., 2021). Universities across Bangladesh as well as around the globe have moved to the virtual classes suspending physical classrooms till the situation improved. This study contributes to the body of literature and was narrowed down to examine the students' learning experience and satisfaction with online learning in Engineering

university because of the fact that, learning experience are the mains constituents that predicts the quality of education or otherwise.

5.2.1 RQ1: Student perception about the online classes

In this study, a survey was administered to a total of 217 students across 6 departments of Islamic University of Technology, Bangladesh to determine the student perception about online classes during Covid-19 crisis and how this learning mode influence or affect their learning and overall academic wellbeing.

Based on that, seven constructs related to online learning experience two key constructs of perception namely *Positive Perception of Online Learning (POL+)* and *Negative Perception of Online Learning (POL-)* have been examined. The finding of the study revealed that student perception about online learning has significant influence on satisfaction of online learning during Covid-19 (SOL). Meaning that the way students perceived online learning and how they utilized online learning environment and technologies is associated to the total satisfaction of online learning. This is in line with the study conducted by Ellis and Bliuc (2019) where they found that there are distinct patterns of association between the different aspect of online learning experience that reveal the impact of online learning technologies on students learning experience.

Similarly, for the perception of online learning itself (POL) have influence to the students' satisfaction of learning and ultimately students learning experience with online in the phase of Covid-19 pandemic. Han and Ellis (2020) also found that there is significantly positive correlation between the perception of integrating face to face and online learning to the online learning contribution and perception of online workload. The study further revealed that the perception of online contribution is negatively associated with the perception of online workload. This is indeed in line with the finding of this study by Raju (2020) where students reported to have higher negative perception of the online learning in the negative POL scale, and score lower points in the positive POL scale, this means that there is a negative impact on the satisfaction about online learning of the students amidst Covid-19 pandemic.

However, this is contrary to the study conducted by Islam et al. (2021) in which the positive perception towards online classes were agreed by the maximum number of students agreed that

online classes was effected and result shoed that students are satisfied with the overall features of online class, Although, 84.19% respondents are private university students. This means that in public university the result may be otherwise, considering the fact that the digital facilities for teaching in public institution are often limited. The current study further discovered that domestic students showed higher negative perception (-POL) then international students. This has notwithstanding due to the factor of the student's category in the Islamic University of Technology IUT.

In brief, over the years, online learning has been considered as flexible learning method and perceived effectively as face-to-face learning when it comes to the quality outcomes (Bączek et al., 2021). However, in this study the finding revealed otherwise. Thus, the currents findings show that the students perceived online learning more negatively during the COVID-19 online classes. This was due to the fact the several factor that experience was not promising. Also in other study conducted by Bali & Liu, (2018) their findings revealed that online learning perceived as lack interactivity compared to face-to-face learning. It is mainly due to the lack of social presence, lack of social interaction, and lacks students' satisfaction.

5.2.2 RQ2: Student learning approaches to online classes

The technological innovations and changing learning environments are influencing student engagement more than ever before (Al Mamun, Azad, et al., 2022; Al Mamun & Lawrie, 2021; Mamun, 2022). These changing learning environments and the transition from face-to-face learning towards distance learning are influencing students' learning approaches in the online environment and require scrutiny to determine how to facilitate better student learning outcomes. The COVID-19 emergency forced such transfer of learning environment to ensure continuity of smooth learning. This sudden shift to online education have made it difficult for the students to adapt the new learning environment (Nishat et al., 2021).

The students' learning approaches to online classes is simply regarded as a student's behavior and skills demonstrated during the online learning. A wide range of literature look into the approaches to learning in related to changing learning environment. To mention few, Al Mamun et al. (2019) in their study to explore the benefits of online learning for scientific inquiry a changing learning environment, they found that many students struggle to control their online learning without direct teacher assistance. As a result, students working with hypermedia in

online contexts must make judgments regarding a variety of topics, including what to learn, how to learn it, how much time to devote to learning, how to access and use instructional materials, and whether they grasp the subject. This shows that there is lack of online learning management with the students that normally spend most of their time in social media. As a result, it caused learning interruption when engaging with learning tools in online environment and thus they took surface approaches to learning. This current study is however indicating that there is direct relation between the students' learning approaches to the learning perception in the online environment.

5.2.3 RQ3: Student approaches to the online learning technologies

As online learning technologies are becoming an integral part of the learning experience at university, the quality of student learning is increasingly shaped by their experience of using these new artifacts (Ellis & Bliuc, 2016). This study addressed the students' approaches to online learning technologies, and it found that students who have prior knowledge with learning technologies enable them to comprehend learning easily. It however reported that there is distinct difference between the perceived learning technologies and approaches to learning technologies. This is in line with the findings of Ellis and Bliuc (2019) in which they found that there is qualitative differences in how students use online learning technologies and how they perceive online learning technologies.

The finding further suggests that the difference in how students use online learning technologies and how they perceived the learning technologies are logically related to quality of learning outcome. This study is also supported by the findings of Ellis and Bliuc (2016) where they discovered that deep approaches to inquiry were linked to deep approaches to online learning technologies in a good and logical way, whereas surface approaches to inquiry were linked to surface approaches to online learning technologies.

Thus, this present study indicates that the overall students learning experience with online classes transition during Covid-19 was not promising. This is also consistent with the findings of Sarkar et al., (2021) in their study to explore public university student's perceptions towards online classes during the COVID-19 pandemic in Bangladesh. Where they found that majority of students face difficulty while participating virtual classes and could not communicate with their friends properly during online classes. Thus, majority of the students did not feel comfortable in

online classes and preferred convention type of learning in the future. This eventually led them to take surface approaches to the use of online learning technologies.

5.2.4 RQ4: Predictability of perception, learning approaches and approaches to online technologies about the student learning satisfaction

Student satisfaction plays a significant role in achieving the vision and mission of universities (Rahman et al., 2021). Students' satisfaction has been defined as the feeling or outlook of students towards their instructional or educational activities, Hence the attitude of learners towards their learning experience is reflected by their satisfaction (Alqurashi, 2016).

Learning satisfaction represents learners' feelings and attitudes toward the learning process, or the perceived level of fulfillment attached to learning. This study revealed the students' satisfaction were influenced by the factors associated with the online learning environment. However, this was not withstanding due to technical issue that was found to be an important factor in determining satisfaction level with online learning. Similarly, in this study, satisfaction is considered to be the dependents variable and its evident that the independent variable such as -POL, +POL, deep AOLT, surface AOLT, deep AOL, surface AOLT have a great significant effect on the satisfaction level (SOL).

Similarly, Technical issue was found to be a very important factor critical to determining satisfaction with online learning, as many students reported to have experience poorer internet connection and electronic devices inconvenience, resulting unpleasant experience and dissatisfaction. This findings are however supported by the study conducted by Nambiar (2020) where they found that traditional learning was perceived more positively than online learning in term of social presence, interaction, satisfaction and overall quality. Even though online classes were reported to be convenient in term of saving time and flexibility, but still students perceived it to be less effective and less structured when compared to classroom mode of learning.

5.2.5 RQ5: Influence of demographic variables on online learning satisfaction

To examine the influence of the demographic variables on the learning satisfaction, the MANOVA was test was employed and the results revealed statistically significant effect for three demographic variables on students learning experience with online learning except in two demographic variables (year and gender). Separate analysis of variance was also run (ANOVA)

to examine the statistical significance of the demographic variable for each of the result of the dependent variable. However, in the approaches to online learning, international students were reported to score higher in the Deep AOL scale while domestic student scored higher the international in the negative POL when considering students category as a variant. For the education level, the result indicates statistically significant impact on positive POL, negative POL, deep AOL, and total SOL. While for the department; the result indicates statistically significant impact on positive POL, and total SOL only. Similarly, there was no significant different found for effect of gender in all variables.

5.3 Implications of the study

5.3.1 Theoretical implications

The present research has several implications contributing to theory of students learning experience with online learning amidst COVID-19 pandemic. This study addressed the issue related to engineering university students online class experiences and satisfaction. As knowing how students perceived online learning and how they experience the learning process offers the frame for effective integration, contribute to the whole students' learning satisfaction and increase the possibility to promote more meaningful study for successful online delivery. It provides clear evidence of correlation between online learning perception, approaches and satisfaction of students' learning during COVID-19. This study is however attempts to fill the void inherent to very limited literature regarding the students' online learning experience during COVID-19 in Bangladesh.

Also, the study has several implications in understanding the engineering university students' learning experience with online learning during the corona outbreak. The study provides a conceptual framework to interpret the relationship between the learning perception, learning approaches and learning satisfaction.

In brief, the study was centered towards investigating engineering students' learning experience with online learning during Covid-19 pandemic. It is worthy to note that learning experience is a broad term and in this context of online phase, some experience may be positive while other may not. As a result, thus, this study analyzed some of the aspect of online learning experience and examined their relationships.

5.3.2 Implications for policy and practice/ Practical implications

The findings of this study would be essential guideline for governments, policymakers, technology developers, and university authorities for making better policy choices in the future. It will however enable the faculty to know the nature of learning that students are experiencing during the swift transition to online mode and to emphasize on the positive experience that will benefit students in the class and try to integrate a more relevant practice in their teaching.

Studies have highlighted the impact of online learning environment to the students learning experience, especially as it related to dissatisfaction and less effectiveness (Nambiar, 2020). This study has found a very important connection between technical issues and students online learning dissatisfaction during the Covid-19 online classes transition. Therefore, universities administrations should expand and extend the technical support to reach all students and teachers, thereby improving their experience and making the online classes more effective. Parents and guardians must also be able to provide with their children a sound electronic devices and qualitative internet service that will help students to join their classes from home conveniently.

As university alone could not ensure all the technical service from all the end, and online learning has both positive and negative effect on students learning experience in online environment, this study would provide a useful direction for successful online learning. But learning experience will always remain the predictor to measure the students' quality of learning in any academic environment. Thus, this study encourages that the negative aspect of online learning should be reviewed and adjust to bring out the best dominant learning in this digitalized world.

5.4 Limitations, generalization, and future direction

The research is limited in terms of the number of universities, only one engineering university was taken, whether, Bangladesh has around seven 7 Engineering universities. IUT notwithstanding, happened to be a unique engineering university in Bangladesh that accommodate students from about 23 out of the 57 member countries of the OIC, the rich academic environment as well as students from diverse cultural background make it possible to even extend the generalization of the findings of this study to other African and Middle

Eastcountries. However, this study did not consider students online learning experience with practical virtual labs, even though the sample is engineering students whom their majority of their course are lab-based course. Therefore, challenges must be there when it comes to practical demonstration of the online platforms and very little research conducted in this aspect. This study therefore calls for further research into integrating practical training courses for online teaching and learning to endorse innovative teaching techniques and alternative assessment plans for instructors, learners, and policymakers. Similarly, the present study does not however, focused on the students' psychological state during the Covid-19 emergent online classes transition to investigate its impact to their learning experience.

Also, the number of participants in this study compared to the general population upon which the finding is generalized is small. Also, there is limited literature that directly connects to this study. Future research can address this issue.

Zapata-Cuervo et al., (2021) investigate Students' psychological perceptions toward online learning engagement and outcomes during the COVID-19 Pandemic, where they found that students' self- efficacy and anxiety significantly impacted their online learning engagement and ultimately influencing online learning outcomes. These findings revealed that COVID-19 is a very important factor to look into while researching about emergent online learning during the COVID-19 outbreak. As the students' psychological state is the key factor that affects the learning perception of students, Khanal, (2021) indicated that anxiety is a negative predictor to influence perceived satisfaction towards online learning. So, its import to emphasize the need for investigating further on how students perceive online learning and what other factors affects their online learning engagement and satisfaction at the particular situation.

The study has also given more attention to undergraduate students because they form a major part of the student in the selected university, and they constitute the greater part of the respondents in this study as shown in Table 4-1. This is so because undergraduate students are found to have more online course work than postgraduate students which in turn made them the predominant users of online learning during the COVID-19. Their engagement with IUT LMS, Zoom and Google meet made transformed them more technologically native. But it is also important that similar focus be channeled to post graduate students in the future.

There are several other factors relating to students' learning experience with online learning that were not used or discussed in this study, as a result, further research needs to be carried out in future to investigate the impact of COVID-19 to the subject matter. Thus, include motivation role, self-efficacy, anxiety and so on, knowing them would further give a better picture as to how emergent COVID-19 online learning would affect the students' learning experience and their overall learning satisfaction.

The findings in this study can be generalized on engineering students across Bangladesh as most of the student characteristics across all classes are the same as well as the taught subjects which are all in line with the national curriculum. Furthermore, IUT as an international university own by the Organization of Islamic Cooperation OIC has over 300 foreign students from different African, Asian and Middle Eastern countries. They form part of the respondents in this study therefore the findings may be generalized on students from similar engineering background in their respective countries. Even though many of the findings for online learning experience during COVID-19 was not very promising as Atmojo & Nugroho, (2020) showed that the emergent online learning does not run well in Indonesia due to lack of preparation and planning as it is an urgent phenomena on which educational institution must respond immediately. However other findings contradicts this study in term of students preparedness to choose between the two method of learning in which some students shows greater interest to take online classes in the future (Artino, 2010).

Online learning is increasingly becoming part of the students' learning experience as many educational institutions were necessitated to transform into fully online and as a result more study is required in order to see how best it can be harnessed and utilized to offer huge academic benefits to both students and teachers. Future study may be carried out on students learning experience with online learning and factors that affect the online learning during this trying time of global crises of COVID-19. The factors such as motivation role toward online learning, anxiety and stress impact of COVID-19 towards students learning as well as effectiveness of virtual laboratories in relation to online learning, all these aspects need to be further studied to tailor the challenges faced by education system in this unprecedented time. As the students' online learning experience during the face of this noble outbreak comprises of positive and negative effects on students' learning, therefore more research needs to be done to identify the

positive and beneficial elements of online learning in order to improve the overall learning process. This study is limited to engineering students only, thus further research is needed with regard to other knowledge disciplines and populations to achieve the desired goal.

5.5 Conclusion

This study investigated the engineering students' learning experience and satisfaction with online learning amidst COVID-19 pandemic in Bangladesh. The regression analysis technique was used to analyze the predictability of the theoretical constructs to determine the student learning satisfaction. The findings of the study revealed that the relationship of the factors affecting students learning experience with online classes during COVID-19. Thus, positive POL, negative POL, surface AOLT, deep AOLT, surface AOL, deep AOL were found to have significant effect on SOL. The result further indicated that students' learning experience with online classes is influenced by satisfaction of online learning. The overall online learning perceived more negatively by the respondents. Technical issue was found to be an important factor critical to determining satisfaction with online classes, resulting an unpleasant experience and dissatisfaction of online classes during the pandemic.

Additionally, independent multiple analysis of variance (MANOVA) helped to examine the significance of the effects of some demographic data on the entailed constructs. The result of the MANOVA analysis suggests a statistically significant effect for three demographic variables on students learning experience with online learning except in two demographic variables (year and gender). We ran separate analysis of variance (ANOVA) to examine the statistical significance of the demographic variable for each of the result of the dependent variable and we found the ANOVA result to be significant between four group means except in gender. No statistically significant differences were found for gender in all the dependents variables.

5.6 Recommendations

The online learning experience of engineering students has been evaluated with several factors such as perception of online learning, approaches to online learning and learning technologies, satisfaction with online learning and so on. To effectively utilized online learning as a means for

learning continuity particularly in the mid of COVID-19 crises when virtually learning is necessary, the following recommendations are made-

1. The management of the engineering universities should make policies specifically for online learning that would enable the students and teachers to enjoy the digital learning in spite the pandemic challenges
2. The universities administrations should expand and extend the technical support to reach all the teachers while they bring the best out of their knowledge to the students, thereby improving their experience and making the online classes more effective
3. Since online learning technologies has the potential to transform students to technologically literate people, therefore technology developers are encouraged to improve their services and applications to offer better quality online platforms for effective online learning
4. Engineering students should be made to understand the benefits of using online learning technologies in order to enrich their perception of its usefulness and get satisfied while fulfilling academic tasks virtually at home or any off-campus environment.

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Appendix A



Islamic University of Technology (IUT)
Dhaka Bangladesh
Organization of Islamic Cooperation (OIC)



Assalamualaikum.

Dear students,

I am a final year Master student in the Technical and Vocation Education Department at the Islamic University of Technology, Dhaka Bangladesh.

As part of my master's degree requirement, I am conducting a Thesis Research titled: "Investigating Engineering Students' Learning Experiences and Satisfaction with Online Classes during COVID-19"

I therefore humbly request you to be one of the participants in this study, any information you give here will be kept confidential, and please note that your honest response will truly contribute positively towards the success of this study.

This survey consists of five sections A-E and will take 8-10 minutes to complete.

I thank you for your participation.

Sincerely yours

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Appendix B

Learning experience with online classes amidst COVID-19 Pandemic

The questionnaire has five main parts namely, A for demographic information, B Perception of online learning (POL), C for Approaches to online Learning technologies (AOLT), D for Approaches to online learning (AOL), and E for satisfaction with online learning (SOL).

A: Demographic Data

1. Gender: Male/ Female
2. Academic level: Postgraduate/ Undergraduate
3. Student Type: International/ Domestic Students
4. Department: TVE/ CSE/ EEE/ BTM/ MPE/ CEE
5. Year of Study: First Year/ Second Year/ Third Year/ Fourth Year

B: Perception of online learning (POL)

Please rate the degree to which you agree or disagree with each of the following statements related to Perception of online learning environment.

5-rating scale

[1] Strongly Disagree [2] Disagree [3] Undecided [4] Agree [5] Strongly Agree

Table B-1: Perception of online learning (POL)

Constructs	Items	Source
Positive POL	POL1: Online classes are more effective than classroom mode	(Nambiar, 2020)
	POL2: Online classes are more convenient than classroom method	
	POL4: Learning and knowledge transfer happens more in online classes	
	POL6: Online classes save time	
Negative POL	POL3: Quality of discussion is low in online classes	
	POL5: Online classes are less structured than classroom mode	
	POL7: Technical issues disrupt the flow and pace of online classes	

	POL8: It is difficult to clarify doubts in online classes compared to classroom mode	
	POL9: The workload for the online activities was too heavy	(Han & Ellis, 2020)

C: Approaches to online Learning technologies (AOLT)

Please indicate whether it's true or not from each of the following statements related to Approaches to Online Learning Technologies.

Not at all True [1] Rarely True [2] Often True [3] Usually True [4] Almost Always True [5]

Table B-2: Approaches to online Learning technologies (AOLT)

Constructs	Items	Source
Deep AOLT	AOLT1: I find I use the online learning technologies in this course to further my research into a topic	(Ellis & Bliuc, 2016)
	AOLT2: I spend time using the online learning technologies in this course to develop my knowledge on key topics	
	AOLT3: I try to use the online learning technologies in this course to achieve a more complete understanding of key concepts	
	AOLT4: I find interacting with online learning technologies in this course promotes deeper understanding of key ideas	
	AOLT5: I try to use the online learning technologies in this course to communicate with other participants to test my ideas	
	AOLT6: I find using the online learning technologies in this course help me to develop my critical thinking	
Surface AOLT	AOLT7: I use online learning technologies in this course mainly to download files	
	AOLT8: I restrict my use of online learning technologies in this course to do as little as possible	
	AOLT9: I do not use the online learning technologies in this course to enable me to achieve my goals	
	AOLT10: I only use the online learning technologies in this course to fulfill course requirements	
	AOLT11: I do not find using online technologies in this course helps me to understand things more deeply	

D: Approaches to online Learning (AOL)

Please indicate whether it's true or not from each of the following statements related to Approaches to Online Learning

Not at all True [1] Rarely True [2] Often True [3] Usually True [4] Almost Always True [5]

Table B-3: Approaches to online Learning (AOL)

Constructs	Items	Source
Deep AOL	AOL1: I try to think about revealing questions when I am researching	(Ellis & Bliuc, 2016)
	AOL2: I often take the initiative when pursuing a line of questioning in research	
	AOL3: Formulating just the right question in my mind helps me to research effectively	
	AOL4: I find I research most effectively when I am proactive about it	
	AOL5: I find I research most effectively when I am proactive about it	
Surface AOL	AOL6: I research in this course mainly because I have to	
	AOL7: Researching something is just looking for what others have found out before	
	AOL8: When I research something, I like others to tell me where to find the answer	
	AOL9: When I research something, it is just like following a formula	

E: Satisfaction of online learning (SOL)

Please rate the degree to which you agree or disagree with each of the following statements related to learning satisfaction about the online learning.

[1] Strongly Disagree [2] Disagree [3] Undecided [4] Agree [5] Strongly Agree

Table B-4: Satisfaction of online learning (SOL)

Constructs	Items	Source
	SOL1: I am satisfied with the online instructional styles of the instructors during Covid-19	
	SOL2: I am satisfied with the learning contents and course structure	

SOL	designed for online classes during Covid-19	(Rahman et al., 2021)
	SOL3: I am satisfied with the instructors and teaching assistants (if any)	
	SOL4: I am satisfied with the use of online discussion forum during Covid-19	
	SOL5: I am satisfied with the exams conducted online during Covid-19	
	SOL6: Overall, I am satisfied with online classes during Covid-19	