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Implications of COVID-19 on Student Learning Satisfaction (SLS): A Remedial Framework for Universities*

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Present study aims to investigate the implications of COVID-19 on the learning satisfaction of engineering students. In this regard, data were collected from 623 students living in the urban/rural areas and studying in the public/private universities of a developing country. Authenticity of the data was checked with the help of KMO (Kaiser–Meyer–Olkin) and Bartlett tests, while descriptive statistics, ANOVA, and multiple regression were used for data analysis. The results indicated an asymmetrical pattern, as the students living in urban areas and studying in private universities expressed the highest level of satisfaction (84.6%), while the students living in rural areas and studying in public sector universities expressed the lowest satisfaction scores (54.1%). It was observed that home learning conditions, availability of suitable computing devices, quality of internet services, and instructional methodology had the greatest impact on student learning satisfaction. Afterwards, structured interviews were conducted with the concerned stakeholders to develop a remedial framework for the guidance of universities. Although, the focus of the study was engineering students, yet the insights of the paper are quite generic and can be applied to other educational fields as well.

Keywords: COVID-19; student satisfaction; online learning; developing countries; urban students; rural students; engineering institutions

1. Introduction

The unprecedented outbreak of COVID-19 has created numerous challenges all over the world, and the global community is struggling to mitigate its socioeconomic implications [1]. In this regard, higher educational institutions (HEIs) also adopted various contingency plans to counter the negative fallout of COVID-19 [2]. As a preventive measure, most of the countries either closed down their campuses or shifted to online learning [3]. However, this phenomenon resulted into reduced student interaction with their course instructors [4] that ultimately affected their interest in virtual sessions [5]. Although massive open online courses (MOOCs) increased the reach to a wider number of audience [6], yet, in the absence of a vibrant campus culture and physical facilities, both student learning and their satisfaction were affected [7]. It is observed that despite obstacles and resource scarcity [8], the swift response of national institutions and teaching community successfully reduced the impact of the pandemic [9]. But, in the whole process, the whole academic structure including its rules, regulations and procedures came under tremendous pressure [10]. Similarly, most of the faculty members and students had no prior experience of digital pedagogy or e-learning protocols [11]. Although ed-tech companies like BYJUs, ZOOM, Tencent, Lark, Ding Talk, Alibaba Cloud, Bitesize Daily, and Microsoft Teams offered multi-featured programs to support an instant transition, but dependency on browser speed, net connectivity, and gadget affordability restricted their across-the-board utility [12]. During the digital transformation, the dependency on information technology was increased manifold, which highlighted the need of a strong infrastructural support [13]. And the issue gained more significance for the students of developing countries, where access to internet, availability of computing devices, and allocation of resources followed a non-symmetrical pattern [14]. Similarly, the students belonging humble backgrounds or living in the remote areas faced more difficulties due to the non-affordability of required resources [15]. In a study conducted by Bao et al. in China, it is observed that the Peking University immediately offered 4437 live online courses (LOCs) to their undergraduate and post-graduate students after the outbreak of COVID-19, however, factors like self-isolation, lack of self-discipline, and poor learning environments

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impacted the usefulness of these programs [16]. In another research, Shehzadi et al. surveyed 408 students in Pakistan and found a positive impact of e-service and e-information on their satisfaction level [17]. However, in a cross-sectional study conducted by Mechili et al. on 863 students in Albania, high levels of depression were observed among students during the quarantine period, that not only affected their mental health but also hampered their learning experience [18]. In a similar study carried out by Islam et al. on 476 university students in Bangladesh, it was revealed that the financial problems and academic delays due to pandemic produced heightened stress and anxiety among them [19]. Another study was done by Auejo et al. on 1500 students of Arizona State University and found heterogeneous effects of COVID-19 on their learning expectations [20]. Furthermore, Toquero discovered that the Philippines Commission on higher education (CHED) decided to suspend online classes just three days after their commencement, owing to the dissatisfactory response of students [21]. Moreover, the phenomenon of internationalization in higher education was also affected by COVID-19, when respective governments took several steps like travel restrictions, self-quarantines, and social distancing to control the spread of the pandemic [22]. Nevertheless, the higher education institutions quickly adapted to online learning, but the non-uniformity of resources between public and private universities resulted into asymmetrical outcomes [23]. However, these handicaps were sufficiently addressed by some institutions with the help of a hybrid pedagogy that incorporated both traditional and virtual teaching, to ensure academic continuity and student satisfaction [24]. On one side, social isolation, virus fears, and health insecurity influenced students' perception towards e-learning [25] but on the other side, their inside-the-home stay due to continuous lockdowns highlighted the importance of a conducive home environment on their learning satisfaction [26]. Under these circumstances, the symmetrical provision of services can reduce the challenges of remote learning [27], besides minimizing the stress among remote area students [28].

From the above-mentioned literature, it is evident that several studies have been conducted in various countries to assess the implications of COVID-19 on higher education. However, the present study uniquely focuses to see the implications of COVID-19 on the satisfaction level of engineering students based on their living in urban/rural areas and studying in the private/public universities of a developing country. In the current research, the term "public-sector universities" is used for those institutions that offer subsidized education and funded by either central or respective provincial governments. Due to affordable education, students of public sector universities come from all financial and social backgrounds [29]. On the other hand, private-sector universities are mostly self-financed and rely on students' tuition to cover their operating costs. They offer expensive programs that are mostly unaffordable to the students of low to middle income families [30]. Similarly, the term "urban area" is used for those places where all basic facilities, including internet service, access to computing devices and other technical supports are available, while the term "rural areas" encompasses both suburban and rural communities, where availability of these facilities is not uniform. The study carries more significance in the context of developing countries, where students of private/public universities and urban/rural areas complete their education in different educational environments. In these situations, it is important to explore whether these disparities compounded with COVID-19 have a symmetrical or asymmetrical impact on their learning satisfaction.

2. Materials and Methods

The theoretical framework for the study was based on the Online Collaborative Learning (OCL) theory of Linda Harasim [31], while determinants of the questionnaire were taken from the previous researches of Ikhsan et al. [32] and Eom et al. [33] and later grouped into ten categories of course understanding; virtual classroom interaction; instructional method; course design quality; instructor delivery style; grading assessment criteria; home learning conditions; suitable computing devices; internet service quality and overall learning experience. An online survey method was used for data collection due to its wide coverage and cost effectiveness [34]. The questionnaire comprised of twenty questions, which was administered to 650 students out of which 623 responded. These students belonged to both private/public sectors engineering institutions and living in the urban/rural areas of the country. The demographic profile of the surveyed students is shown in Table 1.

The students were asked to give their responses on a five-point Likert-type scale including of 1 (highly dissatisfied), 2 (dissatisfied), 3 (partially dissatisfied), 4 (satisfied) and 5 (highly satisfied). Due to multiple survey questions, reliability tests were done to check the reliability and stability of the data. As shown in Table 2, the values of the Cronbach's Alpha (α) are greater than 0.7 in all four groups indicating the internal consistency of data [35]. Similarly, the values > 0.5 in the KMO

Table 1. Demographic profile of the participating students

Demography	Frequency	Percent	Cumulative Percent
Urban–private	155	24.9	24.9
Urban–public	149	23.9	48.8
Rural–private	161	25.8	74.6
Rural–public	158	25.4	100.0
Total	623	100.0	

Table 2. Reliability and validity tests of "student satisfaction" construct

Demography	Questions	Cronbach's Co-Efficient (α)	KMO	Bartlett Test
Urban–private	20	0.79	0.52	0.003
Urban–public	20	0.74	0.50	0.015
Rural–private	20	0.82	0.68	0.000
Rural–public	20	0.69	0.49	0.022

analysis (Kaiser–Meyer–Olkin), while the values < 0.05 in the Bartlett's test indicates the adequacy and validity of the data [36].

3. Results

3.1 Satisfaction Level of Urban–Private Students

Fig. 1 shows the mean satisfaction scores of those students, who study in the private universities and live in the urban areas of the country. Their average satisfaction level is found to be 84.6%. The highest satisfaction is observed in the domains of internet service quality and suitable computing devices, while less satisfaction is noted in the fields of course design quality and virtual classroom interactions. Moreover, these students also feel satisfied with their home leaning conditions, instructors' delivery style, and methodology.

3.2 Satisfaction Level of Urban–Public Students

Fig. 2 shows the mean satisfaction scores of those students, who live in the urban areas and study in the public-sector universities. Their average satisfaction level is found to be 70.3%. Due to living in urban areas, they expressed satisfaction regarding internet services, followed by course understanding and overall learning experience. However, unlike their fellow students in private-sector universities, these students expressed partial dissatisfaction with the availability of suitable computing devices, course design quality and virtual classroom interactions.

3.3 Satisfaction Level of Rural–Private Students

Fig. 3 shows the mean satisfaction scores of those students, who study in the private-sector universities and live in the rural areas of the country. Their average satisfaction level is found to be 63.3%. Although they expressed partial dissatisfaction regarding the availability of internet services in rural areas, but they showed a high level of satisfaction regarding the availability of suitable comput-

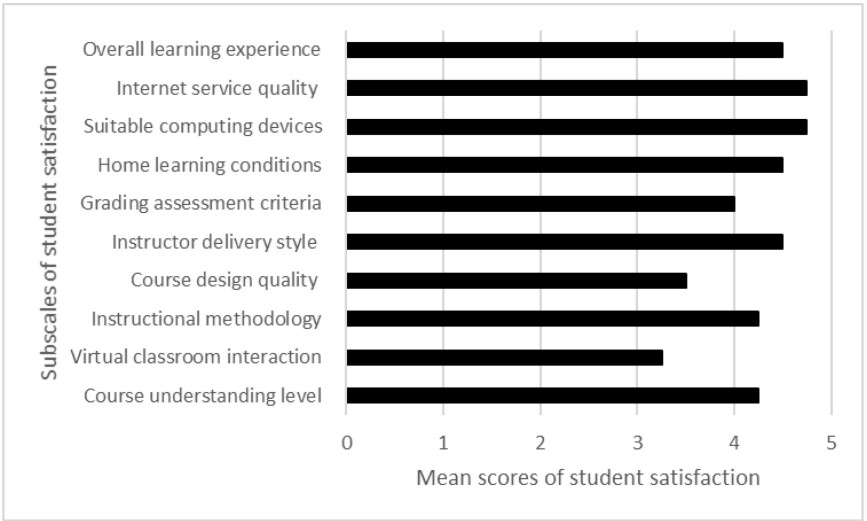

Fig. 1. Mean scores of the satisfaction level of urban–private students.

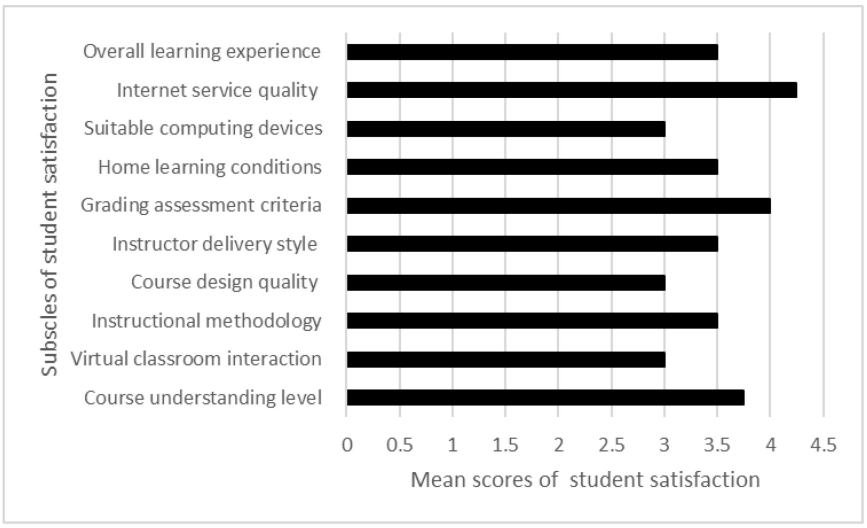

Fig. 2. Mean scores of the satisfaction level of urban–public students.

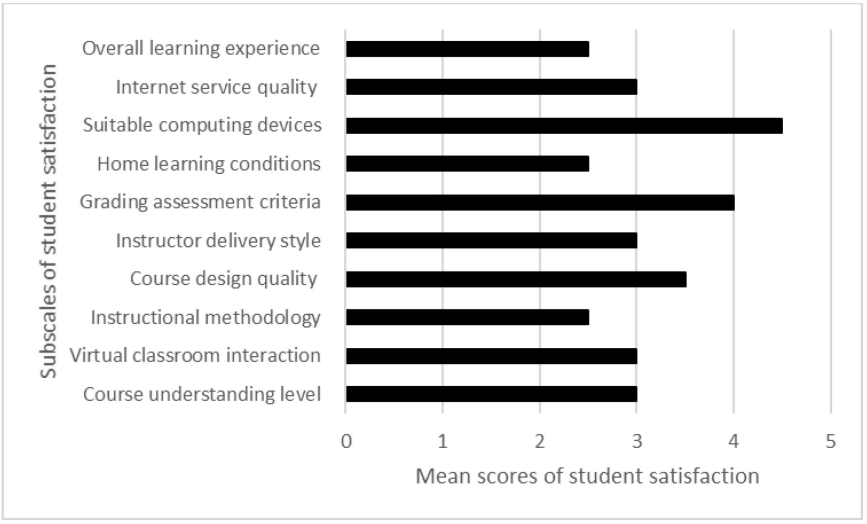

Fig. 3. Mean scores of the satisfaction level of rural–private students.

ing devices for their online education. Similarly, a high-level of dissatisfaction is observed in their overall learning experience, home learning conditions, and instructional methodology.

3.4 Satisfaction Level of Rural–Public Students

Fig. 4 shows the mean satisfaction scores of those students, who study in the public-sector universities and live in the rural areas of the country. Their satisfaction level is found to be 52.1%. They expressed an extreme level of dissatisfaction regarding the availability of internet services, home learning conditions and the availability of suitable computing devices. It can be seen from Fig. 4 that these students expressed a partial to high level of dissatisfaction in almost all areas, except the grading assessment criteria.

3.5 Hierarchical Analysis of Dissatisfaction Causes

Fig. 5 shows the hierarchical analysis of causes for reduced student satisfaction. These causes are categorized under the four clusters of urban-private, urban-public, rural-private and rural-public, respectively. It can be seen from Fig. 5 that course design quality (3.5) and virtual classroom interaction (3.25) causes dissatisfaction among urban-private students but their values range between partially dissatisfied and satisfied. Similarly, the urban-public students also show only partial dissatisfaction among three factors. However, the figure indicates that the students of rural-public areas have expressed extreme level of dissatisfaction in three areas of internet services (1.5), home learning conditions (2) and suitable computing devices (2).

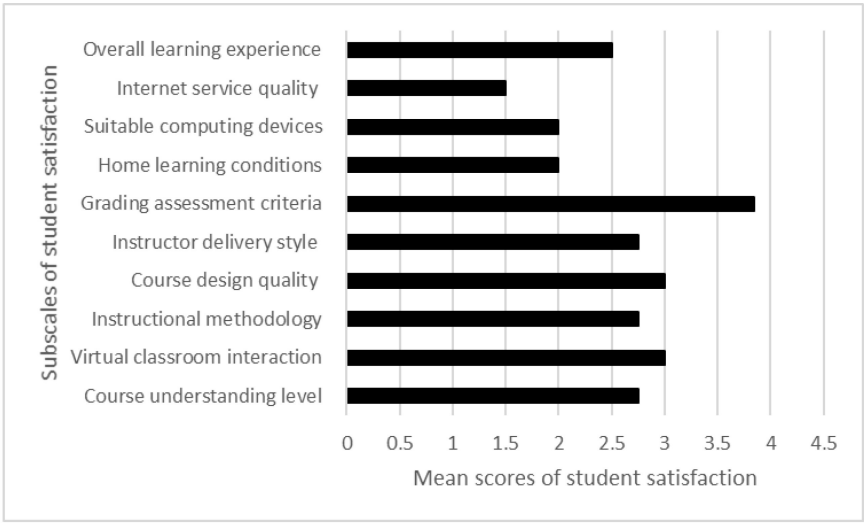

Fig. 4. Mean scores of the satisfaction level of rural–public students.

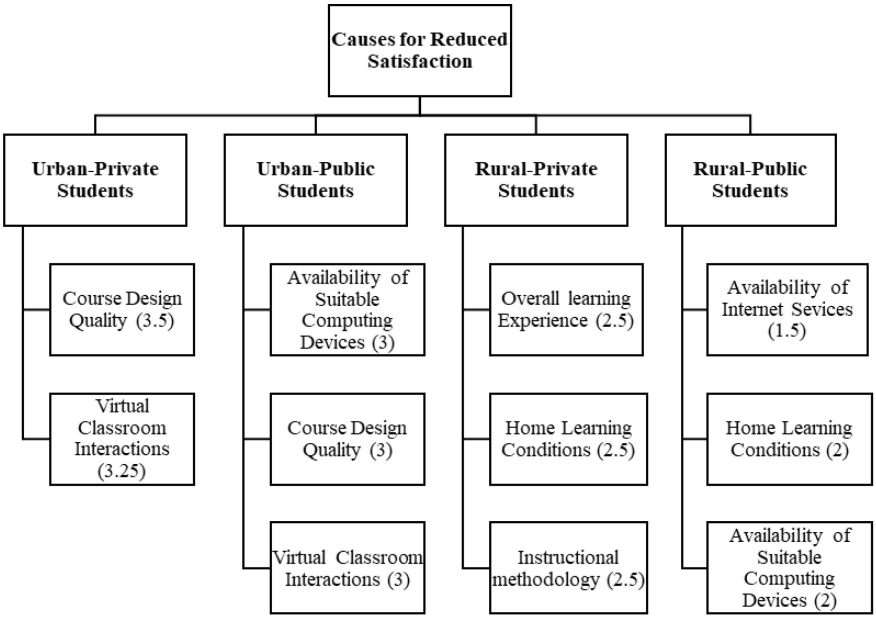

Fig. 5. Hierarchical analysis of causes for reduced student satisfaction.

3.6 Mean Satisfaction Scores of the Four Cluster Groups

Fig. 6 shows the interval plot of the mean satisfaction scores of students belonging to the four demographic clusters. It is evident that students from the urban–private group expressed higher learning satisfaction (84.6%), followed by urban–public (70.3%) and rural–private (63.3%) students while students belonging the cluster of rural–public showed minimum satisfaction (52.1%) in their learning experience.

3.7 Mean Satisfaction Score of Each Individual Factor

Table 3 shows the results of the ANOVA analysis, in which the mean score of each individual factor is compared with the mean scores of the corresponding factor in other groups. Results indicate that there is no significant difference between the mean values of three factors, namely virtual classroom interaction (p-value = 0.162), course design quality (p-value = 0.137) and grading assessment criteria (p-value = 0.385). However, in the remaining seven factors, with p-values < 0.05, a significant difference is detected between the mean satisfaction scores of the four groups. Among them, three factors, namely home learning conditions (p-value = 0.004), availability of suitable computing devices (p-value = 0.002) and internet service quality (p-value = 0.000), have the maximum difference.

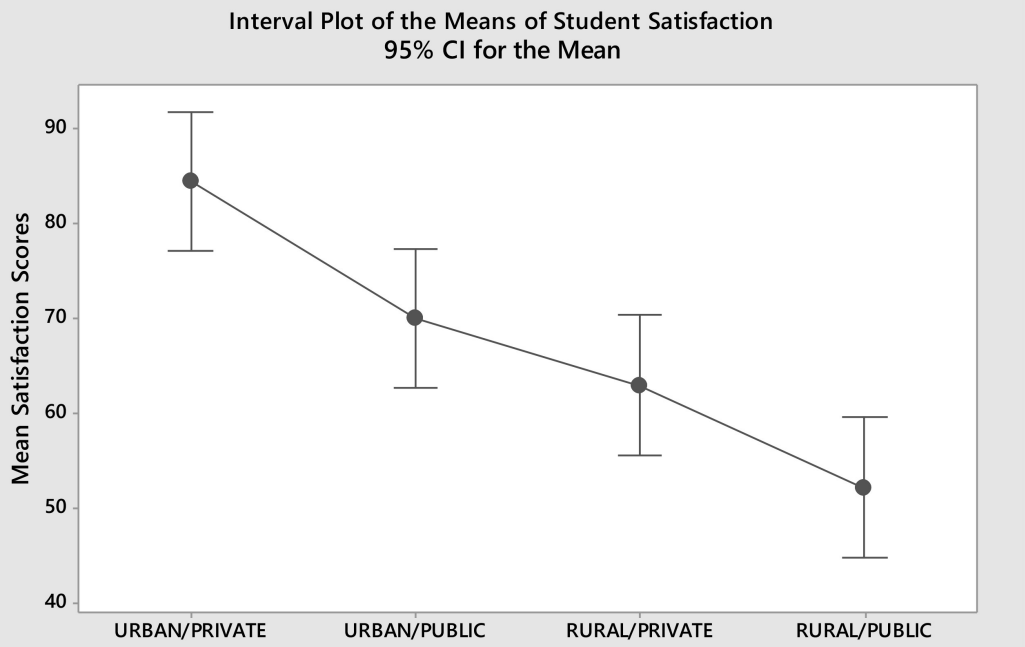

Fig. 6. Interval plot showing the means of student learning satisfaction in the four groups.

Table 3. ANOVA table showing the mean comparison of each individual factor.

Student Learning Satisfaction Factors	Urban-Private (UR/PR) (Mean)	Urban-Public (UR/PU) (Mean)	Rural-Private (RU/PR) (Mean)	Rural-Public (RU/PU) (Mean)	R-Sq (%)	R-Sq (Adj)	p-Value
Course understanding level	4.25	3.75	3.01	2.75	25.0	24.73	0.014
Virtual class interaction	3.25	3.06	3.05	3.02	0.83	0.35	0.162
Instructional methodology	4.25	3.51	2.51	2.75	31.1	30.77	0.010
Course design quality	3.51	3.07	3.50	3.02	4.81	4.35	0.137
Instructor delivery style	4.52	3.51	3.04	2.75	28.4	27.89	0.022
Grading assessment criteria	4.01	4.15	4.05	3.85	0.88	0.29	0.385
Home learning conditions	4.50	3.51	2.53	2.06	47.3	42.15	0.004*
Suitable computing devices	4.75	3.02	4.51	2.01	65.2	59.12	0.002*
Internet service quality	4.75	4.25	3.09	1.52	70.9	66.38	0.000*
Overall learning experience	4.52	3.51	2.52	2.50	39.5	34.72	0.031

* Indicates the significance of values.

Table 4. Regression table showing the effects of predictor variables on student satisfaction.

Predictor Variables	Course Understanding Level	Virtual Class Interaction	Instructional Methodology	Course Design Quality	Instructor Delivery Style	Grading Assessment Criteria	Home Learning Conditions	Suitable Computing Devices	Internet Service Quality	Overall Learning Experience	R-sq (%)	R-sq (Adj)	*p*-Value
Urban–Private	2.26	1.17	2.72	2.36	2.88	1.26	3.29	3.48	3.96	2.25	89.5	81.2	0.012
Urban–Public	2.01	1.24	2.94	2.06	3.14	1.72	4.11	3.72	4.37	1.75	91.2	86.7	0.005
Rural–Private	1.85	2.03	3.54	1.79	3.39	2.01	4.23	4.76	5.18	2.63	90.7	84.8	0.010
Rural–Public	1.92	1.67	4.28	2.23	4.32	1.98	5.22	5.74	4.89	1.97	84.9	80.5	0.002
Average Impact	2.01	1.52	3.37	2.11	3.43	1.74	4.21	4.35	4.6	2.15	89.1	83.3	0.007

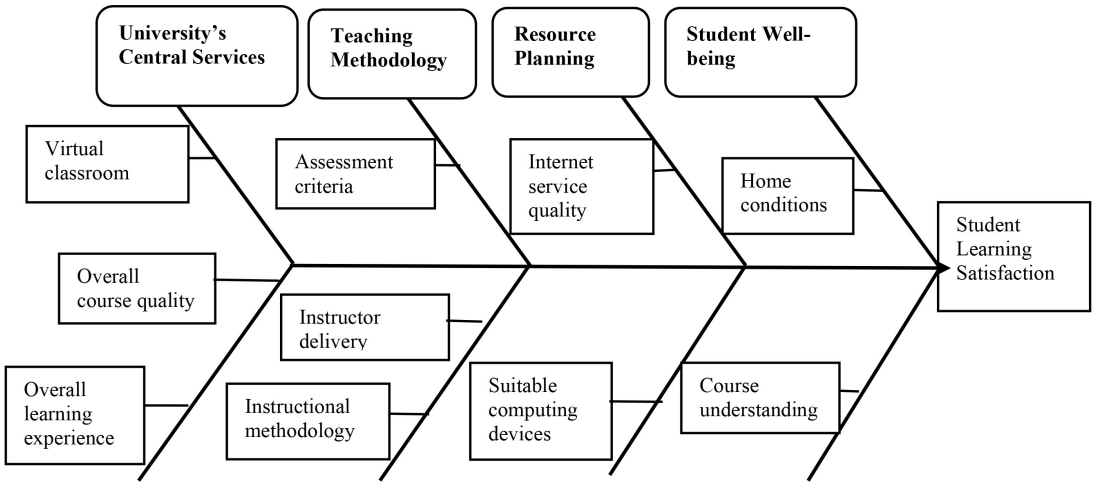

Fig. 7. Ishikawa diagram showing cause & effect of student.

3.8 Impact of Independent Factors on Student Satisfaction

Multiple regression is used to see the impact of each independent variable on student learning satisfaction. As evident from Table 4, the three factors of home learning conditions, suitable computing devices and the quality of internet service have the highest impact on student learning satisfaction. Conversely, the grading assessment criteria and virtual classroom interaction have the lowest impact on student satisfaction. Moreover, the R^2 values in all four clusters indicate that the predictor variables create significant variation in student learning satisfaction. Similarly, an overall R^2 value of 89.1% with a p-value of $0.007 < 0.05$ indicates the statistical significance of the predictor variables in predicting student learning satisfaction.

3.9 Ishikawa Diagram of Student Learning Satisfaction

Fig. 7 shows the cause-and-effect analysis of student learning satisfaction with the help of Ishikawa diagram. As evident, the four effects of university central services, teaching methodology, resource planning and student well-being are articulated with the ten causes. The figure shows that the university central services and teaching methodology can play a dominant role in student learning satisfaction as compared to resource planning and student well-being efforts.

4. Remedial Framework for Universities

In the light of results from the discussion section, a remedial framework was developed for the guidance of universities. In this regard, the research team adopted a three-step strategy to carry out this process. During first step, the key findings of the present study were summarized in order to develop a customized questionnaire. In the second step, a series of online structured interviews were conducted with the students, parents, university management and government officials to get their feedback. During these interviews, the research team thoroughly explained the theme of every question to avoid any ambiguity. In addition, some exclusive sessions were held with the university's academic and administrative staff to further inquire their managerial experience during COVID-19. Finally, in the third step, the research team synthesized all inputs of the relevant literature and concerned stakeholders to formulate a ten-point remedial framework for the guidance of universities. This remedial framework classified into four broad categories is presented below to provide a comprehensive set of guidelines for other universities sharing similar problems.

4.1 University's Central Services

4.1.1 Availability of Strong Servers (ASS)

Due to COVID-19, the whole spectra of undergraduate and graduate level courses were shifted online, thus creating a substantial load on the university servers. This inherent weakness not only hinders the smooth running of programs but also increases the chances of frequent shutdowns. Due to which, students of both urban/rural areas faced difficulties like, audio lagging, virtual inadequacy or poor video conferencing. By ensuring the availability of strong servers (ASS), public/private universities can safeguard the interests of all pedagogical stakeholders that are involved in the process of online learning. In addition, strong servers also help in maintaining a strong centralized knowledge repository that can be accessed by both students and the faculty during online learning.

4.1.2 Uniform Technical Support (UTS)

As evident from findings that learning satisfaction of students' from remote areas or disadvantaged backgrounds is affected due to a non-suitable computing devices, unstable internet and poor access to the required technology. This phenomenon resulted into learning discrepancies between socially disadvantaged students and their advantaged peers. Furthermore, the non-uniform access to educational technologies created inequalities among students based on their socio-economic backgrounds. IT communities can be engaged in this regard to support students facing technical issues in their e-learning. Furthermore, it is necessary that universities must arrange uniform technical support (UTS) to all stakeholders in order to avoid any discrepancy among student learning on the basis of their socio-economic backgrounds.

4.1.3 Development of E-learning Protocols (DEPs)

Since the outbreak of COVID-19, higher educational institutions have swiftly moved from conventional to online learning, but faced unprecedented difficulties in the absence of any e-learning protocols. Nevertheless, the concepts of blended learning and hybrid education was introduced by the institutions, still the quality of pedagogy was hampered due to inadequate e-learning protocols. Resultantly, no policy framework or strategic guidelines were available for the guidance of concerned stakeholders. It is important that the management of universities must develop a customized set of e-learning protocols (DEPs) incorporating the concerns of all stakeholders including teachers, students, parents, the community, and staff.

4.2 Teaching Methodology

4.2.1 Content Breakdown Strategy (CBS)

Due to weak persistency of students to listen long lectures via internet, students faced unprecedented difficulties in absorbing the lecture contents. Moreover, lack of face-to-face interaction between students' and teachers' further compounded the problem. Resultantly, significant amount of loss took place in the effective transfer of knowledge, which underscored the need of designing a digital learning content. In this regard, the faculty members of public/private universities can follow the content breakdown strategy (CBS) and divide bigger lectures into smaller chunks of maximum 10 to 15 min per part. By following this, the content absorption losses can be minimized despite non-uniformity of resources for urban/rural areas and public/private students.

4.2.2 Appropriate Voice Speed (AVS)

During conventional teaching, both teachers and students enjoy face to face interaction for knowledge dissemination, but the process of virtual learning mostly depends upon the teacher's verbal communication. Among four components of effective communication, teachers' listening and speaking play a significant role as compared to his/her reading and writing. On one side, the quality of content is important, but on the other side, it is equally important that how it is delivered. Bringing right kind of clarity, warmth and enthusiasm in voice can make a substantial impact on student learning satisfaction. Similarly, in the absence of video conferencing due to connectivity and societal issues, it is crucial for the faculty members of both public/private universities to select appropriate voice speed (AVS), tone and delivery style commensurate with the understanding level of their students.

4.2.3 Out-of-Class Engagement Programs (OGPs)

In the absence of classroom engagement and the reduction of face-to-face contact hours, the importance for out-of-class engagement programs (OGPs) is also increased. During COVID-19, it has become a challenging task for teachers' to retain the attention and focus of their students. It not only creates a digital divide between students' but also hampers the credibility of overall learning experience. Instructors can adopt the policy of asynchronous classes, where students are facilitated through recorded lectures besides saving them from cognitive overload. Moreover, keeping in view the non-uniformity of urban/rural facilities, it is imperative that the faculty members must engage their students by giving them homework, assignments, and other reading materials to compensate for their online learning losses.

4.3 Resource Planning

4.3.1 Public–Private Partnerships (PPPs)

Since COVID-19, although private universities swiftly moved to online learning due to better resources, the public-sector universities also responded well owing to the nationwide government support. However, both types of institutions faced common problems of net connectivity, student assessments, faculty training, and necessary hardware, thus creating a need of public–private partnerships (PPPs) to share their e-learning experiences with each other. By doing this, not only the educators and learners can improve their connectivity but also help each other in overcoming the shock to conventional education model. In this regard, they can integrate their resources for the

provision of soft loans, access to technology and sharing the available knowledge repositories.

4.3.2 Online Infrastructure Investments (OIIs)

The transition from conventional to digital pedagogy highlighted serious impediments to the smooth and symmetrical transfer of knowledge, due to which dissatisfaction was observed among all stakeholders, including teachers, students, staff and parents. The role of technology has been instrumental during this transformation; however, it cannot be possible in the absence of required infrastructural support. Lack of investment resulted into poor infrastructure furthering the fear of technophobia among teachers and students. Under these situations, it is important that all relevant institutions must make necessary online infrastructure investments (OIIs) to ensure uniform availability of necessary resources in all areas of the country.

4.4 Student Well-Being

4.4.1 Emotional Well-Being Programs (EWPs)

Preventive measures, such as lockdowns, self-isolation, quarantine and social distancing created stress among students that not only affected their cognitive abilities, but also disturbed them emotionally. Due to online learning, students had to work for long hours on computers, tablets and other smart devices, that eventually created anxiety and exhaustion among them. Besides depression, the sudden switching from conventional to digital learning also created a system shock among students, due to which their academic activities are badly disrupted. Under these situations, emotional well-being programs (EWPs) must be initiated on a priority basis for all students regardless of their public/private association and make them capable of handling these stressful situations.

4.4.2 Parents Awareness Programs (PAPs)

As evident in the findings that home learning conditions played an important role towards student learning satisfaction. However, most of the parents were not aware of its importance, and the issue became more critical for those students, who belonged from humble backgrounds and living in small homes. This unawareness on behalf of the parents led to the creation of unstructured home environment, where student learning was hampered by various kind of distractions. Moreover, their own beliefs, social backgrounds and lack of knowledge further restricted them to provide necessary technological assistance to their children during home learning. On the other hand, parents support in this regard can significantly contribute to creating a suitable learning environment for their children. In these situations, it is imperative that parents awareness programs (PAPs) must be initiated to guide parents and other family members about the impact of conducive home environments on the learning efficacy of their children.

5. Discussion

The findings of the present study indicate that student learning satisfaction follows an asymmetrical pattern due to the implications of COVID-19. It is observed that the students living in rural areas and studying in public- sector universities expressed the lowest level of satisfaction with three factors: quality of internet services, availability of suitable computing devices and conducive home learning conditions are found to mainly responsible for dissatisfaction. Further probing reveals that most of the rural–public students come from the lower income strata of the society, due to which they can neither afford necessary computing devices, nor enjoy the privilege of conducive learning environments. Majority of these students live in small homes with limited number of computing devices to share among all siblings. Moreover, the poor quality of internet services in these areas further compound their problems. Because, in the absence of needed technical support, these students cannot benefit from internet based laboratory platforms, which are considered vital to enable their access to online experiments [37]. However, their counterparts living in rural areas but studying at private universities experience these problems at a lower scale because of better finances to afford necessary facilities for online education. Results show that the urban-private students enjoy maximum satisfaction among all four groups due to strong financial backgrounds coupled with their urban living. Moreover, they also enjoy conducive home environments, as most of their family members understand the importance of education, thus furthering the notion that social interaction among virtual communities leads to enhance learning motivation of engineering students [38]. However, in a notable observation, it is found that students from all four clusters score a symmetrical 80% satisfaction rate with the grading assessment criteria. Careful analysis shows that due to COVID-19, most institutions adopted a lenient assessment policy, due to which the student grades have shown an upward trend. As a result, they feel contended and expressed satisfaction with the grading mechanism.

Findings also reveal the significance of instructor's delivery style, as the reliance on teachers' verbal communication further enhances in the absence of face-to-face interaction. Similarly, a lot

Table 5. Remedial table along with the list of needed actions and their sponsors

List of Causes	Needed Actions	Impact	Responsibility
• Virtual class interaction • Overall course quality • Overall learning experience	• Availability of Strong Servers • Uniform Technical Support • Development of E-learning Protocols	University's Central Services	Rectorate
• Assessment criteria • Instructor delivery style • Instruction methodology	• Content Breakdown Strategy • Appropriate Voice Speed • Out-of-Class Engagement Programs	Teaching Methodology	Professors
• Internet service quality • Suitable computing devices	• Public–Private Partnerships • Online Infrastructure Investments	Resource Optimization	Rectorate, Government
• Home learning conditions • Course understanding	• Emotional Well-being Programs • Parents Awareness Programs	Student Well-being	Students, Parents, Government

of variation is observed in the learning satisfaction of those students, who study in the same public sector universities but live in their respective urban and rural communities. The phenomenon further highlights the asymmetrical and non-uniform implications of COVID-19 on student learning satisfaction due to their demographic characteristics.

Finally, based on the inputs from concerned stakeholders and literature review, a ten-point remedial framework is presented in the above-mentioned section. Afterwards, the researchers further identified the list of persons/organizations, who can play an active role in the implementation of these actions. The summary of the findings is presented in Table 5.

The findings of the Table 5 can be beneficial for the universities worldwide, who are struggling to bring symmetry among student learning regardless of their urban-rural backgrounds. The table clearly shows the summary of causes, needed actions, their impact and the sponsors of these remedial actions. In this regard, the university's rectorate is found to play a significant role in the optimization of resources along with improvement in university's central services. On the other hand, professors can bring lot of improvement in their teaching methodology by working on their lecture contents, communication and out of class student engagements. Furthermore, the role of government and parents are equally crucial in the creation of conducive learning environments that can eventually enhance the student learning satisfaction and mitigate the negative effects of COVID-19.

6. Conclusions

The COVID-19 pandemic has exposed many discrepancies in the symmetrical deliverance of quality education among the students of engineering institutions. It is observed that the students living in urban areas and studying at private universities feel more satisfied as compared to students who live in rural areas and study at public universities. Although the provision of quality internet, suitable computing devices, conducive home environments, and effective instructional methodology have the maximum impact on student learning satisfaction, but these facilities are not evenly available. Consequently, the satisfaction level of students also follows an asymmetrical pattern due to their diversified geographical locations and different socio-economic backgrounds. Furthermore, structured interviews and follow-up discussions with concerned stakeholders reveal an overlapping role of parents, university management, and respective ministries in the uniform dissemination of these factors. In this regard, the concerned government departments must ensure quality internet services to both urban and rural areas, while the university management should offer suitable computing devices to their students in the form of soft loans, besides taking care of the effective instructional methodology from their faculty members. Similarly, the parents of these students must also be given awareness to create conducive home environments for effective learning of their children. Finally, the remedial framework was presented for the symmetrical provision of online learning to all students. Nowadays, funds are being diverted to health sectors and efforts are being made toward the revival of economic activities; however, educational spending's must also be safeguarded from these fiscal pressures in order to mitigate the negative implications of COVID-19 on higher education. Although findings of the study are specifically related to one developing country, however, the results can be generalized to all those countries with similar socio-economic and cultural backgrounds. Similarly, the insights of the paper are quite generic and can be applied to other educational fields beyond engineering education as well.

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