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Original Article

Investigating The Challenges of Engineering Students at The University of Tehran in Regard to Online Learning During COVID-19 Crisis: A Mixed Study

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Abstract

During the pandemic of COVID-19, face to face class sessions, in education systems, have been suspended due to various recommendations of governments. To continue teaching and learning, universities have switched to online learning. In the past two years, implementation of online learning, despite its benefits for higher education, has had its drawbacks and students have faced to a variety of challenges. The primary purpose of this study is to investigate the perceptions and opinions of undergraduate engineering students at the University of Tehran about the existing challenges, and their suggestions for making the online learning more efficient in engineering education. This research is performed using a mixed model. A conceptual research model was designed that categorized the main elements of effective online learning into three categories: learners, instructors, and content, and then based on this conceptual model, a questionnaire including Likert and open-ended questions was developed to determine the challenges facing engineering students in online learning in the Corona era. By distributing this questionnaire among incoming engineering students of Tehran University in 2019 and 2020 and analyzing quantitative and qualitative data, to two questions, "What have been the challenges of engineering students in online learning during the Corona era?" And "How has the quality of online engineering education been during the corona pandemic?", was answered. For analysis, qualitative data were coded and categorized using the thematic analysis method and using MAXQDA, and the frequency of each category and code was determined. Quantitative data were also analyzed by statistical analysis methods including descriptive statistics and t-test of independent groups in the SPSS, and then two sets of findings obtained from quantitative and qualitative data were summarized and combined. Based on the results, students' challenges during the pandemic were categorized into five groups: personal challenges, limited social interaction, technology problems, evaluation issues, and concerns about content and teaching methods. Students' feedback is an important tool in assessing the quality of online courses but other stakeholders' conceptions and feedbacks should be studied in future research as well.

Keywords

Engineering Education - Online Learning - Emergency Remote Teaching - Students' Challenges - COVID-19.

Introduction

- Problem Statement

With the outbreak of COVID-19 virus in China, in December 2019, and its rapid spread

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worldwide, World Health Organization (WHO) declared the disease a pandemic, in March 2020. As the outbreak intensified, various countries, including Iran, turned into quarantine and closed a wide range of organizations. Education systems were no exception to this policy and according to a UNESCO report, by May 7, 2020, education systems at all levels got closed in 180 countries (UNESCO, 2020). One of the most common policies in education systems around the world has been to react to the pandemic by implementing "emergency e-learning" protocols in order to reduce the stress of social distance by staying at home, while benefiting from education. Hence, close to 70% of higher education institutions have changed their classrooms to online learning systems (The Difference Between Emergency Remote Teaching and Online Learning | EDUCAUSE, n.d.; Toquero, 2020). In the recent year, although COVID-19 Pandemic has imposed many problems on all aspects of society, including economy, health, and social communication, it has led to the flourishing of some capabilities in the country, including the pervasiveness and prosperity of e-learning and the rapid implementation of online learning programs at universities across the country.

E-learning has many benefits such as continuing learning in crisis situations, expanding access to educational opportunities, flexibility, the ability to document course content to facilitate student access, and reuse for higher education (Dumford & Miller, 2018; Müller et al., 2021; Paudel, 2020). However, the implementation of such courses has its own drawbacks, as well. During the past three semesters that e-learning was implemented in universities across the country due to COVID-19 crisis, students and instructors have faced serious challenges. Teaching and learning were unplanned and processed on a try-and-error basis; hence in many cases, they probably did not have the required efficiency. Therefore, it is necessary to develop and implement an efficient and effective e-learning model in the country. For this purpose, first, the problems and challenges that students faced during this period should be identified, and their suggestions for improving online learning should be considered. Then, as the next step and future research based on the identified problems, a model for effective e-learning in engineering education will be offered, for the purpose of using for COVID-19 and post-COVID-19 eras.

- Background

In most of the previous studies, the lack of significant interaction between students and instructor was known as the main disadvantage of the e-learning. Accordingly, students stated that in the online learning environment, they cannot interact and communicate directly with their instructor and classmates and cannot cooperate with each other like in the traditional classes (Adnan & Anwar, 2020; Angelova, 2020; Kedraka & Kaltsidis, 2020; McKenna, 2018; Oliveira et al., 2018; Tümen Akyıldız, 2020). From instructors' point of view, lack of grounds for meaningful interaction with students, and also not seeing facial expressions of students, in order to get feedback on the appropriateness of speed and the quality of their teaching, have been challenging for them, especially when only video sharing is used for teaching (Ghazal et al., 2015; Mishra et al., 2020). Both instructors and students have complained about the lack of instant feedback on online learning and thus their lack of motivation online. Instructors need to design course resources and activities and have little time to answer students' questions and give and receive feedbacks (Dumford & Miller, 2018; Mishra et al., 2020).

Although, in synchronous e-learning and holding classes in the form of video conference, possibility of instant feedback and interaction between students and instructors is greater, but this type of learning also has its own weaknesses. Based on students' opinions, agreement on class schedules especially in crowded classrooms is challenging. In general, in synchronous online learning, there is no learning feature for the learner at any time, on the other hand, sometimes due to poor management of class schedule, they intersect, and this is stressful for them. Technical problems are also known as the main problems of online lectures, and issues such as low image and sound quality, system interruption and connection, high system traffic, bandwidth problems

and other problems can weaken the learning process and lead to students' dissatisfaction (Angelova, 2020; Ghazal et al., 2015; Mishra et al., 2020).

Another major challenge in e-learning is the problem associated with poor internet connection and excessive cost of internet packages. This is especially challenging in underdeveloped countries where most students are unable to access stable internet due to financial and technical issues (Adnan & Anwar, 2020; Bhusal & Rimal, 2020b; Ekmekci, 2017; Heri Suryaman et al., 2020; Olt, 2018; Paudel, 2020). Turning all learning courses to online version is a big challenging transformation. In general, any online course requires teaching design, careful curriculum planning, effective learning resources such as audio and video content, as well as technical support and pedagogy teams. The sudden emergence of COVID-19, confronted most faculty members with challenges such as lack of experience and knowledge of online teaching and use of information technology, inappropriate teaching strategies, lack of preparation and prior planning, and lack of necessary support and regular class management.

Furthermore, uncertainty about the real presence and active participation of students, lack of experience and knowledge in how to monitor the performance and quality of online learning, lack of knowledge on how to assess learners' knowledge and skills, time consuming resource design and course activities are other challenges (Bao, 2020; Chen et al., 2020; Dumford & Miller, 2018; Ghazal et al., 2015; Korkmaz & Toraman, 2020; Mishra et al., 2020; Tümen Akyıldız, 2020). In addition, in online learning, students face with a lack of favorable learning environment at home and more distraction, and constant computer work, resulting in headaches and eye fatigue. Also, challenges in group activities, lack of appropriate learning habits such as personal discipline, time management, control and path selection personal learning and the high volume of assignments presented are other challenges that students experience (Adnan & Anwar, 2020; Angelova, 2020; Bao, 2020; Oliveira et al., 2018; Paudel, 2020; Tümen Akyıldız, 2020). The COVID-19 pandemic introduced a significant number of students and instructors to the online classroom. However, the reality is that many of these students and instructors were not engaged in a well-crafted and extensively planned online education experience (Bozkurt & Sharma, Ramesh, 2020). rapid transition to online teaching did not allow time for meticulous planning and was not voluntary for students nor for teachers (Bidwell et al., 2020). Besides, given the urgency and the specific characteristics of the pandemic, methods traditionally used for on-campus teaching have just been transferred to the online environment, without further possibility to adapt to the online environment in a way that its potential could be properly developed (Pazos et al., 2020). This, added to the fact that most of the teaching faculty had at that time little or no training in terms of distance education, and could not be expected to become experts in the subject overnight (Bidwell et al., 2020).

Transitioning from a traditional education curriculum and conventional pedagogical methods to virtual learning created an incredible feat for faculty and students (Toquero, 2020). The speed at which the transformation occurred exacerbated existing obstacles and created additional challenges for universities, faculty, and students. Pedagogical approaches and the resulting learning environment during the pandemic can be characterized as crisis learning rather than typical digital learning, further reducing educators' opportunities to address students' individual needs (Pace et al., 2020). These learning needs should also be accurately reflected in curriculum design. Yet, most universities transfer existing curricula directly to online platforms without considering the pedagogical deficiencies that impact students (Toquero, 2020). Therefore, learning styles are primarily overlooked as educators transfer content from one environment to another, contributing to an environment of learning stagnation (Dhawan, 2020).

This type of education adopted during the pandemic has been coined by literature as Emergency Remote Teaching (ERT) and defined as "a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances". Emergency Remote Teaching or ERT involves a sudden and often dramatic shift from a traditional learning environment using

conventional pedagogical methods to a remote (online) learning environment in response to crises, such as the COVID-19 pandemic (Affouneh et al., 2020). These shifts result in a drastically different online learning environment than the typical online learning environment because they are highly stressful. These educational responses to crises often yield anxiety, disorganization, a lack of teacher training, and confused students. Moreover, the resulting learning environment is conducted with a great deal of uncertainty, as educators and students do not know when the crisis will end (Schlesselman, 2020). Often, emergency or crisis teaching pedagogy is a learned skill that most traditional classroom instructors do not have, as they are rarely trained in this area. Therefore, the dynamic global shift to crisis online learning led to breakdowns in communication and reduced educational quality, as educators struggled to adapt to an unknown environment (Abou-Khalil et al., 2021). Subsequently, students often felt lost, disenfranchised, and far less engaged than they would be in a traditional classroom or an organized and well-designed online learning environment absent from crises (Rapanta et al., 2020). Therefore, the inherent difficulties both educators and students face when shifting from a traditional learning environment to an online one are significantly exacerbated by ad hoc crisis learning environments (Hofer et al., 2021).

- Material and method

- Research design

The general goal of this study is to investigate the perception and perspective of engineering students about online learning in the COVID-19 pandemic crisis at the University of Tehran, and the research questions to achieve this goal are defined as follows:

1.What are the main factors influencing the quality of online learning?

2. What have been the online-learning challenges of undergraduate engineering students at the University of Tehran during the COVID-19 era?

3. What are the suggestions of undergraduate engineering students, at the University of Tehran, in order to overcome the challenges and to improve online learning?

This research project is a practical project in terms of its purpose and is considered among the research projects with a mixed model of the intertwined type (Bazargan, 2020). The researcher has used a mixed research design that combines quantitative and qualitative research methods and data with the overall goal of using the strengths of each method to minimize their weaknesses (Creswell & Creswell, 2018). In fact, the research questions are such that in order to answer them and reveal the desired uncertain situation, i.e., the quality of emergency e-learning implementation and the challenges facing engineering students in e-learning, it is necessary to use a combination of quantitative and qualitative data and methods.

First, the conceptual model of the research is designed (Figure 1), and in this research, the framework provided by (Kebritchi & Santiague, 2017) was used as a basis for designing the conceptual model of the research. The three main elements of learners, instructors and content were identified as the basic categories for the effective elements in the quality of online learning, and the sub-categories of each category were collected and summarized in detail and widely. Figure 1 shows the conceptual model designed for this research, which was used to design the questionnaires and also to analyze and code the qualitative data obtained from the open-ended questions of the questionnaire. Then, based on the conceptual model, he designed a questionnaire including Likert questions and open-ended questions to determine the challenges facing engineering students in e-learning, and by distributing this questionnaire among the students of the Faculty of Engineering Sciences, University of Tehran, and analyzing the resulting quantitative and qualitative data with the necessary software, two questions "How was the quality of engineering education during the Corona crisis in Iranian universities?" and "What have been the challenges of engineering students and professors in electronic learning in the era?" will be answered. In this research, self-completion questionnaires with Likert scale questions and open-

ended questions were used to collect data. Based on this theoretical framework, a questionnaire was designed under the title "Efficiency Questionnaire of Online Learning in the Corona Era". This questionnaire included three parts of questions that were related to the three categories of main elements identified, i.e. learners, instructor and content. Due to the length of the designed questionnaire, the Split Questionnaire Design was used and It was divided into two shorter questionnaires. Questionnaire A was made of questions related to the content and questionnaire B contained questions related to the learner and instructor. Table 1 and 2 shows Cronbach's alpha calculated for questionnaires "A" and "B".

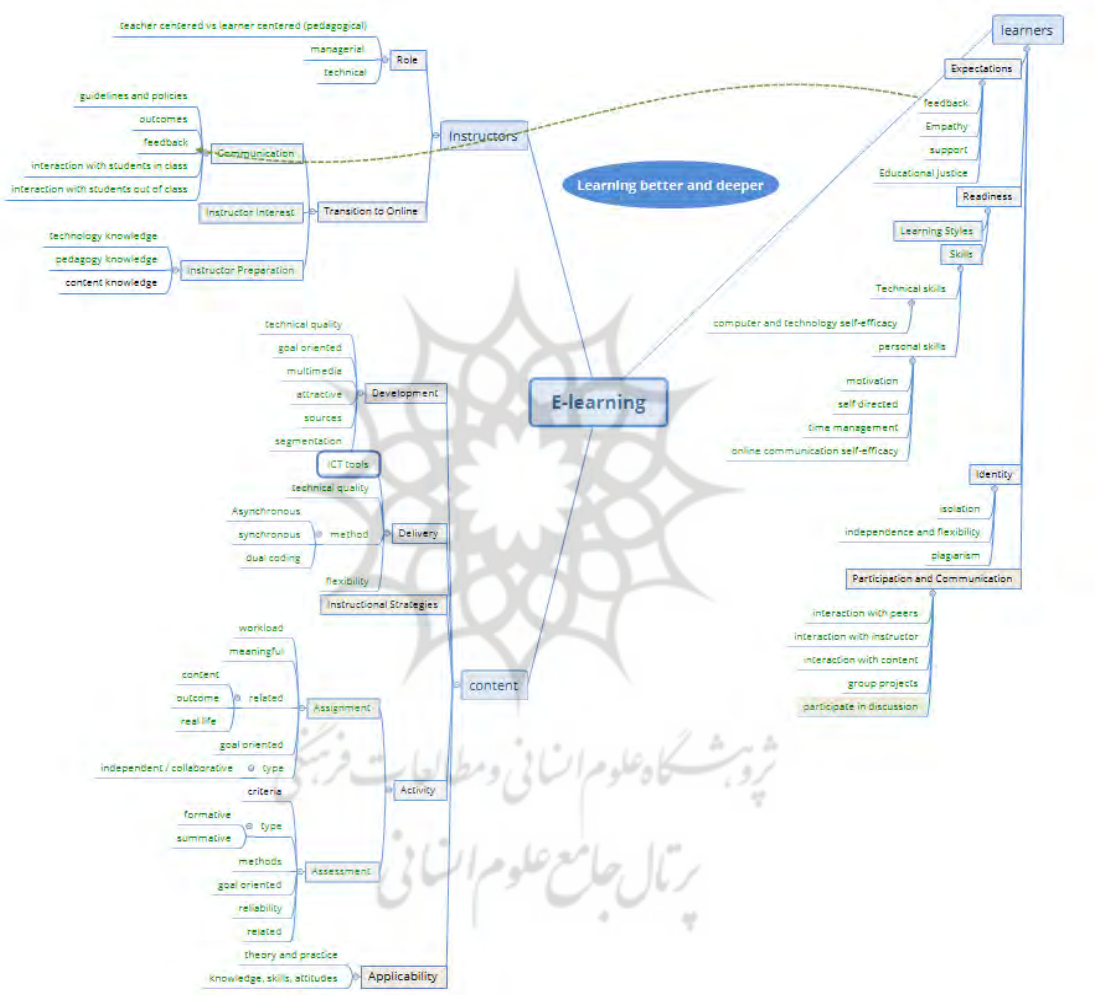

Figure 1. Three major components and the related issues in an online

Table 1. Cronbach's Alpha for questionnaire "A"

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.716	.638	24

Table 1. Cronbach's Alpha for questionnaire "B"

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.843	.832	27

The target audience of this research was the students of undergraduate engineering fields, entering in 2019 and 2020 to the University of Tehran. For this purpose, the email addresses of the students who had taken the "Physics 1" course in 2019 and 2020 were obtained from the Faculty of Engineering Sciences. In total, there were 935 e-mail addresses of incoming students of 2019 and 910 e-mail addresses of incoming students of 2020 in the list obtained from the faculty. In order to implement the questionnaire, Google Form was used and the Google Form link was sent to the email address of the students along with the letter of invitation to cooperate. In the step of calculating Cronbach's alpha, 100 students were randomly selected using the simple random sampling method and questionnaire A was sent to the first 50 students and questionnaire B was sent to the second 50 students. Among them, 32 people answered questionnaire A and 30 people answered questionnaire B, and necessary calculations were made about Cronbach's alpha.

In the main implementation stage of the questionnaire and after removing 100 students from the Cronbach's alpha calculation stage, the Google link of the created final questionnaire form was sent to the email addresses of the remaining students. The questionnaires were randomly sent to the students and each student received only one of the A or B questionnaires. In total, 885 incoming students of 2019 and 860 incoming students of 2020 participated in this research and received emails.

- Results

A total of 340 students participated in answering the online questionnaire, where 180 students answered questionnaire A and 160 of them answered questionnaire B. Likert and open-ended questions were used for preparing the questionnaires. SPSS software was used for statistical analysis of quantitative data. Among the respondents, 237 were male and 103 were female. There were also 177 incoming respondents from 2020 and 163 incoming respondents from 2019. Respondents were studying in the fields of electrical engineering (74 people), mechanical engineering (52 people), computer engineering (49 people), chemical engineering (41 people), mining engineering (23 people), polymer engineering (18 people), industrial engineering (18 people), civil engineering (15 people), oil engineering (12 people), surveying (11 people), materials and metallurgy (9 people), medicine (1 person) and engineering sciences (17 people).

In Table 3, a summary of the descriptive statistics of the Likert questions of Questionnaire A "Content" including the number of respondents to the questions, the minimum and maximum of the selected option, the mean, standard deviation and variance of the distribution of answers for each question is presented separately. This table is arranged in the order of the highest average. Based on the statistical analysis done in this part, the results presented in table 3, teaching methods and strategies used in online classes, difficulty in holding practical classes, workshops and

laboratories, high workload in online classes, lack of meaningful activities that To strengthen problem solving skills and high levels of learning in students, and using lecture methods in online classes and not using learner-oriented methods and students being active and listening during class are the main challenges identified based on questionnaire "A".

Table 2. Summary of statistical analysis of Likert questions of questionnaire "A"

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
W	180	1	5	4.42	.839	.703
L	180	1	5	4.22	1.032	1.065
AE	180	1	5	3.87	1.041	1.084
O	180	1	5	3.61	1.106	1.222
AC	180	1	5	3.54	1.169	1.367
N	180	1	5	3.28	1.215	1.475
Z	180	1	5	3.13	1.301	1.692
AB	180	1	5	3.11	1.081	1.168
S	180	1	5	3.06	1.211	1.466
AA	180	1	5	3.04	1.167	1.361
M	180	1	5	2.93	1.127	1.269
Q	180	1	5	2.90	1.450	2.102
R	180	1	5	2.81	1.213	1.473
AF	180	1	5	2.71	1.331	1.771
AD	180	1	5	2.71	1.156	1.337
J	180	1	5	2.63	1.118	1.250
Y	180	1	5	2.56	1.346	1.813
X	180	1	5	2.51	1.126	1.268
H	180	1	5	2.48	1.096	1.201
I	180	1	5	2.32	1.222	1.493
K	180	1	5	2.01	1.233	1.519
Valid N (listwise)	180					

In Table 4, a summary of the descriptive statistics of the Likert questions of questionnaire "B" including the number of respondents to the questions, the minimum and maximum of the selected option, the mean, standard deviation and variance of the distribution of answers for each question is presented separately. Based on the statistical analysis carried out in this part, the results presented in the table 4, maintaining order and organizing online classes and managing class discussions, not paying attention to individual interests, expectations and abilities in online classes and the lack of personal learning. made, not paying attention to whether the students have learned the discussed topics and to what extent they have achieved the set learning goals, difficulty in doing group work and meaningful interactions between students in the class, using the lecture method in online classes and not using it Among the learner-centered methods, students being active and listening during the class were the main challenges identified based on questionnaire "B".

Table 3. Summary of statistical analysis of Likert questions of questionnaire "B"

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
AD	160	1	5	4.08	1.055	1.114
V	160	1	5	3.71	1.206	1.454
M	160	1	5	3.67	1.232	1.519
S	160	1	5	3.64	.993	.985
AF	160	1	5	3.53	1.075	1.157
W	160	1	5	3.34	1.312	1.722
Y	160	1	5	3.23	1.145	1.311
T	160	1	5	3.09	1.300	1.690
L	160	1	5	2.99	1.264	1.597
AC	160	1	5	2.98	1.226	1.503
AB	160	1	5	2.98	1.141	1.302
U	160	1	5	2.78	1.218	1.484
X	160	1	5	2.66	1.234	1.523
N	160	1	5	2.63	1.068	1.142
AA	160	1	5	2.59	1.236	1.527
Q	160	1	5	2.58	1.206	1.453
P	160	1	5	2.54	1.148	1.319
Z	160	1	5	2.54	1.202	1.445
R	160	1	5	2.53	1.264	1.597
H	160	1	5	2.28	1.214	1.474
I	160	1	5	2.20	1.057	1.117
O	160	1	5	2.10	1.235	1.525
J	160	1	5	2.10	1.083	1.172
K	160	1	5	2.04	1.151	1.325
AE	160	1	5	1.90	1.077	1.160
Valid N (listwise)	160					

Based on the analysis performed by the independent t test in SPSS (Table 5), there is a statistically significant difference in the answers of the students to the question "I would like to repeat the online learning experience again" (sig=0.006 < 0.05) and "I prefer to continue after the corona epidemic." Online learning continues" (sig=0.000 < 0.05) exists between the group of first-year entries and previous entries. In other words, the average level of agreement of first-year students with the statement "I would like to repeat the online learning experience" (1.90) is lower than the previous year's students (2.31) and the average level of agreement of first-year students with the statement "I prefer online learning to continue after Corona" (1.91) was less than the previous year's incoming students (2.51). (P Value = 0.05).

Table 4. Summary of statistical analysis result

	Variables		Numbers	average	Standard deviation	P value	Result	Agree (Agree and completely agree)	Disagree (Disagree and completely disagree)
I am eager for repeating the online learning experience	Academic year	first	177	1.90	1.25	0.006 < 0.05	Meaningful	19.11%	67%
		Second	163	2.31	1.45				
	Gender	female	103	2.21	1.39	0.313	Meaningless		
		male	237	2.05	1.35				
I prefer to continue learning online after COVID-19 pandemic	Academic year	first	177	1.91	1.25	0.000 < 0.05	Meaningful	22.94%	65.58%
		Second	163	2.51	1.52				
	Gender	Female	103	2.22	1.36	0.861	Meaningless		
		Male	237	2.19	1.43				
I find the combination of online learning and face-to-face training more useful for the future.	Academic year	First	177	3.18	1.43	0.305	Meaningful	49%	32%
		Second	163	3.34	1.48				
	Gender	Female	103	3.37	1.42	0.360	Meaningless		
		Male	237	3.21	1.47				

The open-ended questions asked in the questionnaire were as follows:

1. What were the main challenges and problems you encountered during implementation of online courses?

2. What suggestions do you have for addressing these challenges and improving the implementation of online courses in the future?

Qualitative data from open-ended questions were analyzed by thematic analysis method and using MAXQDA Analytics Pro 2020 software. For this purpose, the students' answers to the three questions were entered into the software separately. Frequent words were identified in the answers and the main codes were created based on the theoretical framework developed in the previous stages and assigned to the answers provided. In the next stage, the answers were re-read and additional codes were created if needed and the coding were improved. The coding approach in this research was a combination of deductive and inferential coding because the coding started from the pre-determined theoretical framework and then new codes were added as needed. After all the answers were coded and the codes were specified, related codes were grouped and categories were created, and finally the frequency of the codes and categories created was calculated and presented. All the mentioned steps were repeated for both questions ending (Bengtsson, 2016).

This analysis follows Brown and Clark's (Braun & Clarke, 2006) six-step framework for thematic analysis. The first step was to become familiar with the data, the second step was to generate initial codes and relate responses and significant data for each code, the third step was to create broader categories or themes. For this, the codes were sorted into potential themes and data were collected for each potential theme. In the fourth step, the themes were examined at two levels in relation to the primary codes and in relation to the entire data set. The fifth step entailed defining and naming themes, meaning that each category was revisited once more to define the specific meaning and name of each and to refine the overall story the data was meant to tell. The last step included writing the chapter of results and conclusions and suggestions of this report, to check the accuracy of data analysis and coding.

The data in Table 6 and Table 7 represents the most common codes and topics that are identified, and their frequency. The results of qualitative analysis are in alignment-with the results of quantitative analysis. Inappropriate methods of teaching, passive and teacher-centered teaching strategies (24.34%), high workload (21.74%), low interaction (19.3%), low motivation (18.26%) and poor learning (17.39%) respectively, were frequent codes among students' response.

Table 6. Codes, topics, and frequency of students' answers to question 1

What were the main challenges and problems you encountered while taking the online courses?	Frequency
Assessment Inadequate methods, short and disproportionate time, excessive rigidity, inconsistency of teaching and evaluation level (assignments), injustice, review and feedback, lack of rubrics and appropriate criteria for evaluation.	86
Self-directed learning Motivation, time management, focus, control, and management of personal learning.	85
cooperation Class participation, discussions, class activities, etc., cooperation with the teacher, cooperation with classmates and other students, teamwork.	55
Course activities High volume and unreasonable expectations, homework time and deadlines, useless and irrelevant tasks.	49
Presentation Teaching strategies, attractiveness, student role (teacher-centered versus student-centered), long class time, and inappropriate scheduling.	38
Learning Weakness in learning, falling behind in lesson plan, drop in academic level.	36
Availability and responsiveness of professors Interest and importance of professors, information, non-troubleshooting, readiness, and knowledge of professors.	27
Psychological Fatigue, confusion and other mental health problems, isolation, stress, and anxiety.	27
Conformity and compromise Instructors' empathy and understanding, flexibility, trust.	25
Recorded videos Video attractiveness, video time (long), video quality, inappropriate video segmentation and Presentations.	20
Applicability Non-practical, lack of connection between theory and practice	5
General Facilities and infrastructure, laboratory and workshop, lack of educational justice, excessive use of electronic devices and related harms such as headaches, home conditions.	87

Table 7. Codes, topics, and frequency of students' answers to question 2

What suggestions do you have for addressing these challenges and improving the implementation of online courses in the future?	Frequency
Adaptation and harmonization More empathy and understanding of students, reducing the volume and workload of students, Complete and regular information presentation, better planning for classes and exams, more flexibility in planning, timing, and logical deadlines.	52
Course redesign Coordinate and alignment of teaching and assessment, more appropriate evaluation methods, use of formative assessment instead of summative assessment, definition, and presentation of rubrics and assessment criteria, attractive videos, better quality videos, meaningful and purposeful assignments, more up-to-date teaching strategies and setting learning goals.	45
Availability and responsiveness of professors Troubleshooting and providing the necessary support, professional development of instructors' skills in online teaching.	21
Communications and cooperation More interaction with professors and classmates, more teamwork, surveys, and feedback from students on the teaching-learning process, greater participation, and a more active role of students in the classroom.	17
General Improving infrastructure and facilities, motivating students.	14

discussion

Based on the results of statistical analysis, the high and unreasonable amount of course content, activities and evaluations (with an average of 4.42), the inapplicability of the course content and activities and the absence of real world problems (with an average of 4.22), using the lecture teaching method and not using it Learner-oriented teaching strategies (with an average of 4.08), not having an active role in online classes (with an average of 3.87), efficient and effective participation in group work (with an average of 3.67), self-directed learning management (with an average of 3.34), weakness in practical classes, laboratories and workshops (with an average of 2.99), low motivation to participate in online classes, watch videos, participate in discussions and carry out activities (with an average of 2.96), lack of educational justice and cheating (with The average of 2.90) and the absence of class discussions and the lack of possibility to ask and answer and fix problems (with the average of 2.90) were the challenges that the students had faced during the three semesters of online learning during the Corona era.

Based on the results of qualitative data analysis, the topics that were frequently seen in the answers were: evaluation, self-directed learning and interaction; Students complained about various aspects of evaluation in the online environment. According to them, the methods used for evaluation were not suitable, in order to prevent cheating, the professors considered a large number of questions with a very short response time, which caused poor performance, stress and demotivation of students. Also, they complained about the exams being test-based and only paying attention to the final answer, and they believed that in many cases, the level of teaching, content and presentations did not match the level of evaluation, and there was excessive strictness in conducting the exams. They suggested using formative evaluation methods (with a reasonable amount of activities), designing rubric and specific criteria for evaluation and aligning learning objectives, teaching and evaluation methods. Many students believed that they do not have proper habits for self-directed learning, such as concentration and motivation to participate in online classes, watch videos and study self-reading resources, and manage time to do activities. Also, students generally complained about the lack of quality and meaningful interaction in online classes and they believed that professors do not involve them in class discussions and activities as much as in face-to-face classes, and in their opinion, group activities in the online environment could not be implemented effectively. And they found it difficult to coordinate schedules, meet online with group members, and collaborate with all group members.

By comparing the results obtained from quantitative and qualitative data, it seems that both results are in the same direction and the problem in meaningful interaction, active participation and doing group work, managing the personal learning process, motivation and self-directed learning were the challenges that were common in both series of data. Quantity and quality were seen in abundance. In the case of evaluation, the quantitative data mostly referred to the issue of fraud and high volume, but in the qualitative data, various elements of evaluation such as limited time, only paying attention to the last answer, not using formative methods of evaluation, lack of specific rubrics and criteria, and lack of coordination of the teaching level It was also mentioned with the evaluation level.

The results are also in line with the results of other studies conducted during the Corona era, which include the lack of meaningful interaction and communication between students and

between students and teachers, which causes isolation of students, lack of immediate feedback and the possibility of fixing problems, problems related to exams and evaluation, lack of group activities in Online classes or their inappropriate and superficial implementation, having traditional teaching habits, high homework load and time management are the main challenges that students face (Adnan & Anwar, 2020; Bhusal & Rimal, 2020a; Hernández, 2021; Tümen Akyıldız, 2020; Vielma & Brey, 2021; Yılmaz İnce et al., 2020)

Based on the results of this research, students' challenges during the epidemic can be classified into five groups:

1. Personal challenges, 2. limited social interaction, 3. Technology problems, 4. Issues related to evaluation, 5. Concerns about content and learning methods**.**

Student feedback is an important tool in assessing the quality of online courses, but input is not important by itself. Feedback should be received from all stakeholders (faculty, teaching assistants, management, etc.) and its effect on all aspects should be considered to propose a suitable model for designing and implementing online learning in engineering education based on the obtained data and identified challenges (Vielma & Brey, 2021).

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