Impact of Telecommunication Service Quality in Bangladesh on Online Education during Covid-19

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Abstract: The pandemic situation due to covid-19 has disrupted routine activities such as attending classes physically in educational institutions, which insisted on moving towards online education with the help of advent and increased uses of new telecommunication services. Service quality is the prerequisite for customer satisfaction. Service quality assessment is crucial to ensure increased customer satisfaction in any service. Typically, it is not easy to evaluate service quality because of opacity in the information, and incompleteness characteristics of problems. With the collected data through an online survey, this study aims to analyze the facts that influence the students' perception regarding the impact of telecommunication service quality on online education during the pandemic situation. Initially, some relevant criteria are derived from literature reviews. The proposed model is exerted to evaluate the quality of the online education and telecommunication service in Bangladesh during the covid-19 pandemic with the participation of 350 students answering 39 questions. The collected data is analyzed to assess the current state of service quality by evaluating the students' satisfaction using the entropy technique. The findings of the study suggest that the online education system in Bangladesh is not interactive enough, and the telecommunication service quality here is not sufficient for this purpose. Telecommunication challenges such as poor network quality, overpricing structure of telecommunication services and slow connection speed must be resolved to ensure satisfactory quality of online education.

Index Terms: Online Education, Telecommunication, Service Quality, Entropy Analysis.

1. Introduction

We are heading toward the digital world, and learning is now getting mostly based on modern technology. Technology-based learning systems like e-learning have gained significant popularity in the modern world. There has been significant involvement in learning management systems and is estimated to pass $23.21 billion by 2023 [1]. The pandemic situation due to covid-19 had enforced most countries to entirely shut down their educational institutions. Some of the covid-affected countries along with China had to close their educational institutions in early February 2020. Later, many other countries had to announce the closure of their educational institutions. Almost 186 countries had to implement nationwide closures to prevent the spread of the disease by the end of April 2020, and it affected about 73.8% of total enrolled students (UNESCO, 2020) [2]. To ensure education for the affected students, and to keep the education process going, the education system moved to online platforms. As most countries, in particular, developing countries like Bangladesh were not prepared for online education, technical challenges like device suitability and telecommunication services created some serious obstacles.

This study aims to figure out the current status of telecommunication services in Bangladesh, analyze students' opinions regarding online education, identify telecommunication challenges in the online education system, and propose some recommendations to overcome the challenges. This research may help policymakers to ensure the quality telecommunication service required for online education. The rest of the report includes a background study in section 2, methodology in section 3, result analysis and discussion in section 4, and a conclusion in section 5.

2. Background Study

2.1. Online Education during covid-19

The interruption of the normal education system due to the pandemic situation generated the worst situations,

especially, for university students. In some cases, students could not continue their studies. The long-term closure of educational institutions has forced us to find out the dynamic aspects of online education [3,4]. Online education can become a reliable and less stressful system by transforming the education system with the expansion of educational opportunities and encouraging the development of innovative pedagogical methods [5]. Flexibility in learning, accessibility to experts, and a wide range of available communities attract students to online education. Barabash et al. mentioned distance learning as an effective tool for lifelong learning and emphasized ensuring seamless communication with a quality network that must function smoothly [6,7]. Some studies suggest that though online education is a temporary solution in terms of learning for the current pandemic situation, it lacks interactions [8]. Technical challenges such as internet accessibility issues and device compatibility issues are some other significant disadvantages [9,10]. In the early stage of the lockdown, students were isolated, and it largely affected their socio-emotional balance. Online education was a blessing to them to recover from isolation effects like anxiety and depression. Despite some disadvantages, ensuring the following can produce an effective result from online education [11]:

• Modification of curriculum is necessary.
• The role of teachers will be like mentors.
• Class duration of 15 to 30 minutes seems to be more effective.
• More focus on the psychological and emotional development of students.

2.2. Online Education in Bangladesh

Although the pandemic situation got worst in the later part of 2019 throughout the world, the first covid-affected patient was identified in Bangladesh on March 8, 2020 (IEDCR, 2020). Bangladesh government had to implement the closure of educational institutions from 18th March 2020 until 13th September 2021 to stop the spread of covid-19. Students were suffering severely, and the government had to take some initiatives to find out alternatives. Instead of physical classes, Bangladesh had to move to online education [12]. Although it was factual for the pandemic situation, resource limitations and insufficient infrastructure were the main obstacles to implementing this for developing countries like Bangladesh. Deficiency in network quality, inadequate digital skills, and shortage of technical support from the institutions were some of the concern issues. Besides, educational instructors and their students had to cope with some severe obstacles, such as the pressure of unstable economic conditions, health conditions of self and family members, and an uncertain future [13]. Despite these challenges, it is obvious that moving towards online education was a praiseworthy approach of the government to mitigate the sufferings of the students. To ensure proper output from this initiative, the proper engagement of the academic participants must be ensured. Students should engage themselves properly in this education system with self-motivation, as they are the primary stakeholders [14].

2.3. Telecommunication Service in Bangladesh

The telecommunication sector is one of the most dynamic sectors which have a significant impact on our daily life. Value-added service (VAS), pricing structure, conveniences, customer services, coverage, etc. are some internationally recognized factors in telecommunication service quality [15]. International Telecommunication Union (ITU) is the responsible organization for the telecommunication sector, and Bangladesh Telecommunication Regulatory Commission (BTRC) works to align with ITU to control the telecommunication market in Bangladesh. Due to the dynamic nature of this sector, customers are now very much concerned about service quality [16]. Telecommunication service providers in Bangladesh can be broadly divided into two categories namely public switched telephone networks and mobile phone operators. The majority of the people here are mostly dependent on a mobile network, and currently, four operators namely Grameenphone, Banglalink, Robi, and Teletalk are providing this service.

A. Mobile Subscribers in Bangladesh

In the early stage of the last decade, the majority of mobile users normally used mobile networks for voice calls and messaging services. The situation began to change in the latter part of the decade when people on a large scale started using smartphones. Telecommunication service quality came into consideration by the users. Fig. 1 represents a comparative statistic of the number of users of the four mobile operators according to the BTRC website (btrc.gov.bd).

During the pandemic situation, the number of users has increased significantly for the operators. The figure also shows that Grameenphone is the leading company in Bangladesh in terms of subscriber count.

B. Internet Subscribers in Bangladesh

Internet subscribers are classified into two categories. The first category includes mobile internet users, and the second category consists of internet service providers (ISP), public switch telephone networks (PSTN), and WiMAX users. Subscribers' data was collected from the BTRC website. Fig. 2 illustrates that the majority of internet users use the cellular network, and the total number of subscribers is increasing for both categories during the pandemic period.
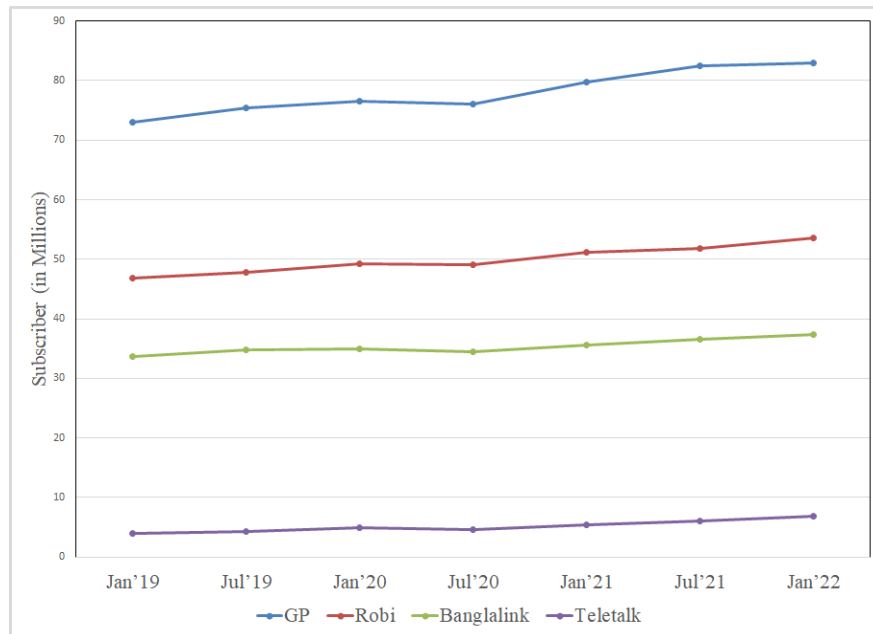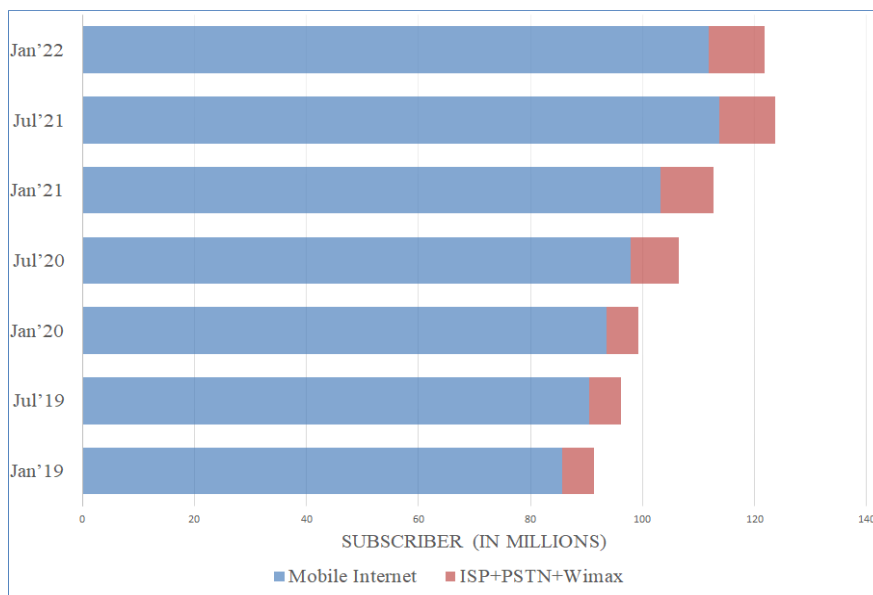
Fig. 1. Mobile Subscribers in Bangladesh

Fig. 2. Internet Subscribers in Bangladesh

C. Covid-19 impact on the Telecommunication Sector

Initially, the pandemic situation due to covid-19 had a severe impact on the telecommunication sector in Bangladesh. Telecommunication operators began to lose their active subscribers from March 2020 to May 2020. The situation began to change drastically, especially when educational institutions started to conduct online classes. Although government-owned Sangsad Television was being used for educational purposes, students had to depend mostly on internet connectivity. As a result, internet penetration started to grow in a significantly increasing order. Fig.3 demonstrates the growth of the internet penetration rate during the covid period in Bangladesh. It also indicates that mobile internet plays a key role in the penetration rate with the majority share.

2.4. Quality of Service (QoS)

For the measurement of the perceived performance of an e-service or online service particularly in terms of users' experience, quality of service (QoS) plays a crucial role. According to DeLone and McLean's IS Success model, quality of service, system, and data are the keys to measuring the success of an online service [17]. Cidral et al. analyzed to identify the success drivers of online education and found that system quality, information quality, and collaboration quality are the key determinants [18]. According to Ahmed in [19], organizational factors of a university like top
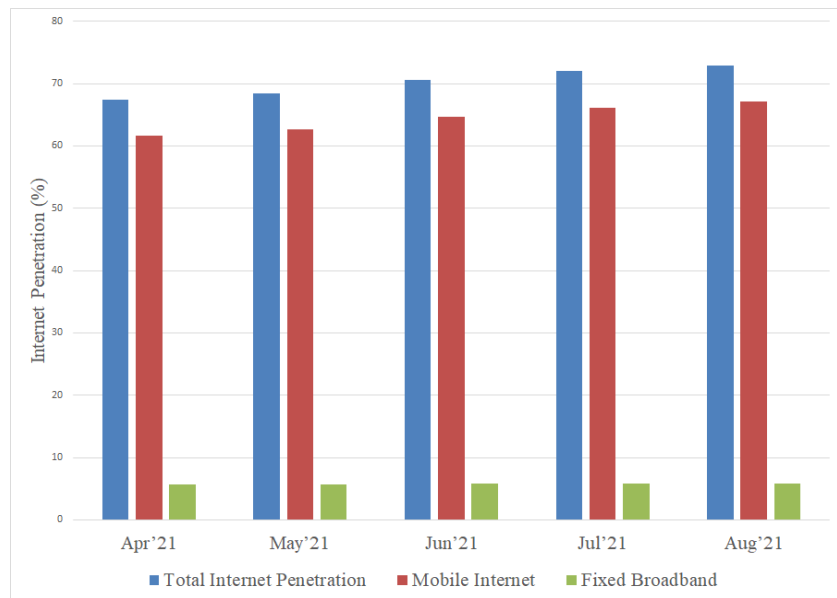
Fig. 3. Internet Penetration Rate

management support and change management have a direct impact on system quality, and system quality along with course content quality and service quality directly influence students' satisfaction. Ram ́fez-Hurtado et al. [20] conducted their study focusing on the educational institutions which are not specialized online-based institutions, rather they had to rapidly shift their educational policy to online mode due to covid pandemic. In some research, the advantages of using an appropriate e-learning website with proper contents [21], the assurance of technical system quality and instructor quality [22], and the combination of telecommunication system and e-learning system to ensure accessibility [23] are found as some key criteria for e-learning service quality. Demir [24] used network quality, pricing, promotions, and conflict handling for performance benchmarking of telecommunication service quality. According to Belwal et al. [25], customer loyalty and customer satisfaction are closely related to service quality. They used the SERVQUAL model to analyze the service quality of two large telecommunication Companies in OMAN. Their findings suggest that reliability and assurance have more impact on customer loyalty compared to other dimensions. Hussain et al. used network quality along with five dimensions of service quality in the SERVQUAL model to analyze user satisfaction in the telecommunication sector, and outcomes from their study recommend that service quality, and network quality plays a vital role in telecommunication operators' losing their customers [26]. Vieira et al. extracted users' feedback from Twitter and radio base station information, and sentiment analysis using deep learning suggest that poor signal strength is the key complaint from the users, which degrades users' quality of experience [27]. Value-added service, tariffs, sales promotion, etc. are also significant in service quality analysis [15].

3. Methodology

In this study, students' feedback on online education and telecommunication service quality is collected and analyzed. The following steps are imitated to conduct the study:

3.1. Data Acquisition

Students' responses have been collected using Google forms. The questionnaire includes a total of 39 questions, of which, 38 questions are in multiple-choice format, and one in paragraph format. The first part of the questionnaire contains demographic information about the students, the second part contains questions related to online education, and the third part consists of telecommunication service-related questions. We provided the Google form link to students of several backgrounds at the university level. Students rated the quality of online education and telecommunication service in five criteria strongly agree, agree, neutral, disagree, and strongly disagree. The dimension and criteria to measure service quality regarding online education are presented in Table 1. The criteria are collected from the literature and divided into three dimensions namely service quality, system quality, and information quality.

Table 2 includes criteria for the service quality of the telecommunication system. Some sample statements from the questionnaire are presented in Table 3.

Table 1. Dimension and Criteria (Online Education)

Dimension	Criteria	Reference
Service Quality	Responsiveness Efficiency Reliability Empathy Interaction Privacy Trust Service for Impaired Students	[20,23,28] [29,30,31] [32,33,34]
System Quality	Availability Ease of Use Flexibility Visual Elements Resources Suitable Environment Digital Library	[20,23,28] [29,30,31] [32,33,34]
Information Quality	Use of Audio Elements Updated Information Useful Information Information Accuracy Information Easy to Understand	[30,31,33]

3.2. Experiment Details

Initially, we perform some preprocessing in the dataset to ensure the reliability of the collected data. Duplicate data are identified using the email address and deleted from the dataset. To analyze user satisfaction with telecommunication services for online education, a comparative analysis approach is used. Here, a comparative view of user satisfaction is discussed from the data of demographic analysis and user satisfaction percentage.

Table 2. Dimension and Criteria (Telecommunication Service)

Dimension	Criteria	Reference
Service Quality	Reliability Assurance Responsiveness Tangibility Empathy Connection Speed Network Quality Customer Service Coverage Area Pricing Structure	[24,25,26] [35,36,37]

Table 3. Sample Questionnaire

Criteria	Statement
Interaction	During the online course, interaction with the instructor is ensured.
Suitable Environment	The most developed technologies are used in the learning environment.
Coverage Area	In my geographical area, the network of the service provider is covered properly.

For ranking the criteria both for online education and telecommunication service, the entropy analysis technique is utilized. In the entropy technique, quantitative data is processed by assigning weight to each criterion. The following steps are followed to determine the weight to rank the criteria from best to worst according to Handayani et al. [38] and Hosen et al. [39]:

Step 1: Normalize collected data by subtracting all scores with the highest score.
Step 2: Divide the normalized score by the sum of all scores using (1).
Step 3: Determine the entropy for each criterion using (2).
Step 4: Determine the dispersion for each criterion using (3).
Step 5: Determine the weight of each criterion using (4).

$$a_{ij} = \frac{k_{ij}}{\sum_{i=1}^{m}\sum_{i=1}^{n} k_{ij}} \tag{1}$$

$$E_i = \frac{-1}{\ln(n)} \sum_{i=1}^{m} a_{ij}\ln(a_{ij}) \tag{2}$$

$$D_i = 1 - E_i \tag{3}$$

$$W_i = \frac{D_i}{\sum D_i} \tag{4}$$

In the equations- m >1; i = 1, 2, 3....n; j = 1, 2, 3....m; where n denotes the number of decision-makers, and m denotes the number of criteria. The experiment model is illustrated in Fig. 4, where the impact of telecommunication service quality on students' satisfaction with the online education system is considered.
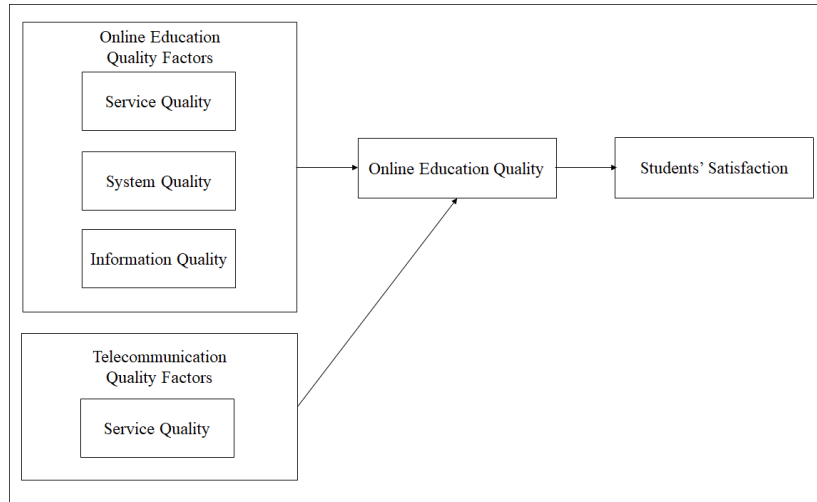
Fig. 4. Research Methodology

4. Result Analysis and Discussion

4.1. Respondents' Demographics

The data is collected by sharing Google form with the participants consisting of- (1) students from both IT and non-IT fields; (2) students from two public and three private universities; (3) students of different education levels in university; and (4) students from a different residential area. A total of 350 students participated in this survey. Table 4 represents the respondent's demographic information.

Table 4. Students' Demographic Information

Demography	Attributes	Percentage
Education Field	IT	63.4%
	Non-IT	36.6%
Education Level	First Year	14.6%
	Second Year	23.7%
	Third Year	19.4%
	Fourth Year	27.4%
	Masters	14.9%
Residential Area	Dhaka City	40.6%
	Other City	23.7%
	Rural Area	35.7%
Prior E-Learning Experience	Never	35.4%
	Sometimes	50.3%
	Very Often	14.3%
Daily Usage of E-Learning	1-3 Hours	74.6%
	3-5 Hours	18.6%
	>5 Hours	6.8%
Type of Network Used	Mobile Network	57.1%
	Broadband / Wifi	42.9%
Number of Networks Used	One Service Provider	60.3%
	Two Service Provider	13.1%
	Randomly from all	26.6%

The result demonstrates that the majority of the students are from the IT field, as our data is collected using Google Forms, and students in this field are most comfortable with such a survey. The number of students from different education levels is well-balanced. A large portion of the students attended the online class from Dhaka. Some students live in Dhaka with their families, also many living in other cities stayed near their campus area, which has increased the total number of participants in Dhaka, and has decreased the number in other cities. Students coming from rural areas mostly have to maintain their expenses by themselves, and they couldn't manage them during the lockdown. As a result, they had to go back to their home which badly affected their study. Though a portion of the participants has some prior e-learning experience, a significant number were introduced to the e-learning system for the first time during online classes. Another statistical result shows that most students are engaged in online classes for 1 to 3 hours on average per day. For this purpose, students are largely dependent on the cellular network (57.1%), and they have resistance to changing network provider as 60.3% depends on a single telecommunication service provider.

4.2. Service Quality Assessment

To analyze the quality of online education and telecommunication service in Bangladesh during the pandemic situation, this section elaborates on the result from the student perspective to identify the gaps. For data analysis, all criteria in Table 1 and Table 2 have been assigned some weights using the entropy technique. Higher weight indicates better service quality. Table 5, Table 6, and Table 7 illustrate the consequences of entropy analysis.

Table 5. Result of Entropy Analysis (Online Education)

Rank	Criteria	Weight	Rank	Criteria	Weight
1	Updated Information	0.051093785	11	Resources	0.05050539
2	Trust	0.050988711	12	Useful Information	0.05050539
3	Availability	0.050886647	13	Information Easy to Understand	0.050329195
4	Responsiveness	0.050886647	14	Privacy	0.049497012
5	Efficiency	0.050787425	15	Digital Library	0.049431124
6	Flexibility	0.050787425	16	Suitable Environment	0.049303572
7	Information Accuracy	0.050787425	17	Empathy	0.048952178
8	Reliability	0.050690896	18	Visual Elements	0.048792567
9	Ease of Use	0.050596925	19	Service for Impaired Students	0.047405376
10	Use of Audio Elements	0.050596925	20	Interaction	0.047175382

Table 6. Result of Entropy Analysis (Telecommunication Service)

Rank	Criteria	Weight	Rank	Criteria	Weight
1	Coverage Area	0.103340692	6	Empathy	0.099636865
2	Responsiveness	0.101799279	7	Assurance	0.099366256
3	Reliability	0.101125755	8	Connection Speed	0.099103398
4	Customer Service	0.100807579	9	Pricing Structure	0.098847861
5	Tangibility	0.099915711	10	Network Quality	0.096056603

Table 7. Summary of Entropy Analysis

	Dimension	Highest Ranked Criteria	Lowest Ranked Criteria
Online Education	Service Quality	Trust	Interaction
	System Quality	Availability	Suitable Environment
	Information Quality	Updated Information	Information Easy to Understand
Telecommunication Service	Service Quality	Service Quality	Network Quality

In Table 7, the result of entropy analysis is summarized, where the highest-ranked criteria indicate that students are mostly satisfied with these criteria, and vice-versa for the lowest-ranked criteria. According to the table, students have trust in the online education system, and they ranked its top position in the online education service quality dimension. The lowest-ranked criterion in this dimension is interaction with the instructor during online classes. Bali et al. in [8] have shown that current online learning lacks interactivity. System availability is the most salient criterion in system quality measurement. The students seem to be satisfied with the fact that the online learning environment can be reached at any time, especially when the classes are recorded. Flexibility and ease of use are also significant parts of this dimension, and according to Salameh et al. in [40], ease of use with support services increases the total number of users for mobile services. Although students seem to be satisfied with system availability, they feel the current online education environment is still not suitable for them. Most of the students think that they are provided updated information in the online education system, and they ranked it highest in the information quality dimension. As only 14.3 percent of users in our study had good prior e-learning experience before the online classes, the majority of them feel that information in the online education system is not easy to understand for them. In telecommunication service quality analysis, the most noteworthy criterion ranked by the students is coverage area. As the majority of the students in the study stayed in the city area during the pandemic situation, even the rural areas are also now covered by mobile operators, students have fewer complaints regarding coverage area. Rather, students have to suffer more for factors like

network quality, connection speed, and pricing structure. On average, students had to attend online classes for 1-3 hours per day, and the poor network quality unmotivated them to attend the classes. Although some of the mobile operators offered cheaper packages for the students in the latter part of the pandemic, it was not affordable for many of the students, and they ranked it in the lower part.

4.3. Users' Satisfaction Analysis

The last question in our survey is directly related to online education, telecommunication service quality, and student satisfaction. Most of the students (80.6%) think that telecommunication service quality in Bangladesh is not sufficient enough for online education. The findings of the research demonstrate several relationships between quality factors (online education and telecommunication service) and students' demographic with student satisfaction. The results indicate that ensuring a high-quality online education system is closely related to students' demographics and telecommunication service quality. Compared to students of IT background, students from non-IT backgrounds have very little prior experience in e-learning modules, which leads most of them (88.28%) to be unsatisfied with the online education system. In addition, 35.40% of students in our study have never used any e-learning module before online classes, and 83.87% of them are not satisfied with the current service quality. A large portion of the participants (74.4%) had to engage themselves for 1-3 hours per day in online education, and the pricing structure of telecommunication service providers was a major obstacle for them. Although participants in this study ranked network coverage in the topmost position, feedback regarding network quality and connection speed is not satisfactory. Among the students, 85.6% of rural areas, 78.17% of Dhaka city, and 77.11% of other cities are not satisfied with internet connection speed and network quality during online classes. According to the authors in [37], as network quality is one of the basic demands of a network user, it is a key determinant of customer satisfaction. During online classes, 57.1% of the students used cellular networks, and 42.9% used broadband/wifi for internet connection. Among them, 85.33% (using cellular network) and 77.00% (using broadband/wifi) are not satisfied with the service quality. In addition, 60.30% of students are users of a single service provider which is an indication of customers' loyalty, but 79.15% of them gave negative reviews regarding telecommunication service quality during online education.

4.4. Recommendations

In the last part of the questionnaire, participants were asked to put some recommendations for the improvement of telecommunication service quality, required for online education. It was an optional question with a long answer text option in the Google Form, and a total of 99 recommendations are recorded from the students' suggestions. Then the recommendations are mapped with the criteria of telecommunication service quality measurement in Table 2, and the outcome is presented in Fig. 5.
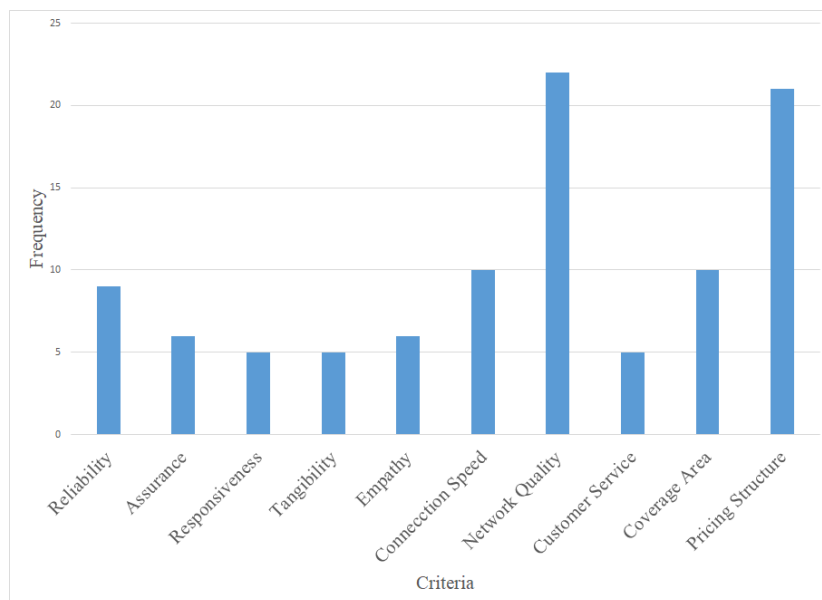

Fig. 5. Improvement Criteria for Telecommunication Service Quality

According to the result of the entropy analysis of telecommunication service quality in Table 6, network quality, pricing structure, and connection speed are the lowest-ranked criteria, and most of the suggested improvement recommendations fall under these categories along with some major concerns in the coverage area and reliability. Since the main objectives of this study are to evaluate the impact of telecommunication service quality on online education and to find out some significant criteria which can help to ensure a high-quality online education system in Bangladesh

to gain students' satisfaction, we recommend focusing on the above-mentioned criteria for improvement.

5. Conclusion

This research explored the students' experiences of getting engaged in online education in Bangladesh during the covid-19 pandemic situation with the help of telecommunication services. The findings of the study demonstrate that the average online class duration was 1 to 3 hours per day, and the majority of the students had to depend on cellular networks. They seem to be satisfied with quality factors like trust, system availability, and updated information on the online education system. In telecommunication service quality analysis, coverage area, responsiveness, and reliability are satisfactory criteria. The challenges faced by the students can be categorized into e-learning barriers and telecommunication barriers. The challenges such as lack of interaction in the online classes, lack of suitable environment, and hardness to understand information fall under e-learning barriers; and telecommunication barriers comprise poor network quality, overpricing structure of telecommunication services, and slow connection speed. The outcomes of this study have some significant implications for the policymakers to develop an online education platform in Bangladesh that will be accepted by the students with great satisfaction. The major limitation of this study is its scope, as it is limited to the students of very few universities. Therefore, it can be suggested that students of these universities might be more digitally competent than the students of other universities or vice versa. Being limited to only the university level, this research may not be taken as a strong case to describe the actual scenario of online education at all levels. Moreover, this study has not explored teachers' experiences which is a potential area for future research.

Acknowledgment

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