INSIGHTS INTO THE ATTITUDE TOWARDS REMOTE EDUCATION OF UNDERGRADUATE ENGINEERING STUDENTS

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Abstract: *The implementation of emergency remote education due to the COVID-19 pandemic may affect students' online learning attitudes. Exploring these attitudes, as higher education adapts to uncertainty, has become more critical than ever. This study aims to obtain information about students' attitudes towards remote education by studying in a hybrid format in the first semester of the 2021-2022 academic year due to the COVID-19 pandemic. A non-experimental research design with quantitative research methods was used. A total of 135 students enrolled in undergraduate programs at the Technical University of Cluj-Napoca, Romania, responded to the survey. The study found that students had a neutral attitude towards remote education. There was no statistically significant difference by gender and residence area. However, the results indicated that the 4th year students had higher attitude scores towards remote education than those in previous years. The findings of this study may also provide suggestions for further developments and improvements in students' online learning attitudes and in the pedagogy of engineering disciplines in the post-pandemic perspective.*

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

1. Introduction

The COVID-19 pandemic has highlighted the challenges of current higher education systems, especially in the field of digital education, and the need to provide effective training for both teachers and students to prepare them for the rapidly changing educational climate. There is no doubt that the COVID-19 pandemic has forced educational institutions to move to online teaching and learning, and this sudden shift has amplified the existing and new challenges of technology-supported learning. A model of emergency remote teaching has been adopted worldwide, in which face-to-face courses are

conducted online (Hodges et al., 2020). Unlike distance learning, emergency remote learning is defined by the geographical separation of students and teachers. While emergency remote education is temporary and obligatory, distance education is an option (Bozkurt et al., 2020). Researchers agree that during the COVID-19 pandemic, there is a case of emergency remote education, which is a branch of distance education (Bozkurt & Sharma, 2020; Hodges et al., 2020). Technology is a reality of the modern world, a constantly changing field, which can bring enormous benefits to the education system, if it is used in an efficient and adapted way. What we need to keep in mind as teachers or researchers is that using an educational tool or using technology is not a goal, it is just a tool to achieve the goals.

In general, attitude is defined as the perception or opinion on a specific problem, can be positive, negative, or neutral, and is composed of three dimensions: cognitive, affective, and behavioral (Guillén-Gámez et al., 2020). In addition, students' attitudes towards ICT reflect students' perceptions and beliefs about the integration of digital technologies into teaching and learning practices and depend on individual characteristics as well as previous technological experience.

Previous research on students' perceptions of online courses compared to face-to-face courses has found that online courses are considered more flexible and compatible with other life activities, such as work-related activities, but less effective for learning (Schwartzman, 2007; Platt, Raile and Yu, 2014), providing fewer opportunities to interact with other students and teachers (Bali & Liu, 2018). However, these courses may not have used up-to-date technological applications that encourage in-depth learning, as well as the fact that the online courses were provided under normal and non-emergency conditions. Investigating students' attitudes towards e-learning, it was found that their attitude was positive and improved when they perceived that e-learning systems were easy to access (Odit-Dookhan, 2018), that e-learning improved the students' learning experience, increased their engagement in courses (Lochner et al., 2016), and that, compared to traditional learning, perceptions of the general online experience are positive, even if they had difficulty using e-learning platforms (Alsaaty et al., 2016).

Investigating students' perceptions of online learning during the COVID-19 pandemic, Allo (2020) showed that students had a positive attitude towards e-learning, considering it useful in this crisis (Allo, M.D.G., 2020). In addition, Hassan et al. (2021) showed that students' perceptions of the quality and satisfaction of online courses are important factors in maintaining students' motivation to learn and their academic performance. However, a strong negative correlation between the impact of the pandemic on learning and the attitudes of higher education students was highlighted in the study by Gonçalves et al. (2020). Students faced obstacles in implementing self-

isolation, such as self-discipline, obstructive learning atmosphere, difficult learning tasks, and learning attitudes (Bao, 2020). Studies conducted worldwide during the isolation period found that there is a significant percentage of students who felt negatively affected (Means and Neisler, 2020; Quacquarelli Symonds, 2020, Chandra, 2020) both in their academic activities and in the social ones (Killian, 2020). Moreover, Quacquarelli Symonds (2020) reported that many students, due to the closure of their schools, had low motivation and negative attitudes towards online learning. Summarizing the situation in European Higher Education, Marinoni et al. (2020) found that autonomous students coped well with remote learning, while students with learning difficulties were overwhelmed. Emergency remote learning does not replace social interaction with other students and teachers (Kedraka & Kaltsidisi, 2020), social relationships being considered an important factor for learning satisfaction in online environments (Richardson et al., 2017).

Recent studies have shown that different demographic factors (such as year of study, gender, previous student achievement, or familiarity with online learning environments) may be related to different levels of motivation and students' perceptions of learning (Chandra, 2020; Hassan et al., 2021). According to Aristovnik et al. (2020), looking at the relationship between socio-demographic and geographic characteristics and student satisfaction with emergency remote teaching, males were more confident in their computer skills in online learning platforms. Moreover, examining the relationship between demographic factors and students' experience, readiness to learn and preference in emergency remote teaching, Chung et al. (2020) demonstrated that females were more satisfied than males, and undergraduate students were more satisfied than graduate students. Both females and undergraduate students also had better overall online learning experiences. In addition, Asgari et al. (2021) showed that, although there is research on online engineering education, there is little empirical research that explores the challenges and factors affecting online engineering education due to the COVID-19 pandemic.

By examining and re-examining students' attitudes towards remote education, institutions could facilitate the transition to online or blended learning for students and teachers and decide which training modules to invest more in their rapid digital transformation. According to national regulations and university autonomy, several educational institutions have offered their students blended learning, which is a combination of online technology-enhanced learning and face-to-face experiences. Although there is a growing consensus among researchers regarding the benefits of blended learning, findings on the effectiveness of blended learning are mixed. Doucet et al. (2020) stated that blended learning pedagogy will be the new norm in the post-COVID education, while neither a full return to online nor a full return to face-

to-face instruction will be desirable after the pandemic, urging universities around the world to rethink the ways of teaching, learning, and assessment (Eringfeld, 2021).

The Technical University of Cluj-Napoca (TUC-N), as a public state university, has limited autonomy, so most of its measures must fall within the limits allowed by national legislation and regulations. At the beginning of the 2021-2022 academic year, TUC-N approved the transition to online courses and face-to-face seminars, laboratories, and other forms of practical activity. Thus, the blended learning environment was designed as a combination of an online approach (in the case of theoretical lectures and speeches) and a face-to face approach (in the case of exercises, assignments or for more practical training).

2. Methodology
2.1. Objective

The aim of this study was to investigate the attitudes of undergraduate engineering students towards remote education during the COVID-19 pandemic. Specifically, the following two research questions guided this study:

(1) What is the level of engineering students' attitudes towards remote education during the COVID-19 pandemic?

(2) Do the attitudes of undergraduate engineering students towards remote education during the COVID-19 pandemic show significant differences depending on demographic variables such as gender, residence area and year of study?

2.2. Participants

Study participants included 135 students from the 1st to the 4th year studying hybrid in various undergraduate programs at the end of the first semester of the academic year 2021-2022 at the Technical University of Cluj-Napoca, Romania. Of the 135 participants, there are 72 males and 63 females, 100 students live in urban areas and 35 students in rural areas, 23 subjects are enrolled in 1st year, 44 students in 2nd year, 48 students in 3rd year, and 20 students in 4th year.

2.3. Instruments

The study employed quantitative research methods by using the means, standard deviations, frequency counts and percentages. To measure the attitudes of undergraduate engineering students the Scale of students' attitude towards remote education (Tzafilkou, K., Perifanou, M., Economides, A.A., 2021) was used. There was a total of 30 items developed in 5 remote education

functional dimensions: online attending lectures; online communicating with professors; online collaborating with peers; online find, access and study educational material; online doing assignments and homework. Each dimension is divided into 6 attitudinal items related to students' perception: easiness, usefulness, enjoyment, control, interest, and flexibility. The respondents ranked the answers on a 5-point Likert scale from "mostly in the usual (traditional) learning mode" to "mostly in the remote (online) learning mode". The Cronbach alpha reliability coefficient for the questionnaire in the present study was $\alpha = .903$.

For this study, we adopted the following terminology from the authors of the scale to help students perceive homogeneously the definitions of 'usual' (traditional/ classic) and 'remote' teaching and learning:

• *Usual (traditional/ classic) teaching and learning* mean that the teacher by physical presence in the classroom teaches synchronously using technology (e.g., PowerPoint presentations; computer lab; software applications) and asynchronously using the Internet (e.g., e-mail; Learning Management System – Moodle; cloud sharing – Google Drive, Dropbox; open educational resources). In most courses, the teaching and learning format can be blended and not just face-to-face, as it was before.

• *Remote teaching and learning* mean that the teacher teaches both synchronously and asynchronously only through the Internet, without the physical presence. Teaching and learning, communication, projects, assignments, educational materials, etc., all are done exclusively online, through the Internet.

Along with the pandemic process, teachers were not obliged to use a common platform in this process, being recommended by the university to use their choice (Microsoft Teams, Moodle, etc.) while conducting their online activities.

The online questionnaire using Google Forms was sent out via e-learning platform. Students were informed about the nature of the study and were assured that the questionnaire was confidential and that no identifying or personal information would be included in the study. The data collected from the questionnaire were arranged, organized, tabulated, and analyzed using descriptive statistics in the SPSS version 24.0.

3. Results

Aiming to investigate the attitudes of undergraduate engineering students towards remote education during the COVID-19 pandemic, it was resorted to the calculation of the means for each dimension of the scale. The analysis based on observed scores by subscales, for each variable followed, showed a medium level of attitude towards remote education (Table 1). The

data showed that undergraduate engineering students had overall neutral attitude towards remote education (M = 3.38, SD = 0.951).

Regarding subscales, in our study the undergraduate engineering students had a higher attitude towards 'Online Find, Access & Study Educational Material' (M = 4.05, SD = 1.028) and neutral attitude towards 'Online Attending Lectures' (M = 3.27, SD = 1.116), towards 'Online Communicating with Professors' (M = 3.10, SD = 1.163) and towards 'Online Doing Assignments & Homework' (M = 3.58, SD = 1.100). The lowest mean was found at the 'Online Collaborating with Peers' subscale (M = 2.89, SD = 1.188)

Variables	N	Mean	SD
The dimensions of the students' attitude towards remote education			
- Online Attending Lectures	135	3.27	1.116
- Online Communicating with Professors	135	3.10	1.163
- Online Collaborating with Peers	135	2.89	1.188
- Online Find, Access & Study Educational Material	135	4.05	1.028
- Online Doing Assignments & Homework	135	3.58	1.100
Total	135	**3.38**	0.951

Table 1. The level of attitudes towards remote education

The results of the analysis are presented in Table 2 that reproduces the percentages of responses within the five subscales underlying the research.

Mostly in the usual (traditional) learning mode *f (%)*	No difference *f (%)*	Mostly in the remote learning mode *f (%)*
Subscale 1: Online Attending Lectures		
265 (32.73)	179 (22.1)	366 (45.17)
Subscale 2: Online Communicating with Professors		
266 (32.83)	252 (31.13)	292 (36.04)
Subscale 3: Online Collaborating with Peers		
313 (38.65)	261 (32.23)	236 (29.12)
Subscale 4: Online Find, Access & Study Educational Material		
80 (9.88)	160 (19.76)	570 (70.36)
Subscale 5: Online Doing Assignments & Homework		
133 (16.41)	279 (34.45)	398 (49.14)

Table 2. The distribution of frequencies at five subscales

From Table 2 above, the frequency of responses to the five subscales shows that the undergraduate engineering students have a slightly higher attitude towards remote education than traditional education. More than half of the respondents (70.36%) prefer to find, access and study educational

materials in online format, considering it an easy, useful way, offering pleasure, control, engagement, and flexibility to students, while 9, 88% prefer the traditional way. Almost half of the participants (49.14%) prefer online/ remote education more when students have assignments and homework to complete, while only 16.41% of respondents consider it easy, useful, enjoyable, have control, are interested, and have flexibility when doing assignments and homework. Of the 135 participating undergraduate engineering students, 45.17% of them prefer the online/ remote learning mode in attending lectures, while 38.65% of the respondents prefer the traditional learning mode in collaboration with their colleagues.

The results of the descriptive statistical analysis for research question no. 2 showed that background variables of undergraduate engineering students such as gender and residence area did not show differences in attitude scores (Table 3). The Mann-Whitney U test was used to examine the attitudes of undergraduate engineering students towards remote education according to their gender and residence area. The findings obtained are presented in Table 3:

Variable	Cases	N	Mean Rank	Sum Rank	U	Z	p
			Gender				
Attitudes towards remote education	Female	63	61.12	5329.5	1834.5	-1.913	.056
	Male	72	74.02	3850.5			
			Residence area				
Attitudes towards remote education	Urban	100	66.88	6688	1638	-.563	.574
	Rural	35	71.20	2492			
p < .05							

Table 3. Mann-Whitney U Test results on attitudes towards remote education by gender and residence area

The data show that there was no statistically significant difference in the students' attitudes towards remote education according to their gender (U = 1834.50, p = .056) whereas the effect size is small (r = 0.33). On the other hand, the data show that there was no statistically significant difference in the attitudes towards remote education in terms of residence area (U = 1638.00, p = .574, r = 0.09).

Students' attitudes towards remote education were analyzed according to year of study in which they are enrolled in various undergraduate program and the Kruskal Wallis H test was used to analyze the students' attitudes scores. The findings obtained are presented in Table 4:

Variable	Cases	N	Mean Rank	df	$X2$	p
Attitudes towards remote education	1st year	23	53.74	3	22.454	.000
	2nd year	44	52.78			
	3rd year	48	77.23			
	4th year	20	95.73			
p < .05						

Table 4. Kruskal Wallis H Test results on attitudes towards remote education according to year of study

From the table above it can be seen that the scores of the attitudes towards remote education differ significantly according to year of study ($X2 =$ 22.454; p < .05). Regarding the effect size, it is observed that the difference between the four groups is a large one (r = 0.83). Given the mean rank, it is understood that the 4th year students have a higher attitude towards remote education than that of the students from previous years. In other words, the 4th year students are more likely to attend lectures online, communicate online with teachers, collaborate online with colleagues, find, access and study online educational materials, and do assignments and homework online. Also, it has been observed that there are significant differences between 1st and 3rd years of study (U = 376.00, Z = -2.165, p = .030, r = 0.53), between 1st and 4th years of study (U = 60.500, Z = -4.130, p = .000, r = 1.62), between 2nd and 3rd years of study (U = 697.500, Z = -2.804, p = .005, r = 0.61) and between 2nd and 4th years of study (U = 146.500, Z = -4.252, p = .000, r = 1.25).

4. Discussion

Understanding and measuring students' opinions about attitudes toward remote education are considered significant in the processes of integrating online and face-to-face teaching forms, as well as in the implementation of blended learning. Thus, this study focused on attitudes towards remote education reported by undergraduate engineering students during the pandemic. The results indicate that students' attitudes are neutral, with a higher mean for finding, accessing, and studying educational materials, and a lower mean for online collaboration with peers. Also, data revealed that according to gender and residence area there were no statistically significant differences in the students' attitudes towards remote education. However, scores of attitudes towards remote education differ significantly according to the year of study. Compared to students in previous years, students in 3rd and 4th years are quite trained. They are experienced in studying, have set learning objectives, and know what their expectations are in terms of learning outcomes. First-year students are at the beginning of a new educational cycle, and one semester was not enough for them to make the transition from the high school context and develop all the skills necessary for higher education. Second-year engineering students have experienced online learning since the

first months of this pandemic once they were admitted to university. They have to put in more effort to keep up with the learning process. Recognizing the importance of the first year in particular and how students begin their university experience may be the best predictor of how their university experience will end (Maloney & Kim, 2020). These results indicate that younger students are most at risk when it comes to developing motivation to learn; they may need more support than older students when learning takes place online. Teachers should understand them better, help them cope with learning anxieties, develop self-confidence, and provide additional support during learning. In this sense, a blended learning environment can reduce increased student effort and ensure a less stressful learning process (Sharma & Sarkar, 2020).

From the students' attitude scale, it was shown that access to many study materials and the possibility to review them are among the preferences of most students. The use of digital tools is an important area for teachers who are interested in how to best deliver the curriculum and achieve the best outcomes for students. Teachers can use different types of teaching tools in remote education, including online discussions, chat, audio-video interaction, breakout rooms, polls, whiteboard interaction or surveys in synchronous and asynchronous formats. All these tools are available and can have an impact on student learning as we explore how best to implement them in virtual classrooms. Accessing course content for those who cannot attend synchronously has led teachers to have videos recorded, uploaded, and easily reviewed. Understanding that students have diverse characteristics and challenges makes teaching a multimodal approach. In some online courses, teachers focus more on content delivery, rather than on developing interactive content in the form of student-centered learning. Nowadays, students focus on digital technologies that not only provide the transfer of knowledge, but also allow them to use the game format to perform work tasks: gamification, network interaction, project-based learning, augmented reality, virtual reality, etc.

A slightly above average score was obtained by the students on the sub-scale regarding online doing assignments and homework, which shows the students' preference for this format in carrying out evaluation activities. Teachers could devote more time to continuous and formative assessment to provide quality online learning, by facilitating assessment criteria, avoiding over-assessment activities, providing prompt and effective feedback, supporting reflection processes, encouraging ethical practices, identifying, and supporting students with difficulties in online learning. 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.). In technical higher education multimodal quizzes contribute to greater engagement because students can benefit from formative assessment. Also, conducting online exams in a more transparent and objective way (e.g., open book online exams), applying current features of Learning Management Systems or secure exam browser settings can increase student engagement and satisfaction.

In our study, students highlighted the lack of interaction and communication with teachers or colleagues as one of the biggest shortcomings of remote education during the pandemic. Recent research findings emphasize the importance of social interaction and collaboration as factors in student well-being and learning satisfaction (Beaunoyer et al., 2020; Kedraka & Kaltsidisi, 2020). Also, Karalis and Raikou (2020) showed that most students consider online education, compared to face-to-face education, as lacking in collaboration, social interaction, and socialization. Teachers need to identify best practices for effective communication to encourage students to participate in the new online learning environment. For example, Craig and colleagues (2020) suggest the use in teaching-learning activities of network tools, such as Net.Create, to bring students closer and to make learning more efficient and enjoyable in difficult times. The findings of our study confirm previous research that emphasizes the importance of the social element in academia to help students expand their life experience, become more independent and confident, develop interpersonal, communication, teamwork skills, peer learning, time management skills etc.

An educational institution acts not only as a knowledge-building environment, but also as a place for communication and socialization of students. Indirect communication with the teacher through the computer screen reduces the engagement and emotional involvement of students in the learning process. However, it is important to remember that technology may not be able to replace a teacher. In online or hybrid learning, teachers need to address the social dimension of students' learning experience. Thus, the Community of Inquiry (CoI) framework is a guiding model that describes how students connect with their teachers and peers in online learning using cognitive presence, teaching presence, and social presence (Garrison et al., 2000). For example, research conducted by Fiock (2020) supports the idea that building an online community positively impacts student learning, engagement, and motivation. Including activities in the online classroom where students can learn by doing improves student engagement and academic performance. This allows students to achieve deeper learning not only by memorizing concepts, but also by being able to apply them. That is why it is important to design active learning with both student-teacher and student-student interactions. Teachers must also be aware of creating a strategic link between designing meaningful learning outcomes, assessing outcomes, and

engaging students. Thus, teaching during the pandemic provides an opportunity for teachers to strategically redesign teaching to achieve meaningful learning outcomes. However, it should be noted that any decision regarding learning technologies should not take precedence over the design and development of learning objectives and educational content.

A particular concern is decreased motivation to learn and understanding of study material. These trends are related to the traditional face-to-face teaching approach, while the online approach requires updating pedagogical methods and using new interactive approaches with students. This, the absence of important advantages of the face-to-face approach, such as eye contact, visual control, concentration, and retention of students' attention etc., should be compensated by the introduction of innovative digital learning technologies. A solution to increase study motivation is the careful design of online instruction. Student engagement in online courses should be achieved by designing interesting and engaging assignments and applying innovative pedagogy to capture student interest. Engagement leads to successful learning. Student engagement being the state of mind students are in during learning, it represents the combination of thinking and feeling, therefore the essential components of both technical and supportive teaching. Thus, according to Barkley & Major (2020), teachers can reassess classroom tasks and activities to focus on student engagement techniques. Teachers should emphasize cognitive, behavioral, and emotional engagement to achieve key learning outcomes, such as: analysis and critical thinking, synthesis and creative thinking, application, problem solving, performance etc. The engagement of teaching staff, their interest and sensitivity for the development of students, the expectations transmitted clearly and constantly, treating students correctly and with respect are a prerequisite for student engagement (Ulmanen et al., 2016; Luo et al., 2019). If students attend classes just to be present or to get good grades, they are unlikely to engage beyond a superficial level.

The results of this study from the perspective of students' attitudes towards remote education showed that teachers need to pay attention to supportive elements in teaching as much as the technical delivery. Specifically, teachers should ensure that students feel included and supported, through genuine care, empathy, communication with their peers and providing helpful feedback. Being present and having a socio-emotional presence can make students feel more supported.

Conclusion

This research considered the views of undergraduate engineering students regarding their attitudes towards remote education. It is a proven fact that before the COVID-19 pandemic, for most students and teachers, online

education was not adopted as a formal teaching and learning methodology and that this mode of education is clearly different from face-to-face activities. Looking to the future, academia has become aware that it should be prepared as appropriately as possible. Online learning is definitely here to stay. It is also very certain that the use of online communication can help a wider diversity of students to access education. Although the students in this study had a neutral attitude towards remote education, this does not mean that it will be the only form of education compared to a traditional/ face-to-face one. Regardless of the measures taken, a percentage of education will continue to use the online or hybrid format, which means that, in the post-pandemic perspective, the academic community should address any problems, shortcomings and inequities that may have arisen during the pandemic, especially for students in their first years of study. To accelerate the implementation of online pedagogy in post-pandemic higher education, this study suggests deepening the learning community and interaction between students and teachers and developing students' distance learning skills as part of pedagogical support.

The small sample size and participation of students from the same university were some of the limitations of this research study, which limits the generalizability of the results. The data in this study were collected through a self-report instrument, and further research could enrich the data sources by qualitatively analyzing students' online learning experiences to support the findings. Because the results are based solely on student perspectives, including the views of faculty members in future studies could help to understand the issues teachers face in remote education.

The results provide important information for teachers, administrators, managers, as they plan and develop curricula, educational services, and policies that support the learning needs of all students.

Biographical note

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