

ONLINE LEARNING EXPERIENCES OF ENGINEERING STUDENTS IN THE POST-PANDEMIC PERSPECTIVE

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Abstract: *The COVID-19 pandemic has created a crisis that has critically affected higher education institutions. With the sudden shift to emergency remote education during the pandemic, students' online experiences have become a growing concern among teachers. This study aims to gain insights into students' experiences of online activities in a hybrid learning approach. A total of 80 students enrolled in undergraduate programs at the Technical University of Cluj-Napoca, Romania, responded to an open-ended online questionnaire. This study used the content analysis to find out the positive and negative experiences in online learning, the preference for continuing instruction in a certain format and the reason for choice. The results showed that students' resources and skills played an important role in terms of positive or negative study experiences: cost and time effectiveness, easy access to many study materials and good distance learning skills helped to cope with this pandemic, while little or no interaction with colleagues and teachers and too many hours on screen caused difficulties and dissatisfaction among other students. Despite these issues, most students are interested in continuing their online instruction, but also face-to-face or hybrid activities. This study can provide recommendations derived from the interpretation of participant feedback for improvements in future online learning experiences.*

Keywords: *students' experiences; online learning; emergency remote education; engineering students; COVID-19 pandemic.*

1. Introduction

A recurring theme in recent literature that has addressed teaching during the COVID-19 pandemic is emergency remote teaching (ERT). With the emergence of the current pandemic, many educational institutions had to act quickly and started providing education through electronic platforms. Specialists have described ERT as a sudden temporary shift in the delivery of

instruction to an online delivery mode due to crisis circumstances, as opposed to online courses that were originally designed to be delivered digitally (Hodges et al., 2020). The primary goal in these circumstances is not to recreate a functioning educational environment, but rather to provide immediate access to education in a manner that is easily implemented and available during an emergency or crisis. It is worth noting that this type of education depends to a large extent not only on technology or digital infrastructure, but also on a set of socio-psychological attributes that have affected the entire educational community (teachers, students, parents, etc.) (Bozkurt et al., 2020). Specialists consider that equating the idea of ERT with online teaching is not quite appropriate. Hodges et al. (2020) showed that well-designed online learning situations are significantly different from online courses offered in response to a crisis.

Moreover, a paradox emerged during the pandemic: while some studies indicated that students had a positive attitude towards emergency remote learning, others indicated that students did not prefer online teaching to face-to-face teaching in this period. On the one hand, there are several advantages of online learning, with studies suggesting that the flexible educational environment, independence in time and space, and opportunities to repeat activities asynchronously by re-accessing learning materials (Ahmed et al., 2020) were positively evaluated by the students. Then, the adoption of modern teaching-learning methods (e.g., flipped learning, inquiry-based learning, problem-based learning etc.), the quality of course materials and videos and the adoption of alternative assessment approaches have positive effects on the learning process and student satisfaction (Elfirdoussi et al., 2020). Students had more control over when and how they completed course learning activities. However, online learning requires various student qualities, such as knowledge of using technology, time management and organization and interaction using online technologies (Joosten & Cusatis, 2020). On the other hand, during the pandemic, the digital divide increased inequality and social injustice and negatively affected the education process at all levels, with psychological effects such as anxiety, frustration or boredom on students, teachers, and parents (Aristovnik et al., 2020). In addition, Sun et al. (2020), in their study of students' experience during online courses, found that students believe that teachers should know how to adapt their lectures to the online environment, not just transfer online information that was usually taught in a traditional way and that they should provide an adequate number of projects and assignments. Other studies from Romania (Coman et al., 2020; Potra et al., 2021) showed that students reported several disadvantages of online studies, such as information overload, limited interaction, teacher-related obstacles, concentration-related difficulties, technical problems, teachers' lack

of technical skills, teaching styles not adapted to online training and considered them less beneficial in terms of achieving learning outcomes. Thus, although the negative impact of the pandemic is undeniable, we should not neglect the potential positive experiences.

Universities need to be aware of their students' preferences and attitudes towards online learning practices as opposed to their traditional learning experiences. Understanding student perceptions has important implications for the quality of learning because it affects students' motivation to learn, helps teachers rethink course design principles, provides the opportunity to adapt teaching methods to new learning environments and students' needs, and improves curricula. The study by Lochner and colleagues (2016) indicated that, when used as an additional method to traditional courses, online learning improved students' learning experience and increased their engagement in courses. Comparing traditional and online learning, the study by Alsaaty and colleagues (2016) showed that a large percentage of students assimilated more information in face-to-face courses than in online courses, and that they perceived their online learning experiences positively, although they encountered difficulties in using e-learning platforms. The study by Kedraka and Kaltsidisi (2020) concluded that the pandemic period could be seen as an opportunity for universities to improve the use of digital technology for enhanced learning experiences. While most studies emphasize positive attitudes towards online learning, other studies have shown that students believe that online courses do not provide the same value as face-to-face courses and that students would rather accept a blended learning, that is a combination of online and face-to-face courses rather than just online learning.

A widely influential model of effective online learning experiences is the Community of Inquiry developed by Garrison et al. (2000), who emphasize three dimensions of the online learning experience: the teaching presence is the content and climate developed by the instructor; the social presence involves the development of interpersonal relationships and communication in an environment of mutual trust; and the cognitive presence involves constructing and confirming meaning around course content through dialogue and reflection. For online learning, all these three dimensions and their overlap reflect the dynamics of online learning experiences, which are key elements for improving the quality of online education.

In our study, we start from the view that exploring students' learning experiences is an integral part of how educational communities can be involved in initiating effective adaptations to digital transformations in higher education in a post-pandemic evolution.

2. Methodology

2.1. Objective

This study aims to gain insights into students' online experiences in the hybrid approach within the courses they have attended.

1. What are the positive aspects that students have experienced in online learning?

2. What are the negative aspects that students have experienced in online learning?

3. What are the students' perceptions regarding the format of continuing their instruction and the reasons for choice?

2.2. Participants

A total of 80 undergraduate students from the Technical University of Cluj-Napoca participated in this study, of which 49 males and 31 females, 64 urban residence students and 16 rural residence students, 10 first-year students, 23 second-year students, 37 third year students and 10 fourth year students.

2.3. Instruments

A qualitative method was utilized to collect data to achieve the purpose of this study. Four open-ended questions were used to ask students about their perception on the positive and negative experiences of online instruction in the hybrid approach, the preference for continuing instruction in a certain format and the reason for choice. The online questionnaire using Google Forms was sent through the e-learning platform. Data were analyzed using NVivo 12 qualitative analysis software, which facilitates efficient management of qualitative data, grouping and regrouping of data to discover meaningful topics, categories, and themes and to increase the efficiency of data interpretation processes. Qualitative responses to the four questions were grouped into themes and several key themes emerged. The students were also assured that the information they provided would only be used to fulfil the purposes of the research. Their participation was entirely voluntary, anonymous and in no way affected the evaluation of the study subjects.

At the beginning of the 2021-2022 academic year, our university approved the transition to online courses and face-to-face seminars, laboratories, and other forms of practical activity in a blended approach which is designed as a combination of online approach (in case of lectures and theoretical speeches)

and face-to face approach (in case of exercises, assignments or for the more practiced trainings).

3. Results

The open-ended questions asked students to express their most significant positive and negative academic learning experiences during the pandemic, then their preference for continuing instruction in a certain format and the reason for choice. Their suggestions were assorted and after coding, were divided into several themes, as follows (Table 1):

Table 1. Students' positive and negative experiences of online learning

Suggestions	Frequency	Percent
Positive experiences	122	51.69
cost and time effectiveness regarding travel and accommodation	20	8.47
easy access to many study materials	19	8.05
good distance learning skills	13	5.51
flexible opportunities for participation	11	4.66
modernization of teaching, learning and assessment	8	3.39
audio-video recording of courses/ laboratories	8	3.39
time for personal development	8	3.39
emphasis on practical and essential aspects of activities	6	2.54
well-functioning telecommunications	5	2.12
more time spent with family	5	2.12
learning from the experiences of all colleagues	4	1.69
good communication skills	3	1.27
time for both academic study and work	2	0.85
good emotional health	2	0.85
social support from teachers	2	0.85
no positive experience	2	0.85
other positive experiences	4	1.69
Negative experiences	114	48.30
little or no interaction with colleagues and teachers	18	7.63
fatigue due to many hours on the screen	13	5.51
low study skills	11	4.66
lack of practical aspects	10	4.24
unclear, excessive and short-term assessment	10	4.24
poorly functioning devices and software	9	3.81
poor study motivation	8	3.39
teachers' poor digital pedagogical skills	4	1.69
non-objective evaluation	3	1.27
teaching not adapted to the digital environment	3	1.27
anxiety, fear of communication, depression	3	1.27
confusion about future studies	3	1.27
low efficiency of online courses/ laboratories	2	0.85
lack or deletion of records after a while	2	0.85
daily routine	2	0.85

low hygiene safety measures	2	0.85
confinement	2	0.85
no negative experience	2	0.85
other negative experiences	7	2.97
TOTAL	236	100

Looking at the positive experiences of online learning, the results indicate that cost and time effectiveness regarding travel and accommodation ($f = 20$) was most valued especially by students in the pandemic context. It is worth mentioning that up to 19 students had easy access to many study materials despite these times. About 13 students expressed their good distance learning skills (independent study skills, time management skills, study materials organization skills), while good communication skills (ease of expressing opinions, ask questions, get information, present projects) were highlighted only by 3 students. The high frequencies of student experiences regarding flexible participation opportunities were appreciated by 11 students. Personal development time ($f = 8$) was quite valued by the students, while 5 students stated that they spent more time with their family. Also, efficient use of time for both academic study and work was mentioned by 2 students. The modernization of teaching, learning and assessment, especially the methods of promoting interaction are mentioned in the answers of 8 students, as the possibility of recording courses and their resumption is expressed by 8 students. The focus on the practical and essential aspects of the activities is highlighted by 6 students. Well-functioning telecommunications were mentioned no more than 5 times in the student responses. Teamwork and active group support as indicators of the functioning of a learning community were valued by 4 students.

In terms of negative experiences of online learning, the results showed that little or no interaction with peers and teachers, lack or poor functioning of the learning community had the greatest negative impact on learning during the pandemic ($f = 18$). Fatigue due to too many hours on the screen was felt by 13 students. Some students had problems in understanding the content, in focusing attention ($f = 11$) and it was perceived as a challenge in the home environment. According to student comments, distance learning involved more self-learning, and the tight schedule of meetings required the content to be reviewed independently afterwards. Lack of motivation to learn ($f = 8$) due to the uncertainty and increased stress caused by the pandemic was another negative experience. Feelings of loneliness, anxiety, fear, depression were expressed by 3 students, mentioning the need for support from teachers or peers, while another 3 students highlighted confusion about continuing their studies. Students mentioned that in their experiences with online learning they

faced teacher's lack of digital pedagogical skills ($f = 4$). Students also stated that they missed practical aspects, practical works and said that there was too much theory ($f = 10$). Unclear or excessive assignments, large number of exercises in the allotted time, too short time for assessment, announcing the change of assessment conditions shortly before the exam are some of the opinions expressed by the 10 students. Also, many respondents admitted to having problems with the operation of devices and software, connecting to the Internet or the learning platform ($f = 9$).

Table 2. The preference for continuing instruction in a certain format and the reasons for choice

Suggestions	Frequency	Percent
Preference for continuing instruction in a certain format	103	100
face to face	21	20.39
online	65	63.11
hybrid	11	10.68
I don't know	6	5.83
Reasons for continuing instruction in a certain format		
<i>face to face:</i>	21	20.39
losses in online education	8	7.77
effective, interactive learning	7	6.79
other reasons	6	5.83
<i>online:</i>	65	63.11
no travel, saving time and money	11	10.68
many online materials, reviewing them	10	9.71
better time management	9	8.74
a more efficient, safer, simpler, easier way of teaching and learning	8	7.77
flexibility regarding time and space	8	7.77
the importance of personal and other health	4	3.88
carrying out parallel activities at the workplace with academic ones	4	3.88
better communication of information, clear explanations	3	2.91
the best and safest solution through online education	3	2.91
quiet, comfort at home	3	2.91
other reasons	2	1.94
<i>hybrid:</i>	11	9.71
online courses and face-to-face laboratories/ seminars	9	8.74
other reasons	2	1.94
TOTAL	103	100

For students who opted for face-to-face/ conventional instruction, the participants list the losses recorded in online instruction: lack of communication, attention, understanding, fatigue problems, lack of practical experiments, damage to mental health. For others, the reasons emphasized the possibility of teacher-student and student-student interaction. Students thought that in the face-to-face classes, it would have been easier to ask for help from teacher or peers, and learning would have been more efficient then. Most students did not know their colleagues at all and for this reason, group work was felt to be difficult. Some respondents felt that there were no opportunities for critical thinking or discussion during online activities, others mentioned that teachers did not take into account the students' previous skills. Because of this, some students became frustrated with either too slow or too fast progress in the course. Most students said that it would be important to continue their online instruction because they have easy access to many study materials and the opportunity to review them. Other reasons for continuing the online instruction that students said were saving time, especially for those who must travel long distances to get to classes, flexibility of time and space, but also the fact that it is a more efficient, easier, simpler way of teaching and learning. For 11 students, the possibility of a hybrid instruction seems to be the best option in which the courses are conducted online, and the laboratories, seminars and other practical activities take place face to face.

In short, the results of the open-ended questions analysis provide us with important insights into students' experiences. There is still a need to rethink activities for the "new normal" and that it is time to reinforce the positive experiences and look deeper into the negative experiences.

4. Discussion

This study focused on engineering students' reported experiences with online activities in the hybrid approach during the pandemic. Within the open-ended questions, the aspects that strengthen and weaken learning experiences can be divided into different categories, from students' resources and skills to the delivery of instructional activities and the use of digital technologies. The results of the study showed that online instruction brought a mix of positive and negative experiences during the pandemic. Participants' experiences varied widely and are, therefore, in line with previous studies.

It is noteworthy that students highlighted positive experiences in online learning, the rating being determined by the ability to save time for travel and accommodation, to have easy access to study materials, to have good distance learning skills or to have flexible opportunities for participation. The flexibility offered by online education, cost, and time efficiency in terms of travel and accommodation were highly valued by most students. While it is

important to set guidelines and be consistent, a little flexibility is very important to meet the needs of digital natives and show them support, especially for those students who are experiencing difficult times, stressors, or health issues. This finding is also highlighted in previous research that has shown that online learning allows students to use their time more efficiently (Jung & Rha, 2000; Fidalgo et al., 2020). Also, in terms of cost-effectiveness, it has been stated that online education is generally cheaper than face-to-face education (OECD, 2020). Saving time is accompanied by a combination of personal development activities and time spent with family. Lacking control over face-to-face interaction, many students do not spend time reviewing study materials before class, preparing their workspace, or getting ready for online learning.

Furthermore, students' own resources and skills played an important role in positive and negative online learning experiences: on the one hand, good distance learning skills helped them cope with the pandemic situation, on the other hand, poor understanding of content and low concentration of attention caused difficulties and dissatisfaction among the other students. The results of this study are consistent with research by Bhagat and Kim (2020), which highlighted a growing demand for online learning and the need for digital skills to make the teaching-learning experience richer and more value-oriented for all students. Negative experiences may be related to students' learning behaviors and the degree to which they have the skills to succeed in online learning. Research by Yeh et al. (2019) showed that certain learning strategies and behaviors can help students achieve better results in online learning. One of the challenges of higher education is educating students to be able to activate and maintain thoughts, emotions, motivation, and behaviors aimed at achieving learning goals, a process called self-regulated learning. These types of strategies are desirable because students who adequately regulate their learning typically acquire more in-depth knowledge, pursue learning goals, and achieve higher performance. Regarding the focus on the digital classroom, students stated that they were distracted from the home atmosphere because it was a non-private place of study. Additionally, distractions often occur when students lack time management skills, causing them to do household chores and homework at the same time.

Another negative experience reported by students was the lack of communication and interaction practices with teachers or peers. Affecting the opportunity for informal communication that accompanies the educational process, most students often indicated problems related to the socio-emotional aspects of learning, such as: lack of socialization and direct interaction, lack of sharing experiences and information between peers or enjoying social interaction during breaks. Social relationships and interactions are considered

important to the learning experience in online environments. Recent research findings emphasize the importance of social interaction and collaboration as sources of student well-being and learning satisfaction (Miller, 2020; Kedraka & Kaltsidisi, 2020). It is suggested that teacher-student interaction can be developed through face-to-face meetings and/or online learning activities. Online etiquette suggestions for student teaching include verbal/ visual confirmation of student attendance, frequently asking students to raise their hands or participate, using poll and interactive discussion forums, and breakout rooms. Students experienced positive emotions because the courses were conducted online, giving them flexibility in the schedule, more free time, or the opportunity to express opinions or ask questions. However, students experienced negative emotions in online learning: academic stress, fear of failure, boredom and depressive thoughts that distracted students from academic activities. As Miller (2020) points out, the pandemic affected families, students, and teachers both emotionally and psychologically, and feelings of fear, anxiety, uncertainty “were as contagious as the Coronavirus and affected learning climates” (2020, p. 4). Teaching during a pandemic can be beneficial for building resilience. Interactions between students and teachers are the key to fostering collaboration and relationships, but it is not enough to ensure a social presence. The connectedness of the participants, their emotional and affective responses to each other, and their interactions by sharing their ideas increase social presence. For instance, teachers could ask their students if they are still doing well and what learning remedies or alternatives they could agree upon as a class, rather than just a one-way ERT approach.

For successful online teaching-learning-assessment activities, the important elements are for teachers to ensure that students are active, not passive in front of digital devices and to establish a close relationship with students based on respect, professionalism, availability, and support, because positively influences students' motivation to study. Adopting an online learning environment is not only a technical matter, but also a pedagogical challenge that can be overcome by selecting and adapting the educational content and materials, by designing and implementing appropriate instructional strategies. The focus should be placed on minimal attention to students' needs, on active processing of information (making connections with prior knowledge and from other disciplines, critically analyzing information etc.), on interest to feel excited (Clark & Mayer, 2016). Also, an aspect highlighted in our study is that the academic workload increased during emergency remote education. Academic integrity in assessments is another key factor affecting student motivation for study and objective examination. To ensure the objectivity of assessments and to prevent academic fraud, emphasis should be placed on

continuous assessment throughout the semester (e.g., projects or topics with a certain degree of complexity, critical analysis topics, problem solving etc.). Another possibility expressed by students would be the open-book online exam with the possibility of addressing some topics of analysis, critical thinking, case studies, solving complex problems etc.

Lack of practical aspects and unclear and excessive assignments caused students' discomfort. During the fully online education period, laboratory activities were particularly frustrating for students, because they anticipated the opportunity to handle equipment that did not materialize in the online learning environment. By moving to the hybrid approach and participating in face-to-face laboratory activities, students were able to physically contact and manipulate different materials. However, to compensate for the lack of physical presence at the lecturers, the teachers recorded videos that briefly describe the practical aspects and the appropriate equipment in them, to be used during the online meetings with students. As a provider of high-quality education, the university must pay special attention to the practical training of students, otherwise both the individual and society may pay the price of educational failure. On the one hand, students need to develop functional competencies that will facilitate their access to the labor market. On the other hand, employers may have difficulty to find workers with the appropriate competencies. Thus, in the development of a sustainable society, the training and development of professional and transversal competencies are key factors.

The above results obtained from the students' answers in combination with the technical issues, underline the need for a better knowledge of communication applications, both in synchronous and asynchronous form. Schleicher's study (2020) indicated the lack of training of a significant percentage of teachers in distance learning of new technologies, which affects the instructional practices that teachers choose to communicate with students, but also the way they create, share, and present the educational material. Emphasizing that teachers should be familiar with learning platforms and educational technology, have the skills to use this technology, and be encouraged to use educational technology at a minimum in all courses, regardless of training mode, can help institutions and teachers to be better prepared in the future. Implementing teacher professional development with reference to online pedagogy and the use of digital tools could benefit both university instructional practices and student experiences.

Finally, we should not overlook students' responses to the reasons for continuing instruction in a certain format in the post-pandemic perspective. Impressively, more than half of the answers to this question were directed towards online instruction. Most of them refer to reasons such as access to

many study materials and their revision, saving time, more efficient, safer, and simpler way of teaching and learning, but also flexibility of time and space. This conclusion is consistent with the study of Karalis and Raikou (2020) who also showed that students favor online education because attending the course was easier and the difference from the face-to-face process was exciting. Based on the results of this and other studies, it is necessary to identify students at risk of school failure and then support them in developing learning skills in all areas.

Thus, both online and face-to-face instruction are needed; while the flexibility of time and space offered by remote learning is seen as an advantage, the need for face-to-face interaction and a learning community, especially in the early stages of their studies, seems obvious to our students. As Holzer and colleagues (2021) concluded, online learning should be designed in a way that maximizes the strengths and limits the weaknesses of online education.

5. Conclusion

Despite the moderate acceptance of online learning by the students, some challenges have been identified. Taking students' responses into account, this study recommends the following ideas to teachers and policy makers:

- Investing in online instruction to ensure the continuation of academic studies, especially in times of emergency.
- Creating a community of support to help students better cope with the psychological and educational implications, including in emergency situations.
- Creating and fostering student-teacher and student-student interactions that will help reduce students' feelings of isolation and increase their confidence and engagement in learning.
- Developing students' self-directed learning and time management skills by promoting the values of commitment, adaptation, resilience, integrity, and self-confidence.
- Familiarizing teachers with models/ frameworks that allow the combination of pedagogy and technology.
- Avoiding overloading students with courses, assignments, and assessments, because especially during periods of disruption, students' physical and psychological well-being is of great importance.
- Strengthening the training of teaching staff related to the development of digital pedagogical skills, together with practical interactive ways of working with students.

Although digital technologies are transforming the nature of university teaching and learning, or even disrupting students' learning experiences, they will inevitably continue to be an integral part of the future of university

education around the world. Understanding students' perceptions and learning experiences is considered important in the process of integrating online forms into didactic activities, as well as in the implementation of blended learning. This study has some limitations, so that due to the rather small number of participants in our study, more general conclusions could not be drawn based on the results obtained. Collecting additional data through face-to-face interviews would have benefited this study. The fact that the data were collected from only one public university in Romania and from undergraduate studies is another limitation of the study. Despite these limitations, this study makes important contributions to improving our understanding of how blended learning might be conducted in the post-pandemic perspective.

Although the pandemic has presented a very difficult challenge for universities to change their approach to education, to use new technologies and to find new ways for students to learn, we should not waste this valuable learning opportunity.

Biographical note

Lorena Peculea is lecturer PhD at the Specialized Department with Psycho-pedagogical Profile from Technical University of Cluj-Napoca. Her teaching and research interests are interdisciplinary ones, such as education and curriculum, teaching and learning, assessment, e-learning, pre-service and in-service teacher training, psycho-pedagogical counselling, educational management, ethics and academic integrity. Scientific contribution was materialized by participating in research-development-innovation projects and institutional projects, participating in national and international conferences, and publishing the studies and articles in prestigious national and international journals.

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