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COVID-19 pandemic influence on undergraduate female engineering students' performance in Bangladesh

Sher Shermin Azmiri Khan[1], Muhibul Haque Bhuyan[2]
[1]Department of Computer Science and Engineering, Central Women's University, Dhaka, Bangladesh
[2]Department of Electrical and Electronic Engineering, American International University Bangladesh (AIUB), Dhaka, Bangladesh

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ABSTRACT

This paper explores the impact of the online teaching-learning of the Computer Science and Engineering program's female students at the Central Women's University in Bangladesh due to the COVID-19 epidemic. A survey was directed to comprehend the students' perspectives on online engineering education. The performances of the same students under the same course instructor of various courses as well as of different students under the same course instructor of the same courses before the pandemic and during the pandemic were investigated. After that, this paper analyzed students' experiences of the evaluation method before and during the outbreak, and then found out the transformation of the students' concerns regarding online engineering education. The research was based on the student surveys and observations, and their academic performances. All indicators exhibited that the procedure that was implemented had a positive impact on students' achievement. Students' involvement, particularly in the core courses that are essential to fulfilling their degrees, had improved. Furthermore, students gained more precise and constructive knowledge from the course teachers during the pandemic, as such the impact on the students' learning due to the online teaching of Computer Science and Engineering students were positive than before the pandemic.

Corresponding Author:

Sher Shermin Azmiri Khan
Department of Computer Science and Engineering, Central Women's University
6 Hatkhola Road, Dhaka-1203, Bangladesh
Email: shermin03@gmail.com

1. INTRODUCTION

The Coronavirus (COVID-19) was the first outbreak in December 2019 in Wuhan, China, and spread quickly across the world. Just after three months, the World Health Organization (WHO), announced COVID-19 as a worldwide epidemic. As of July 2020, more than 15 million COVID-infected patients were reported to the WHO, and around 620,000 deaths in 213 countries and territories on earth [1]. For minimizing the transmission of the virus, various countries declared strict protocols, such as complete or partial lockdowns, give guidelines to maintain social distancing, border shutdowns and travel restrictions. The impact of the COVID-19 outbreak on education was tremendous; all the schools, colleges, and universities were closed and about one billion learners saw the closure of their educational institutions due to the COVID-19 outbreak by the end of June 2020 [2]. As a result, traditional, on-campus classes were immediately substituted by online classes in several countries including Bangladesh [3]–[11].

Bangladesh identified its first three cases of COVID-2019 on March 8, 2020 [12]. The government of Bangladesh declared to stop all the educational institutions from primary to tertiary level as part of protecting pupils from the transmission of the COVID-2019 pandemic. All academic institutes of Bangladesh

were closed since March 17, 2020 while writing the report. As such, the students are being compelled to stay at home and do not go outside of the home without very necessary cause. During that period, the academicians started to search for various alternative ways of administering academic operations by them from homes to continue the teaching and learning process.

Central Women's University (CWU), the first private women's university in Bangladesh, was shut down in the middle of the Spring 2020 semester, and at that time we faced some serious problems regarding the class conduction processes. Most of the private universities of Bangladesh decided to go online classes, and faculty members are guided to conduct classes from their homes. Hence, Central Women's University is not an exception. It also switched to the online mode of teaching-learning and thus began the online classes on March 18, 2020.

To give facility to the method of online teaching and learning we used modern technologies. As e-learning is a distance education, to conduct class different modern equipment, such as Smartphones, laptops, personal computers, tablets, stylus pens, headphones, earphones, microphones, cameras, multimedia and internet connectivity, were needed. The classes may be conducted through several online platforms, such as Zoom, WebEx, Google Meet, Facebook and YouTube. But most of the faculty members of CWU use the Zoom platform. Besides, Google Classroom was also used to share lecture sheets, PowerPoint slides containing texts, graphics, figures, images, audio and video files.

The objective of the paper is to contemplate the methods and practices of online teaching adopted by the CSE Department, Central Women's University. Online assessment policies of the student outcome during the COVID-19 pandemic were analyzed. Students' learning strategies before and after pandemics to achieve this goal were also investigated. Altogether, the data indicate that during online education students' performance had increased and higher scores were expected. This study involves more than 50 students enrolled in three different subjects of the CSE Department at the CWU during three academic semesters. Data were obtained in the Fall-2019, Fall-2020, and Spring-2021 semesters when the restrictions due to the COVID-19 pandemic have been in force.

2. LITERATURE REVIEW

Due to lockdown in many countries in the world, the traditional on-campus/face-to-face education system is disrupted and more than 400 million students from various countries of this world are currently not attending their classes. So, we have to find out a complete substitute to overcome the situation. And online education is the only alternative to that. Many countries of the world, like Azerbaijan, Bangladesh, Georgia, Iraq, Nigeria, Morocco, Ukraine and the UK, are operating educational activities on an online platform through online schools and open universities [13]–[15]. So, we can say that distance learning (online/mobile/e-learning) has many advantages that are worth proving any more. The issue has been considered in many research papers already [16]–[18]. Now time demands to contract classes online, the educational institutions should build their strategy of deciding their course learning outcome, and make decisions of class conduction method, they should change their curriculum and teaching delivery method, assessment techniques, and the other educational activities within a recognized virtual platform.

Due to COVID-19 face-to-face classes have suddenly shut down and a dramatic change had happened in the educational field and a sudden shift to online learning. Ripoll et al. [19] share their experience of adapting remote learning in the Biotechnology program at Francisco de Vitoria University in Madrid, Spain, for the course of Biochemical Engineering. They got teacher comments, the academic performance of students, and student surveys. All pointers indicated that students' performance showed progressive impact due to the adopted procedure.

In 2019 the COVID-19 was the first outbreak in China. The Ministry of Education of China declares that education and teaching-learning had great importance under the epidemic situation [1]. In one research the others summarize the teaching method of digital circuits' online course and provide some direction and reference for the schooling method in a university in China [20]. They tried to find out teaching methods to increase hands-on training and apply theoretical knowledge in teaching methods.

One research paper shared the experiences by analyzing and collecting the responses of 393 South Korean college students who had switched to distant teaching due to the COVID-19 pandemic. They attempted to know the students' satisfaction and dissatisfaction due to the online teaching and development areas via an online study [20]. They found that most of the students use laptops for online classes. Students who participated in this study said that they are satisfied with the availability of educational equipment and feel comfortable with the educational environment offered by remote learning. Students showed their largest dissatisfaction due to network instability which disrupted their remote learning classes. Their learning outcomes show that the online learning background is stress-free and appropriate for most of the students, which can be a significant element in learning that certainly affects students' academic achievement.

During this COVID-19 pandemic time, the world's student population at the university level is undergoing scholastic turbulences on an extraordinary level. In Bangladesh, over 5,000 institutions including all universities both public and private, colleges, and professional institutions are under lockdown and more than four million students of tertiary education become idle [21]. For the shutdown of face-to-face classes, all the students from primary to tertiary level have to remain at home and attend their distant classes through various platforms. Research work was conducted concerning the field of tertiary-level education in Bangladesh. A semi-structured interview is done on 50 students and the thematic analysis method was used for data analysis [22]. The study found that limited access to the internet, unavailability of electronic devices, low speed and high cost of internet, and problems in using online platforms are the main barriers to online education in Bangladesh. It is suggested to take essential steps to enhance the situations during the pandemic.

A study was done on female students at the Copperbelt University in Zambia to find out the effect of the COVID-19 epidemic on online engineering education [23]. A survey was conducted for undergraduate and postgraduate female students to understand their viewpoints on online engineering education amidst the COVID19 pandemic. The findings of this study emphasized unstable internet access and connectivity, lack of practical lab experiments, unfavorable home study environment, and finances as major setbacks to online learning. Home chores and childcare responsibilities were among other challenges students faced during online engineering education.

3. RESEARCH METHOD

In this study, an online survey technique using Google Form was utilized to gather data from the undergraduate female students studying in the CSE department of the Central Women's University of Bangladesh. The research is done on the undergraduate female engineering students because CWU is a university for only women, and the difficulties faced by the female students during online classes were also investigated. The students give their opinion on online engineering education amidst the COVID-19 pandemic. They also gave their concern on course outcomes before and during the COVID-19 pandemic. The online survey was made for the period between June 15th and 20th, 2021 for data collection. The questionnaires were sent to the students through Messenger group and Facebook. The questionnaires are designed to get the full consent of the female students of the engineering field to find out the difficulties they faced, advantages and disadvantages of distance learning the course outcome they achieved. The reliability of questionnaires was tested with Cronbach's alpha and Content validity was evaluated by content validity index (CVI) and content validity ratio (CVR). Both I-CVI and S-CVI were evaluated to get the values of S-CVI/UA and S-CVI/Ave. The result analysis of students also had done, who do courses under the supervision of the author. Statistical analysis is done on the same course of different students of the different semesters, and a different course of the same students in a different semester. About 50 students provided complete information on the survey and study of the result. To understand the online learning outcome, strategy on engineering education decisions, mode of learning, and other challenges amidst the COVID-19 pandemic a descriptive statistical analysis was conducted.

4. RESULTS AND DISCUSSION

This article has also done the validity and reliability of questionnaires. Cronbach's alpha was used to test the reliability of the questionnaires. The Cronbach alpha of the responses is 0.954. To measure validity CVR and CVI were used. The calculated I-CVI was composed of 0.63 and greater. The S-CVI/UA and S-CVI/Ave values are 0.74 and 0.85 respectively. The result shows that the CVR was 0.71. These results showed that the questionnaires have good reliability and validity.

The survey reports on question 1 are shown in Table 1 where it is observed that approximately 78.9% of students always or very often took part in the online classes. Only 5.26% of students could not take part in the remotely conducted classes at all. However, they cannot attend the class for a number several of reasons, such as poor network connection, non-availability of the internet, due to the high price of internet, disruption of electricity, home chores and childcare responsibilities.

Table 1. Student responses to question 1

Class participation type	Number of students (%)
Always	73.68%
Time to time	15.79%
Very often	5.26%
Not at all	5.26%

There were four objective-type questions given in Table 2 with their mean values and standard deviation and percentage of students agreeing with the questions. The mean and standard deviation and percentage of students agreeing on each question responses to four objective type questions. After that, the average of the mean values of these questions was calculated and found as 3.32 and the average standard deviation as 1.199. However, the standard deviation of the mean value was calculated as 0.48.

Table 2. The mean and standard deviation and percentage of students agreeing on each question

Question No.	Questions	Percentage of students agreeing on each question	Mean	Standard deviation
1	Do you think that the online class is an alternative approach of learning method instead of on-campus learning?	52.6%	3.05	1.4327
2	Do you think that the online class approach adopted by CWU is the right choice considering this pandemic situation?	84.2%	3.84	1.1673
3	Do you think that the online assessment process (class test, quiz or viva, assignment) adopted by the Faculty Members of the Department are effective for learning outcomes?	84.2%	3.58	1.0174
4	Do you think that the online class will be effective in improving the quality of education at the university level?	52.6%	2.79	1.1822

The online survey was also done on the course outcomes [24] of the core courses (Basic Electrical Circuit, Database Management System, and Data Communication) taught by a single teacher to the very same batch of students. In the Fall 2019 semester, the teacher taught a Basic Electrical Circuit course to the students which are before the outbreak of COVID-19. The same teacher taught the Database Management System course in the Fall 2020 semester and the Data Communication course in the Spring 2021 semester to the same batch of students. The teacher questioned the students in the survey about the course outcomes of these courses. A comparative study of these course outcomes for the same batch of students was performed. Fall 2019 was completed before the pandemic started, whereas the Fall 2020 and Spring 2021 semesters were conducted during the pandemic. During the pandemic, the students participated in online classes. The results are given in various charts in Figures 1 to 3. Each figure has four sub-figures (a, b, c, and d) that demonstrate the students' perception of their course outcome attainment on four different questions on each course as shown in Table 3. The x-axis of each sub-figure shows the agreement level in five stages from poor to excellent and the y-axis shows the number of students in percentages.

From the analysis of each figure, Figure 1 (a) shows that 42.11% of the students feel very good or excellent in the Basic Electrical Circuit course's first outcome, while Figure 1 (b) shows that 47.37% feel very good or excellent in the second outcome, 42.1% feel very good or excellent in the third outcome as in Figure 1 (c), and 47.37% feel very good or excellent in the fourth outcome as in Figure 1 (d). On the other hand, Figure 2 (a) shows that 73.69% of the students feel very good or excellent in the Database Management System course's first outcome, while 52.63% feel very good or excellent in the second outcome as in Figure 2 (b), 78.95% feel very good or excellent in the third outcome as in Figure 2 (c), and 73.68% feel very good or excellent in the fourth outcome as in Figure 2 (d). A similar observation in the Data Communication course, Figure 3 (a) shows that 63.15% of the students feel very good or excellent in this course's first outcome, while 63.16% feel very good or excellent in the second outcome as in Figure 3 (b). There were 57.9% feel very good or excellent in the third outcome and 47.37% feel very good or excellent in the fourth outcome as can be seen in Figures 3 (c) and (d) respectively.

Table 3. Questionnaires for the course outcome

Course	Question
Basic electrical circuit	Are you able to methodically obtain the algebraic equations that describe the performance of an electric circuit?
	Can you develop an analysis method of a network with any number of sources in any arrangement?
	Can you solve the principle of superposition theorem and Thevenin-Norton equivalent circuits?
	Do you realize the requirement of transformers in the transmission and distribution of electric power and other applications?
Database management system	Do you understand database concepts and structures?
	Do you understand the data modeling and database development process?
	Can you use database management systems such as MySQL?
	Can you use database query language, i.e., SQL?
Data communication	Do you understand the fundamentals of how computers communicate?
	Are you familiar with the architecture of several different networks?
	Do you have the ability to convert analog and digital signals?
	Do you understand the basic aspects of packet-based protocol design, multiplexing, and transmission media?

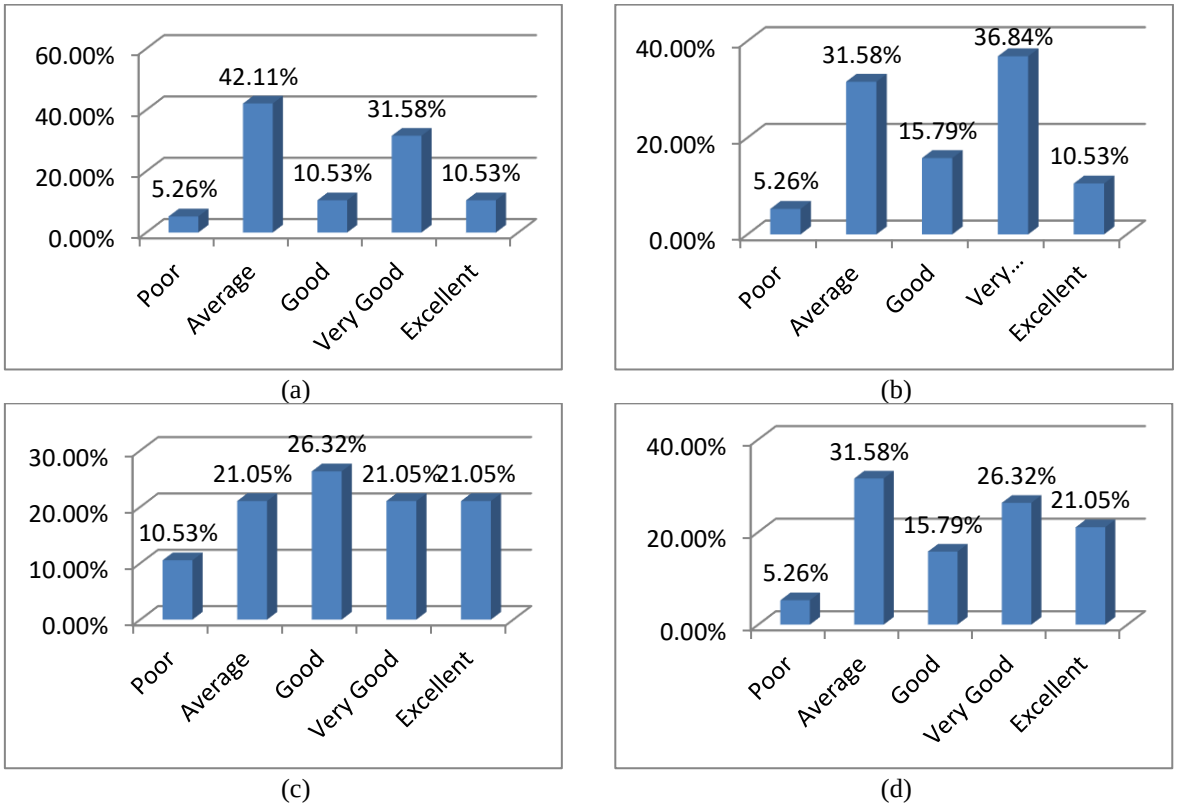

Figure 1. Results of the online survey of students for the basic electrical circuit course in (a) first outcome, (b) second outcome, (c) third outcome, and (d) fourth outcome

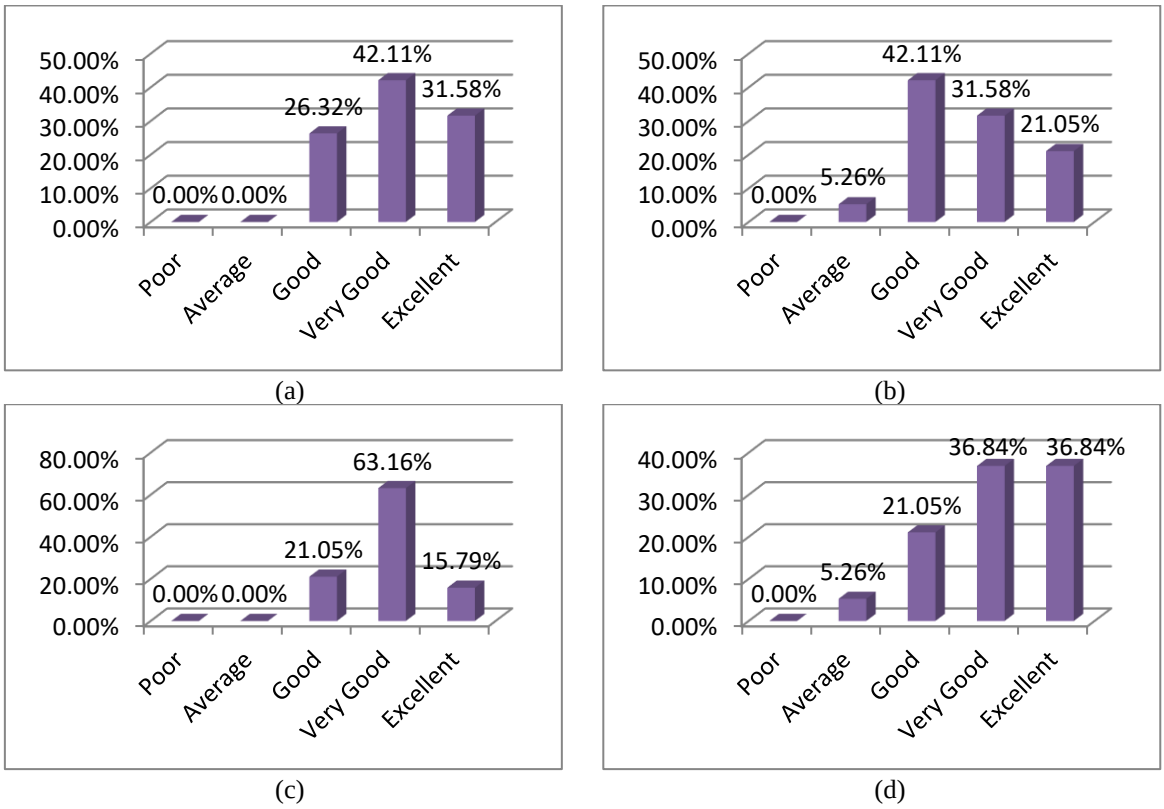

Figure 2. Results of the online survey of students for the database management system course in (a) first outcome, (b) second outcome, (c) third outcome, and (d) fourth outcome

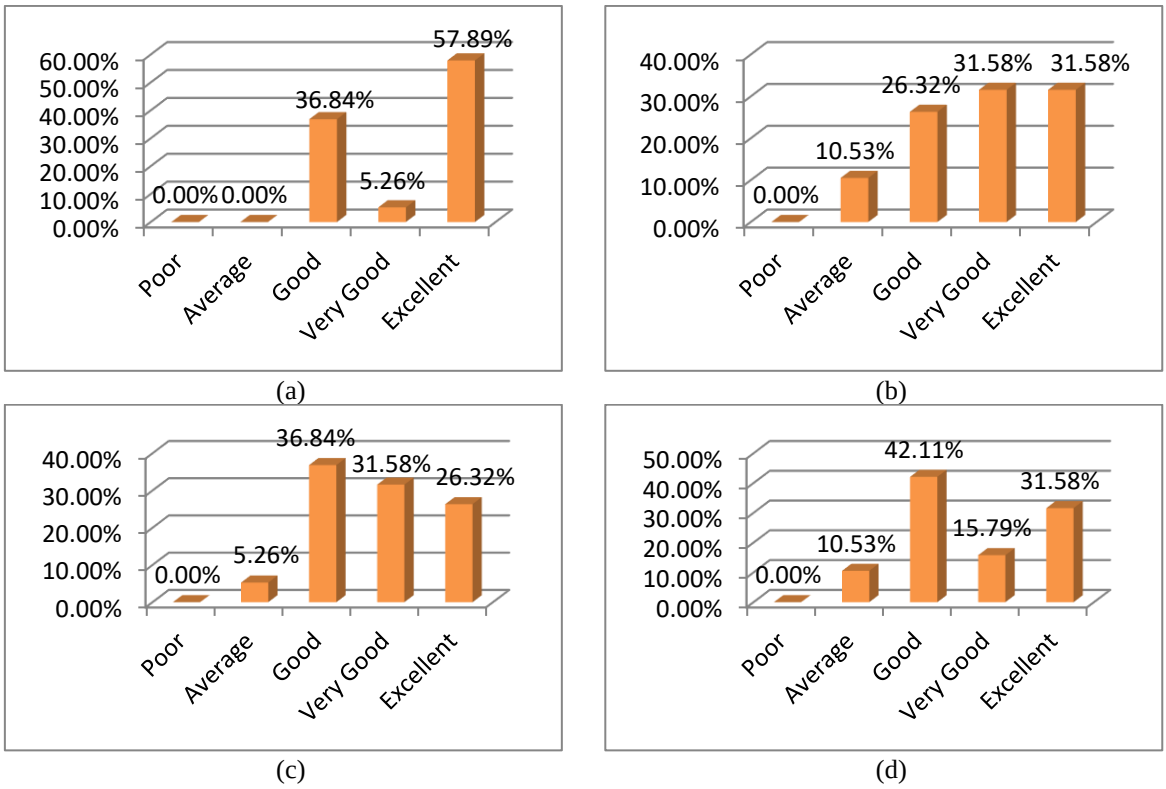

Figure 3. Results of the online survey of students for the data communication course in (a) first outcome, (b) second outcome, (c) third outcome, and (d) fourth outcome

The comparison shows that during the pandemic, the results of the students were better than the results before the pandemic. In Figure 4, the x-axis shows the letter grade, and the y-axis shows the number of students who accrue each grade of different subjects in different semesters. Here, we observed better grade attainment during the pandemic.

In Figure 5, the x-axis shows the letter grade and the y-axis shows the percentages of students accruing each grade of different subjects in a different semester. Figure 5 shows the result of Database Management Systems in Fall 2019, Fall 2020, and Spring 2021 semester, and found that about 66.67% of students get a higher grade (A+, A, A-) in the Fall 2019 semester, and almost 68.42% of students get a higher grade (A+, A, A-) in Fall 2020 semester, and 80% of students get a higher grade (A+, A, A-) in Spring 2021 semester. The last two semesters are during pandemics and students attend online classes. The results find that the students can perform better through online classes. It is suggested that in the online mode of education, the academicians may resort to the cognitive domain of Bloom's taxonomy of the teaching-learning process as it was found an effective way of transferring knowledge to the students in various copies of literature [25]–[30].

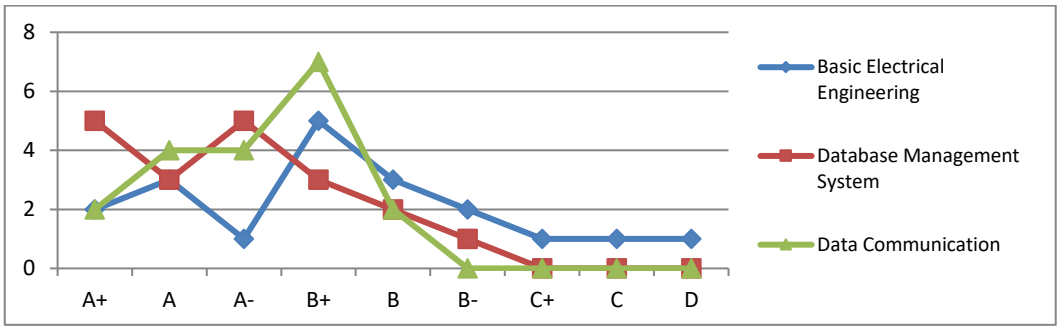

Figure 4. Grade of the same students of three different subjects in three different semesters

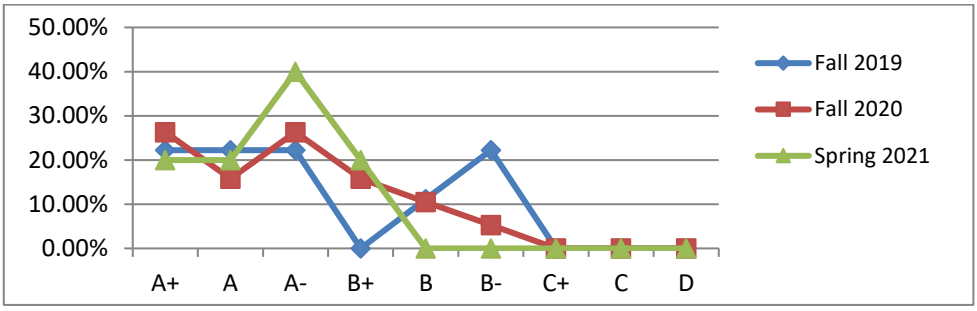

Figure 5. Grade of different students of the same subject (Database Management System) in three semesters

5. CONCLUSION

This study analyzed Bangladeshi female undergraduate engineering students' experiences of alternative remote teaching-learning methods adopted during the COVID-19 epidemic. The results show that online education is a significant part that influences academic achievement positively. Students feel calmer and more convenient during the online study. From this study, it was found that students achieved good grades through online classes. They were more successful to acquire course outcomes when they participate in online classes. From the result analysis, it was found that the major challenge of online learning is the non-accessibility of high-speed and reliable internet services in rural and remote village areas of Bangladesh. So, the government of Bangladesh should ensure cheap and high-speed data for students all over the country.

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BIOGRAPHIES OF AUTHORS

Sher Shermin Azmiri Khan completed her BSc degree in Electronics and Communication Engineering (ECE) from American International University Bangladesh (AIUB), Dhaka, Bangladesh in 2002. She completed her MSc in ICT from Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh in 2012. She is studying for her MPhil degree in Computer Science and Engineering (CSE), at Jagannath University, Bangladesh. She is working as an Assistant Professor in the Department of CSE, Central Women's University, Dhaka, since October 2010. Previously, she worked in several software development organizations for around 10 years. Her research interest includes tertiary engineering education, Digital image processing, Deep Learning, and optical fiber communication. She is a member of IEEE and a member of the Bangladesh Computer Council. She can be contacted at email: shermin03@gmail.com.

Muhibul Haque Bhuyan did his BSc, MSc, and PhD degrees in Electrical and Electronic Engineering from Bangladesh University of Engineering and Technology (BUET), in 1998, 2002, and 2011 respectively. He is working as a Professor at the Department of Electrical and Electronic Engineering (EEE) of American International University Bangladesh (AIUB), Dhaka. He has over 130 research papers to his credit. His research interests include MOS device modeling, biomedical engineering, embedded and control systems design, teaching-learning, and OBE. He is a program evaluator of the Board of Accreditation of Engineering and Technical Education (BAETE), Bangladesh under IEB. Prof. Bhuyan is a Member of IEEE, a Life Member and Treasurer of the Bangladesh Electronics and Informatics Society (BEIS), and a Life Fellow of the Institution of Engineers Bangladesh (IEB). He can be contacted at email: muhibulhb@gmail.com.