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Similarities and Differences between Online and Face-to-Face Education: Students' Perspectives

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Abstract: *This study compares online education to traditional face-to-face education in terms of effectiveness as perceived by university students. Within the framework of the COVID-19 pandemic, the research provides valuable insights into the rapid adaptation to digital learning environments. Through data collection and analysis, the study examines key aspects such as the benefit of feedback, the quality of teaching materials, the assessment and grading strategies, and the social interaction in the online educational environment. The results indicate a generally positive perception on online education, showing advantages in successful communication and feedback, customization of educational resources, and adaptability of the assessment techniques. The respondents in this study, more exactly the students of Politehnica University of Timişoara, have rated online methods as just as effective, or even better, as traditional methods in some aspects. These findings suggest that online education can provide a comparable or even better educational experience, with significant implications for the development and implementation of future teaching strategies. The present study makes a contribution to the existing topic by highlighting the potential of online education in improving the accessibility and customization of education.*

Keywords: *online education; face-to-face education; students' perspectives; higher education; teaching; learning; assessment.*

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Introduction

As a result of the COVID-19 pandemic, education has changed during the last years, from face-to-face, to online, and back to face-to-face and/or blended. Many countries in the world have adapted their educational systems in order to support the needs of a changing educational environment and society (UNESCO, n.d.) and have turned to already existing methods and tools from online and/or blended education. Several aspects have undergone significant transformation. Teachers have tried to adapt their teaching methods and materials (Almahasees et al., 2021; Alonso Diaz & Blazquez Entonado, 2009; Gherheş et al., 2021; Gülmez & Ordu, 2022; Marshall et al., 2020; Stigmar & Körnefors, 2005; Otts et al., 2021; Stoian et al., 2022) "in order to present all the subjects comprehensibly in the new learning environment" (Gülmez & Ordu, 2022). Along with these, they have modified the assessment methods and criteria to match the different input received by students and the contextual background influencing the teaching-learning process (Chisadza et al., 2021; García-Peñalvo et al., 2021; Glushkova et al., 2021; Hosseini & Hashemi Toroujeni, 2017; Moralishvili & Chkhobadze, 2021; Öz & Özturan, 2018; Prisacari et al., 2017; Wiggins, 1998). At the same time, since social distance among the participants in the learning process has also been affected, teachers have tried to ensure students' participation and motivation continuously (Archambault et al., 2017; de Moya Martínez & Syroyid Syroyid, 2021; Garrad & Page, 2022; Lan et al., 2019; Niebuhr & Niebuhr, 1999).

As far as students are concerned, they have also faced numerous challenges in these times of change (Almahasees et al., 2021; Aboagye et al., 2021); Gherheş et al., 2021; Stoian et al., 2022; Yaşar, 2021). They had to adapt their learning styles to different concepts to match their needs and the teachers' requirements (Alonso Diaz & Blazquez Entonado, 2009). Students have become more independent, managing their own time and study, but, at the same time, coping with a huge amount of information not to be left behind (Dell et al., 2010; Gherheş et al., 2021; Stoian et al., 2022; Yaşar, 2021). With the transition back to face-to-face education, it has been expected that students "exhibit cognitive, social, and psychomotor changes in their behaviours in the classroom environment as well as motivation and concentration problems and discipline problems" (Alonso Diaz & Blazquez Entonado, 2009).

After all the changes that have taken place recently in Higher Education, the question regarding which type of education is better or suits mostly the modern human has become even more debatable (Almahasees et al., 2021; Alonso Diaz & Blazquez Entonado, 2009; Atwa et al., 2022; Fisher et al., 2022; Gherheş et al., 2021; Gülmez & Ordu, 2022; Janmaimool & Nunsunanon, 2021; Paechter & Maier, 2010; Stoian et al., 2022). Is face-to-face education better, maybe due to human interaction? Is online education better as it offers freedom? Or maybe blended learning is the answer since it combines both types?

Literature review

Numerous studies have been conducted in order to find the correct answer, if there is any. Even before the pandemic, there has been an interest in comparing and contrasting face-to-face and online environments. Researchers have constantly observed their common, as well as distinctive, points from various aspects (Wibowo et al., 2016; Alonso Diaz & Blazquez Entonado, 2009; Basque & Pudelko, 2004; Dell et al., 2010; Stigmar & Körnefors, 2005; Lan et al., 2019; Öz & Özturan, 2018; Paechter & Maier, 2010; Prisacari et al., 2017; Siampou et al., 2014; Tutty & Klein, 2008; Williams et al., 2012). Attention has been paid to the satisfaction and efficacy of the teachers' task in relation to their work in both face-to-face and online environments (Alonso Diaz & Blazquez Entonado, 2009), the interplay between pedagogy and media technology (Stigmar & Körnefors, 2005), the way online and face-to-face learning styles and collaboration influence the engagement and cognitive load of the students (Lan et al., 2019), interaction (Vu & Fadde, 2013) and the effect of collaboration on performance and learning (Basque & Pudelko, 2004; Dell et al., 2010; Siampou et al., 2014; Tutty & Klein, 2008; Williams et al., 2012), students' experiences and preferences (Paechter & Maier, 2010) or assessment (Wibowo et al., 2016; Öz & Özturan, 2018; Prisacari et al., 2017), to mention just a few.

The subject of face-to-face vs. online education has become even more popular in the COVID-19 pandemic as online teaching has turned from a preference or a possibility into a must. The most visible shortcoming has been isolation. Students have become unable and, sometimes, unmotivated, to empathize, to socialize and to establish healthy communication with teachers and peers ((Almahasees et al., 2021; Aboagye et al., 2021; UNESCO, n.d.; Garrad & Page, 2022; Gülmez & Ordu, 2022; Tartari & Kashahu, 2021; Yaşar, 2021). Tartari

& Kashahu (2021) have pointed out that "effective cooperation among students in online learning process is limited". In the same line, Hollister et al. (2022) reported that the students mostly complained about online learning due to its lack of social interaction, as it impacted their learning experience since they did not engage in lectures and did not interact much with teachers and peers. Few studies, though, have compared the differences between face-to-face and online collaboration and their influence on the students' cognitive load, engagement and social interdependence (Basque & Pudelko, 2004; Dell et al., 2010; Lan et al., 2019; Paechter & Maier, 2010; Shimizu et al., 2022; Siampou et al., 2014; Tutty & Klein, 2008).

Other researchers have observed online learning as far as quality is concerned. The flaws pointed out have been, among other things, that teachers do not have technical skills and do not adapt properly their teaching style to the context of online environment (Coman et al., 2020; Hollister et al., 2022), that they do not have the contemporary pedagogical knowledge used in technology-based learning (Tartari & Kashahu, 2021), the teaching materials and their effectiveness and the difficulty in understanding the materials explained online (Hollister et al., 2022; Tartari & Kashahu, 2021), ineffective time management and overwhelming work load (Hollister et al., 2022; Hussein et al., 2020; Shin & Hickey, 2021), and the use of breakout rooms within lectures (Hollister et al., 2022). However, numerous studies have shown students' preference for online learning because it provides nonstop access to learning materials asynchronously as well as it encourages self-learning (Adedoyin & Soykan, 2023; Almahasees et al., 2021).

Research has been continued through the return to face-to-face learning and mainly focused on what students preferred and how both types of education could be combined (Anderson, 2021; Cullinane & Montacute, 2020; UNESCO, n.d.; Gherheş et al., 2021; Gülmez & Ordu, 2022; Stoian et al., 2022). Most students preferred a form of online education adapted to their needs, highlighting blended learning (Stoian et al., 2022). Few students pointed out their preference for face-to-face education, especially those exposed to it before the pandemic (Gherheş et al., 2021), Moreover, the return to face-to-face learning, when the COVID-19 finished, came with worries regarding the decrease in the level of students' performance as students, apart from having conceptual gaps and learning losses, got also used to achieve high marks

without effort, even without attending classes or actively participating in them (Bayindir, 2021; Gülmez & Ordu, 2022; Marshall et al., 2020).

Within this context of changes and debates, in which there is no clear answer regarding which system of education is better, online, face-to-face or blended, or which is more suitable for the modern student, the present study aims to shed more light on the topic. Particularly, it intends to investigate the transition to online education in relation to students' perspectives, paying attention to relevant and current issues, namely the efficiency of online education compared to the face-to-face education. It focuses on the students of Politehnica University of Timisoara and their answers to a questionnaire investigating key aspects of the educational process, such as teachers' feedback, the quality of the educational materials, the strategies of assessment and social interaction. The research ultimately seeks to find out ways to integrate technology efficiently into the educational process in order to improve the students' educational outcomes.

The present study aims at the following objectives:

- To identify the main differences between online and face-to-face education from students' perspective, focusing on 5 key aspects, i.e. teaching methods, teachers' feedback, course content and resources, assessment and grading, and educational climate,
- To determine the factor structure of online education as opposed to face-to-face education with regard to the parameters specified in the research tool, i.e., teachers' role, course content and available resources, assessment and grading methods, feedback received as well as the overall educational climate.

Methodology

Study sample

The data for the study was collected between May and June 2022, a period in which a representative sample of respondents, namely students of the Politehnica University of Timişoara, was involved. The sample was diverse, including students coming from all years of study and from the various specializations offered by the university, which allowed for a broad and varied perspective on the researched topic. The responses of 368 subjects were recorded, a significant number that contributed to the reliability of the results. The distribution between the two genders was balanced. The margin of error was calculated to be

±5%, a standard percentage for this type of research, given the size of the university's student population (approximately 13,000 students). This margin of error provides reasonable confidence in the accuracy and representativeness of the data collected relative to the entire student population. The average age of the students involved was 22.5 years, the university students' typical life stage. Moreover, the gender distribution of the sample was consistent with the demographic structure of the student population of the Politehnica University of Timişoara, thus ensuring that the results of the study are relevant and applicable to the entire student community.

Research and data collection tools

In this study, a non-standardized questionnaire was used for the data collection. Its structure was designed to effectively cover the various dimensions that the team members aimed at researching in the study. They encompassed aspects referring to the teachers' role, the course content and the available resources, the assessment and grading methods, the feedback received as well as the overall educational climate. For each of these dimensions, a series of statements were formulated. Subsequently, these statements were grouped and transformed into coherent response variants to facilitate the collection of structured and comparable data.

For the creation of the questionnaire, we have applied the Delphi Method (Aydin & Öztürk, 2023), in which the experts were the students, as co-researchers. Initially, there were 97 items that were analyzed by the students during the Social Sciences Research Methods seminar. After 4 iterations, the 35 statements that discuss the role of the educational climate, the role of the teacher and the available resources, the methods of assessment and marking, as well as the feedback received, were singled out. In this case, the Content Validity Report value (Lawshe, 1975) turns out to be 1, as a consensus was reached with all the respondents (Lawshe, 1975; Taherdoost, 2016). The measurement scale used for each statement was a 5-point Likert scale. The results obtained after the questionnaire was applied to students, were used in the presentation of the results both as statistical averages and as percentages of respondents. The final questionnaire contained a total of 10 questions. The closed-ended questions, based on a five-level scale, were designed to evaluate and compare the students' face-to-face and online educational experiences. Questions that collected factual data

about the respondents, such as age, gender, college, specialization, year and cycle of study, were also included in the research with the aim of having a complete picture of the participants' profile. The questionnaire had a pilot test, which was conducted on a sample of 50 students approximately two months prior to the implementation of the questionnaire in the actual study. This step was essential to customize the questions, ensuring that they were perfectly suitable for the study's objectives.

Data collection

The questionnaire, intended for students, was available online, giving them the freedom to fill it in in a completely anonymous and unconstrained way. This meant that the students could choose to start or stop completing the questionnaire at any time, without any obligation or pressure. No incentives or rewards were offered for participation; the obtained responses were voluntary and were not influenced by external factors. In addition, the questionnaire was designed so as not to collect personal data that could reveal the identity of the respondents, protecting the participants' confidentiality and anonymity. For the completion of the questionnaire, the necessary average time was estimated to be 15 minutes, enough to ensure a detailed collection of information, but also reasonable so as not to discourage participation. The response rate was approximately 35%, reflecting the level of student engagement and interest in the survey topic. After collecting the responses, the analysis of the data was carried out with the IBM SPSS Statistics software package.

Results

O1. To identify the main differences between online and face-to-face education

Teaching methods are the means through which teachers convey information and encourage learning. They are important to ensure that information is delivered efficiently and effectively to students. They also help increase students' interest and motivation, develop learning skills, improve information retention, and adapt to the students' individual needs. The use of appropriate teaching methods can contribute to an improved learning experience and to the achievement of the educational objectives.

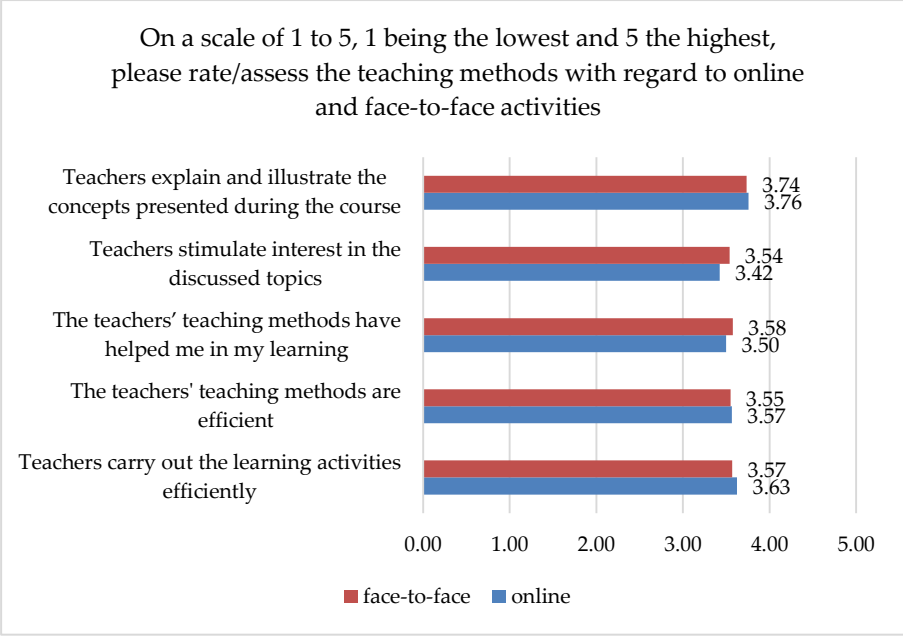


Figure 1. Assessment of teaching methods

For the present study, the comparison between face-to-face and online activities has shown some small differences between the two recorded environments (Figure 1). The average values for online teaching are slightly higher than those for face-to-face teaching, suggesting a marginally more positive perception of the respondents regarding the effectiveness of online teaching. Differences between averages ranging between 0.02 and 0.12 points were recorded, indicating a relatively small variation between the two teaching methods. The relatively close scores can lead to the conclusion that teachers have managed to adapt the teaching methods in such a way that the differences are almost imperceptible.

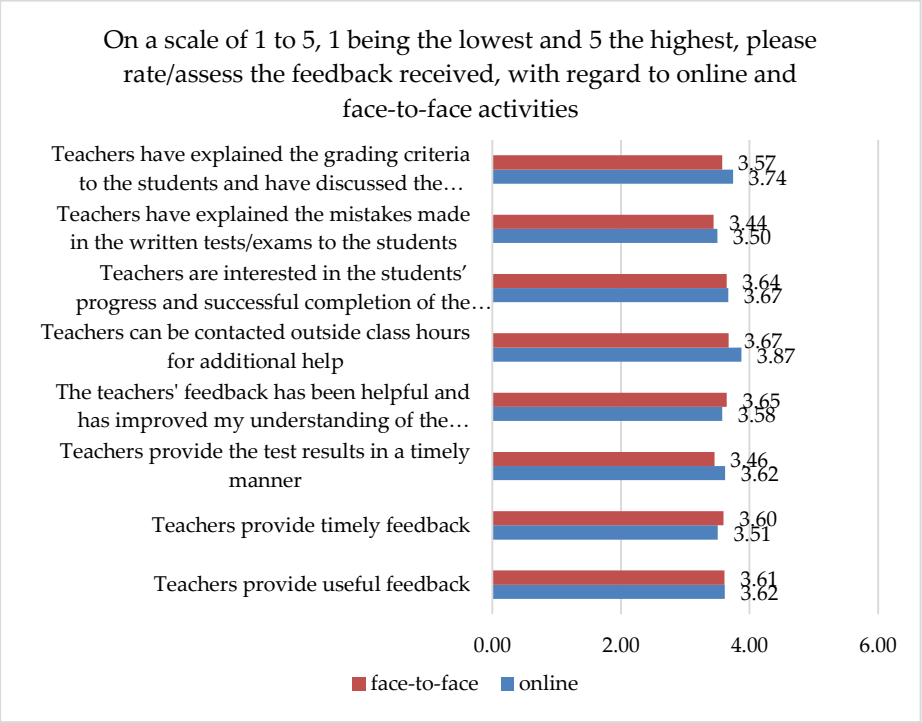


Figure 2. Feedback assessment

By analyzing the average scores for each question, it can be observed that, in general, the average values for online activities are mostly higher than those for face-to-face teaching (Figure 2). The largest difference is noticeable for the question *Teachers can be contacted outside class hours for additional help*, where online teaching received an average score of 0.20 points higher than face-to-face teaching. This could indicate the fact that students perceive contacting teachers outside of class as easier or more effective online. The scores for the other questions are relatively close, with a slightly favorable trend for the online environment, indicating thus that, in general, students feel that the transition to online activities has not significantly affected the quality of feedback or the communication with the teaching staff.

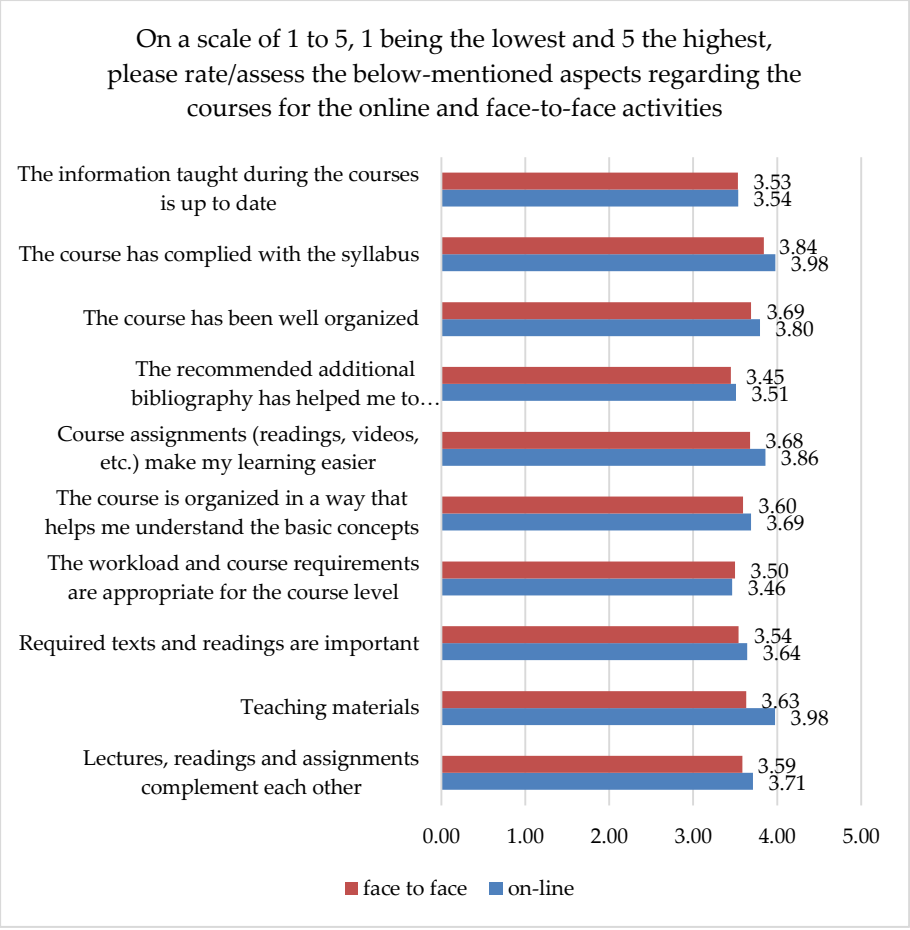


Figure 3. Assessment of course content and resources

The average values indicated in the graph (Figure 3) show a general trend where students perceive online courses as slightly more advantageous than the face-to-face ones. The differences between the two forms of teaching are varied but not excessively large, suggesting that students find qualities in both. For example, for the question *Teaching materials*, where the largest difference of 0.35 points can be noticed, online courses seem to provide materials that students consider to be better aligned with their learning needs. This may showcase the advantages of technology and the accessibility of digital resources. On the other hand, the question *Course workload and requirements are appropriate for the course level* shows a marginally better score for face-to-face teaching, possibly due to the perception that direct interaction with teachers can

help manage the workload more efficiently. As stated above, the differences are relatively small, implying that, while there is a slightly more favorable perception towards online teaching, it does not completely replace the value of face-to-face teaching.

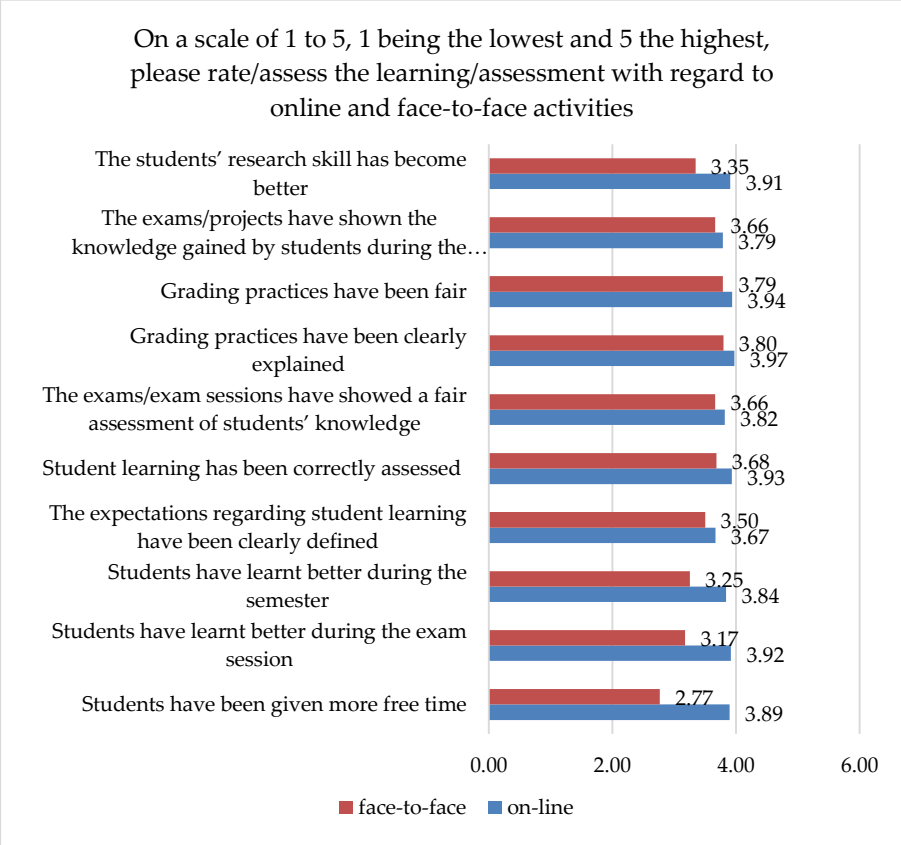


Figure 4. Perception towards assessment and grading

For most of the assessed aspects, it can be seen that the scores for online teaching are higher than those for face-to-face teaching, indicating a general positive perception of students towards online teaching and assessment (Figure 4). The biggest difference between the two teaching methods can be noticed in *Students have been given more free time*, where online teaching obtained an average score of 3.89 compared to 2.77 for face-to-face teaching. This suggests that the online method may offer students greater flexibility in managing their time. In contrast, the smallest difference between the two methods can be found in

Students have learnt better during the semester, where the scores are almost equivalent between the two teaching methods, with a slight preference for the online version. Based on these data, it can be concluded that students perceive online learning and assessment as generally efficient and beneficial, especially in terms of flexibility and access to resources.

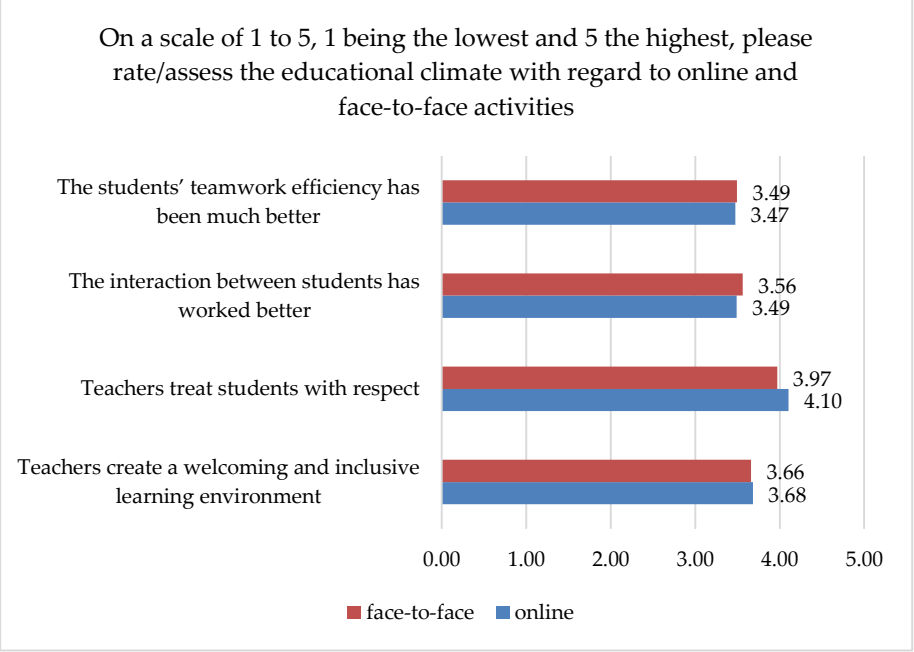


Figure 5. Perception towards the educational climate

The assessments for the teamwork efficiency and the interaction between students show close scores for the two methods, with a slight predilection for the online method (Figure 5). This may suggest that the use of digital technologies in education facilitates efficient interaction, possibly due to the online tools that support communication and coordination.

As far as the teachers' respect for students and the creation of a promising and inclusive learning environment are concerned, high scores can be observed in both methods, with a marginal difference in favor of the online environment. This could indicate the fact that online platforms provide additional channels of communication and interaction that can improve the students' perception of the teachers' respect and support.

The data analysis suggests that the transition to online teaching is perceived by students to be at least as efficient as the face-to-face teaching, in the case of the social and interpersonal aspects of education, having potential advantages regarding communication and interaction with the teachers. These positive perceptions of the online environment can be used to improve the educational strategies and to optimize the teaching practices in both contexts.

As no significant differences between the parameters of online and face-to-face education have been found, the patterns of responses (Howitt, 2006) or the main dimensions of the responses received from this complex set of variables have been further identified. Subsequently, the exploratory factor analysis for the two types of education has been used in order to seek any differences between the factor structure of online and face-to-face education.

O2. To determine the factor structure of online education as opposed to face-to-face education with regard to the parameters specified in the research tool, i.e., teachers' role, course content and available resources, assessment and grading methods, feedback received as well as the overall educational climate.

In this study, the factor analysis on the two learning methods, i.e. online and face-to-face, from the students' perspective will be compared by first discussing online education and then the face-to-face one.

Factor analysis - Online education

The research steps are as follows:

- The Cronbach's Alpha test verifies the internal consistency and reliability of the items in a questionnaire;
- The Kaiser-Meyer-Olkin (KMO) test shows the adequacy rate of the chosen sample (Tabachnick & Fidell, 2013) for the factor analysis;
- The Bartlett's test of sphericity determines whether the data set is appropriate for conducting an exploratory factor analysis;
- The factor extraction displayed in table and graph form;
- The saturations of the variable values corresponding to each extracted factor, determined after the factors have been rotated;
- The assessment of the correlation coefficients among the factors.

The Cronbach's Alpha test was employed to verify the internal consistency and reliability of the items in a questionnaire and its coefficients can have values between 0 and 1. Their value above 0.7 is necessary (Cronbach, 1951).

As per table 1, all Cronbach's Alpha values exceed 0.97, indicating excellent consistency among the questionnaire items considered.

Table 1. Cronbach Alpha calculation for online education variables	Cronbach's Alpha if Item Deleted
1. Teachers carry out the learning activities efficiently	.976
2. The teachers' teaching methods are efficient	.976
3. The teachers' teaching methods have helped me in my learning	.976
4. Teachers stimulate interest in the discussed topics	.976
. Teachers provide useful feedback	.976
6. Teachers provide timely feedback	.977
7. Teachers provide the test results in a timely manner	.977
8. The information taught during the courses is up to date	.977
9. Teachers explain and illustrate the concepts presented during the course	.976
10. The teachers' feedback has been helpful and has improved my understanding of the course materials	.976
11. Teachers can be contacted outside class hours for additional help	.977
12. Teachers are interested in the students' progress and successful completion of the course	.976
13. Teachers create a welcoming and inclusive learning environment	.976
14. Teachers treat students with respect	.977
15. Lectures, readings and assignments complement each other	.977
16. Teaching materials	.977
17. Required texts and readings are important	.977
18. The workload and course requirements are appropriate for the course level	.977
19. The course is organized in a way that helps me understand the basic concepts	.976
20. Course assignments (readings, videos, etc.) make my learning easier	.977
21. The recommended additional bibliography has helped me to understand the course content	.977
22. The course has been well organized	.976
23. The course has complied with the syllabus	.977
24. Students have been given more free time	.978
25. The interaction between students has worked better	.977
26. The students' teamwork efficiency has been much better	.977
27. Students have learnt better during the exam session	.977
28. Students have learnt better during the semester	.977

29. Student learning has been correctly assessed	.977
30. The exams/exam sessions have showed a fair assessment of students' knowledge	.977
31. Grading practices have been clearly explained	.977
32. Grading practices have been fair	.977
33. The exams/projects have shown the knowledge gained by students during the course	.976
34. The students' research skill has become better	.977
35. Teachers have explained the grading criteria to the students and have discussed the mistakes made by the students during the seminar activities	.977

As seen in table 1, all the items have a Cronbach Alpha coefficient above 0.976. Therefore, a very good consistency of the questionnaire items, regarding the online education items can be observed.

The Kaiser-Meyer-Olkin (KMO) test shows the adequacy rate of the chosen group (Macovei, 2014) for the factor analysis. The KMO test should yield a value as close to 1 as possible, with a minimum acceptable value of 0.5, indicating that the items can be categorized into different factors. For the researched group, the value of the KMO test is 0.967, i.e., it shows an adequacy of the group results to a factor analysis.

The Bartlett's test of sphericity reports a Chi-square value of 12,451.938, with 595 degrees of freedom (df) and an associated probability of $p < 0.01$. It posits that the data set is adequate for an exploratory factor analysis.

Table 2. Kaiser-Meyer-Olkin (KMO) and Barlett's test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.967
Bartlett's Test of Sphericity	Approx. Chi-Square	12451.938
	Df	595
	Sig.	.000

Based on the factor analysis, four factors have been extracted and they have values exceeding 1, indicating that they possess greater explanatory power than an individual variable. The remaining factors that were not extracted exhibit unexplained error variance. The rotation of the factors indicates that the first factor accounts for 26.414% of the variance, the second factor for 16.368%, the third for 13.927%, and the fourth for 13.486%. Collectively, these four factors explain 70.196% of the variance, which is a highly favorable percentage for this study.

Factor 1 – Teachers' role – corresponding to the teachers' role in the educational activity.

Factor 2 – Courses and teaching materials - corresponding to the need for self-improvement.

Factor 3 – Assessments - corresponding to the assessment activity that follows the teaching periods.

Factor 4 – Interaction between peers– an aspect pursued in students' activities, corresponding to the transversal competence of teamwork, necessary to be developed in all students.

These factors are going to be discussed in relation to their meaning to education, the results encountered in the present study and then, linked to other studies in the field.

Factor 1: Teachers' role in the educational activity

Teachers play a crucial role in education, significantly impacting the learning process and its outcomes. The teaching methods and its environment, the teachers' interest in their subjects and students or their feedback and availability affect students' learning and performance. The role of the teacher has changed throughout the years due to the requirements of society or the evolution of education. For example, the shifts during COVID-19 from face-to-face to online and the other way around have been very demanding for teachers as they had to adapt themselves, their behaviors and their teaching materials and methods. Within this important topic of the role of the teacher in education, the present study investigates students' opinions on particular issues regarding teachers' role, namely teachers' management skills, the effectiveness of their teaching methods, their ability to raise interest and provide useful and on-time feedback, their communication skills, their ability to be up-to-date and explain their concepts, their availability outside office hours and their interest in and their respect for students.

Factor 1 applies the following saturation levels to the variable values in the questionnaire: *teachers provide timely feedback* with 0.752; *teachers provide useful feedback* with 0.748; *teachers create a welcoming and inclusive learning environment* with 0.737; *teachers are interested in the students' progress and successful completion of the course* with 0.710; *the teachers' feedback has been helpful and has improved my understanding of the course materials* with 0.701; *teachers stimulate interest in the discussed topics* with 0.696; *teachers provide the test results in a timely manner* with 0.694; *the teachers' teaching methods have helped me in my learning* with 0.686; *the information taught during the courses is*

up to date with 0.685; *the teachers' teaching methods are efficient* with 0.679; *teachers carry out the learning activities efficiently* with 0.675; *teachers explain and illustrate the concepts presented during the course* with 0.667; *teachers can be contacted outside class hours for additional help* with 0.640; *teachers treat students with respect* with 0.601.

Other researchers have also focused on the role of the teacher in online education, even before the pandemic. Alonso Diaz & Blazquez Entonado (2009) have indicated that interaction between students and teachers was greater in online due to reasons such as being part of the training system or of the final evaluation, the lack of pressure of the timetable or other face-to-face constraints, as already indicated by other studies in the field (Stigmar & Körnefors, 2005; Strømsø et al., 2007). During the COVID-19 pandemic, studies have highlighted the presence of teachers that care about their students, their flexibility for assignments' deadline and their availability to connect with students (Garrad & Page, 2022). Students appear to have been satisfied with the interaction between students and teachers during online teaching and learning and preferred to ask and respond to questions by using chats, Zoom or other virtual platforms than in class in person (Almahasees et al., 2021; Hollister et al., 2022; Vu & Fadde, 2013; Castelli & Sarvary, 2021). Interaction between teachers and students has been pointed out as crucial to the educational process, since there is a strong connection between students' academic achievement and productive behaviors and the quality of the teacher-student relationship (Archambault et al., 2017; Gülmez & Ordu, 2022; Hughes & Kwok, 2007; Konishi et al., 2010; Niebuhr & Niebuhr, 1999; Schwab & Elias, 2014). Building caring relationships, providing individual attention, and fostering effective communication (Gülmez & Ordu, 2022) are all equally significant. Providing effective feedback is also a necessary technique as it increases students' motivation and achievement significantly (Moralishvili & Chkhobadze, 2021).

Factor 2: Courses and teaching materials

Closely connected to the teacher and his/her role in education, the second factor, *Courses and teaching materials*, focuses on the organization of the lectures and their connection to basic notions and syllabuses, the assignments and their role to facilitate learning, the readings and supplementary bibliography and their usefulness in the understanding of the course, and how all these aspects (lectures,

assignments and readings) complement each other. The workload and the adequacy of the requirements of the course are also considered.

Factor 2, related to the courses and teaching materials used during the educational process, applies the following saturation levels to the variable values in the questionnaire: *the recommended additional bibliography has helped me to understand the course content* with 0.706; *course assignments (readings, videos, etc.) make my learning easier* with 0.695; *required texts and readings are important* with 0.686; *the workload and course requirements are appropriate for the course level* with 0.682*; lectures, readings and assignments complement each other* with 0.646*; the course is organized in a way that helps me understand the basic concepts* with 0.636; *teaching materials* with 0.618; *the course has been well organized* with 0.597; *the course has complied with the syllabus* with 0.550.

Previous studies have been carried out on the courses and other teaching materials used in class. For example, Alonso Díaz & Blázquez Entonado (2009) have paid attention to several categories, such as theoretical content, activities and design, in terms of satisfaction and efficacy from students' and teachers' perspectives. The researchers found that online learning was more satisfactory and efficacious in terms of the design and structure of the theoretical content, "the resources used to reflect the theory itself". Students argued that online they could always go back to summaries and conceptual maps. In face-to-face classes, the teachers often neglect "the need to guide the student through the conceptual development of the subject-matter". As for the activities, students indicated higher satisfaction and efficacy online. However, online learning may overwhelm the student with a high amount of practical content that may lead to saturation and, even, drop-off. Other studies, such as Paechter & Maier (2010), point out students' preferences for online learning due to its clear, coherent and adequately distributed and structured information. Researchers have also pointed out flaws, such as, teachers' lack of technical skills and their teaching style improperly adapted to the online environment (Coman et al., 2020; Hollister et al., 2022), the lack of contemporary pedagogical knowledge such as teaching techniques and methods used in technology-based learning (Tartari & Kashahu, 2021), and the teaching materials and their effectiveness and the difficulty in understanding the materials explained online (Hollister et al., 2022; Tartari & Kashahu, 2021).

Factor 3: Assessments

As for the third factor, assessments and evaluations are necessary aspects of education and can also affect the quality of students' learning. The type of assessment, its correspondence to the input provided to the students and its correctness are some of the more disputed issues. Assessments have as primary goal the improvement of student performance, apart from determining students' needs, assessing their knowledge, evaluating their performance, as well as developing their desirable skills and their ability to reflect critically on their work (Moralishvili & Chkhobadze, 2021; Wiggins, 1998). The present study intends to have a closer look at particular issues, such as the clarity and correctness of the marking practices, the correct evaluation of students' learning for the course and the evaluative feedback received throughout the class.

Factor 3 applies the following saturation levels to the variable values in the questionnaire: *grading practices have been fair* with 0.731; *student learning has been correctly assessed* with 0.717; *the exams/exam sessions have showed a fair assessment of students' knowledge* with 0.714; *grading practices have been clearly explained* with 0.699; *the exams/projects have shown the knowledge gained by students during the course* with 0.631; *teachers have explained the grading criteria to the students and have discussed the mistakes made by the students during the seminar activities* with 0.491.

Numerous studies support online computer-based assessment (Wibowo et al., 2016; Armoed, 2021; Hosseini & Hashemi Toroujeni, 2017; Martinavicius et al., 2017; Öz & Özturan, 2018; Prisacari et al., 2017) and consider it a "promising alternative to traditional paper-based testing" (Fisher et al., 2022), which can improve students' performance. This may be due to its flexible multimodal solutions (Flaherty, 2020; García-Peñalvo et al., 2021), the ability to have access to notes and other materials during a limited time slot (Fisher et al., 2022), its saving of resources by digital scoring (Seale, 2002), lower level of anxiety (Fisher et al., 2022) and more confidence (Atwa et al., 2022; Refae et al., 2021). Collaborative or instructor-driven online learning has turned out to lead to better students' performances than the independent, self-guided one (Chisadza et al., 2021; Means et al., 2010). Students have turned out resilient to a new type of learning that included online presentations and computer-based assessments (Fisher et al., 2022). They particularly like open book exams, in-lecture polls, optional finals, and the replacement of exams with assignments (Hollister et al., 2022). In a study carried out

by Moralishvili & Chkhobadze (2021) on assessment problems during face-to-face and distance learning, students were satisfied with online assessment and with its adequate and useful criteria which helped them improve their learning. They even considered it fairer than face-to-face one or equally fair, a conclusion that surprised the researchers. Another reason for students' satisfaction is probably their high marks, which may be due also to more tolerant grading standards and assessment practices, such as open-book tests or no-fault final exams, which focused, rather than on memorization, on deeper conceptual understanding, while still covering academic integrity and fairness issues (Hollister et al., 2022).

Nevertheless, researchers have found several shortcomings to online assessments, namely, obtaining high marks without effort, even without attending classes or actively participating in them (Bayindir, 2021; Gülmez & Ordu, 2022; Marshall et al., 2020), the lower level of validity, reliability and quality assurance in measurement and evaluation which led to grade inflation (Newman, 2015; Fisher et al., 2022; Yeşilyurt, 2021, March) and academic fraud (Glushkova et al., 2021). Additionally, the assessment practices have sometimes been limited in terms of the variety, methods of implementation in the online environment, and the tools used (Almahasees et al., 2021; Tartari & Kashahu, 2021; Williams et al., 2012), reiterating the founding that home-based online assessment is not equivalent to or superior to face-to-face assessment (Fisher et al., 2022).

Factor 4: Interaction between peers

Finally, an issue considered improving students' performance and learning is the activity carried out with their peers and their teamwork. The interaction between students, especially in small groups, helps them discuss and reflect on particular subjects and, thus, get a deeper understanding and learn from one another (Billett & Choy, 2013; Haugland et al., 2022; Janmaimool & Nunsunanon, 2021; Laal & Laal, 2012). Within this context, the present study intends to point out students' perceptions on their interaction in face-to-face and online learning. Particular attention is paid to the efficiency of teamwork and the way the interaction has been performed.

Factor 4, regarding the interaction between peers, applies the following saturation levels to the variable values in the questionnaire: *the students' teamwork efficiency has been much better* with 0.825; *the interaction between students has worked better* with 0.809; *students have learnt better during*

the semester with 0.727; *students have learnt better during the exam session* with 0.719; *the students' research skill has become better* with 0.545; *students have been given more free time* with 0.525.

Other researchers (Fisher et al., 2022) consider that online learning encouraged more effective communication between students and students and students and staff through email, chat, live class questions, online assessment, and feedback. Fisher et al. (2022) point out that the classroom environment has turned from passive to "enriching active" for both students and teachers. Various studies have highlighted the advantages of using online collaborative technologies to support participants who may not have the chance to meet or interact with their peers in person (Chu et al., 2009; Reed et al., 2017). In turn, other researchers point out that online learning does not provide a favorable environment for collaboration between students and thus, collaborative learning, as it limits interaction, minimizes direct contact and encourages social distancing (Almahasees et al., 2021; Atwa et al., 2022; Tartari & Kashahu, 2021; Wut & Xu, 2021). Students are not all in the same place, which makes them difficult to coordinate and monitor during class, as well as their access to the Internet may be different (Lan et al., 2019; Mustakim et al., 2021). Lan et al. (2019) found that online collaboration required a higher cognitive load, due to the necessity of learning how to use the platforms, and a higher engagement, as students were more willing to engage.

To summarise the discussion above, the four factors resulting from the factor analysis show that the students under investigation were guided in their online activity by the teachers' role, the courses and training, the assessments and the interaction.

Table 3. Correlations between the factors found for the online education

Component Transformation Matrix				
Component	Teachers' role	Courses and teaching materials	Assessments	Interaction between peers
1. Teachers' role	.648	.489	.431	.393
2. Courses and teaching materials	-.483	-.273	.345	.757
3. Assessments	.313	-.129	-.789	.512
4. Interaction between peers	-.499	.818	-.268	.098
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				

Table 3 shows the following correlation coefficients between the factors:

- Factor 1 and Factor 2 have a correlation coefficient of 0.48;
- Factor 1 and Factor 3 have a correlation coefficient of 0.431;
- Factor 1 and Factor 4 have a correlation coefficient of 0.393;
- Factor 2 and Factor 3 have a correlation coefficient of 0.345;
- Factor 2 and Factor 4 have a correlation coefficient of 0.757;
- Factor 3 and Factor 4 have a correlation coefficient of 0.512.

These correlation coefficients are quite good and are worth analysing in further research.

4.2. Factor analysis - Face-to-face education

Calculation of item fidelity and interassessor agreement – calculation of the Cronbach Alpha coefficient (Cronbach, 1951).

Item reliability coefficient alpha and the split-half reliability method evaluate the internal consistency of a questionnaire's items, ensuring that the items measure the same construct.

Cronbach's Alpha coefficients range between 0 and 1 (Cronbach, 1951). A value above 0.7 (Cronbach, 1951) or 0.8 is required for empirical research based on existing theories, or even 0.9 for a much more accurate description (Macovei, 2014).

Table 4. Calculation of Cronbach Alpha for the face-to-face education items

	Cronbach's Alpha if Item Deleted
1. Teachers carry out the learning activities efficiently	.981
2. The teachers' teaching methods are efficient	.981
3. The teachers' teaching methods have helped me in my learning	.981
4. Teachers stimulate interest in the discussed topics	.981
5. Teachers provide useful feedback	.981
6. Teachers provide timely feedback	.981
7. Teachers provide the test results in a timely manner	.981
8. The information taught during the courses is up to date	.981
9. Teachers explain and illustrate the concepts presented during the course	.981
10. The teachers' feedback has been helpful and has improved my understanding of the course materials	.981
11. Teachers can be contacted outside class hours for additional help	.981

12. Teachers are interested in the students' progress and successful completion of the course	.981
13. Teachers create a welcoming and inclusive learning environment	.981
14. Teachers treat students with respect	.981
15. Lectures, readings and assignments complement each other	.981
16. Teaching materials	.981
17. Required texts and readings are important	.981
18. The workload and course requirements are appropriate for the course level	.981
19. The course is organized in a way that helps me understand the basic concepts	.981
20. Course assignments (readings, videos, etc.) make my learning easier	.981
21. The recommended additional bibliography has helped me to understand the course content	.981
22. The course has been well organized	.981
23. The course has complied with the syllabus	.981
24. Students have been given more free time	.982
25. The interaction between students has worked better	.982
26. The students' teamwork efficiency has been much better	.982
27. Students have learnt better during the exam session	.981
28. Students have learnt better during the semester	.982
29. Student learning has been correctly assessed	.981
30. The exams/exam sessions have showed a fair assessment of students' knowledge	.981
31. Grading practices have been clearly explained	.981
32. Grading practices have been fair	.981
33. The exams/projects have shown the knowledge gained by students during the course	.981
34. The students' research skill has become better	.981
35. Teachers have explained the grading criteria to the students and have discussed the mistakes made by the students during the seminar activities	.981

As per table 4, all items have a Cronbach Alpha coefficient above 0.981. Thus, it can be said that a very good consistency of the questionnaire items regarding the face-to-face education items, has been obtained.

Table 5. Kaiser-Meyer-Olkin (KMO) and Barlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.971	
Bartlett's Test of Sphericity	Approx. Chi-Square	13795.520
	df	595
	Sig.	.000

The Kaiser-Meyer-Olkin (KMO) Test (Table 5) shows the measure of adequacy of the chosen sample (Macovei, 2014) for the factor analysis. The KMO test requires a value as close to 1 as possible, with 0.5 being the minimum acceptable threshold, indicating that the items can be grouped into distinct factors. For the sample analyzed, the KMO test value is 0.981, suggesting that the sample is appropriate for factor analysis.

The Bartlett's test of sphericity (Table 5) reports a Chi-square value of 13,975.520, with 595 degrees of freedom (df) and an associated probability ($p < 0.01$), indicating that the data set is suitable for exploratory factor analysis.

Four factors have been extracted, each with a value greater than 1, indicating that they have more explanatory power than a single variable. The remaining factors that were not extracted exhibit an unexplained error variance. The rotation of the factors reveals that the first factor accounts for 25.526% of the variance, the second factor for 18.661%, the third for 15.711%, and the fourth for 14.112%. Altogether, these four factors explain 74.009% of the variance, which represents a highly favourable percentage.

The variables are ordered based on the saturation they have in the extracted factors. It can be seen that the factor structure is the same as for the online education, but the loading of the factors on each variable is different, the dissimilarities being insignificant.

Factor 1 – Teachers' role – corresponding to the teachers' role in the educational activity.

Factor 2 – Courses and teaching materials **-** corresponding to the need for self-improvement.

Factor 3 – Assessments - corresponding to the assessment activity that follows the teaching periods.

Factor 4 – Interaction between peers – an aspect pursued in students' activities, corresponding to the transversal competence of teamwork, necessary to be developed in all students.

In the case of face-to-face education, the factors will not be explained individually and linked to their meaning in education, as this has already been done in the previous section focusing on online education. Here, the results found out for each factor will be presented and discussed in relation to previous studies.

Factor 1: Teachers' role in the educational activity

Factor 1 applies the following saturation levels to the variable values in the questionnaire: *teachers provide useful feedback* with 0.764; *teachers provide timely feedback* with 0.751; *teachers carry out the learning activities efficiently* with 0.742; *the teachers' teaching methods are efficient* with 0.729; *teachers stimulate interest in the discussed topics* with 0.703; *the teachers' teaching methods have helped me in my learning* with 0.693; *the teachers' feedback has been helpful and has improved my understanding of the course materials* with 0.690; *teachers create a welcoming and inclusive learning environment* with 0.675; *teachers are interested in the students' progress and successful completion of the course* with 0.657; *teachers can be contacted outside class hours for additional help* with 0.621; *teachers provide the test results in a timely manner* with 0.618; *teachers explain and illustrate the concepts presented during the course* with 0.611; *The information taught during the courses is up to date* with 0.602; *teachers treat students with respect* with 0.527.

Several other studies conducted on the role of the teacher in face-to-face education have indicated that students prefer the physical interaction with their teachers as its lack affects their progress and personalities (Almahasees et al., 2021). Gülmez & Ordu (2022) point out that, after the pandemic, teachers have used methods and techniques found in the online environment, such as flexibility, variety and technology in their class materials and the students' assignments. At the same time, they kept their expectations low, considering that students may have cognitive and interpersonal gaps.

Factor 2: Courses and teaching materials

As for Factor 2**,** it applies the following saturation levels to the variable values in the questionnaire: *the recommended additional bibliography has helped me to understand the course content* with 0.742; *required texts and readings are important* with 0.732; *teaching materials* with 0.708; *the course is organized in a way that helps me understand the basic concepts* with 0.668; *course assignments (readings, videos, etc.) make my learning easier* with 0.656; *the workload and course requirements are appropriate for the course level* with 0.650; *lectures, readings and assignments complement each other* with 0.616*; the course has been well organized* with 0.586; *the course has complied with the syllabus* with 0.545.

Other studies, such as Paechter & Maier (2010), indicated students' preference for face-to-face learning to apply conceptual knowledge and learning skills. It has also turned beneficial to develop

attitudes and modify perceptions (Alonso Diaz & Blazquez Entonado, 2009). Nevertheless, students admitted they did not spend a lot of time learning in face-to-face education but considered their course less complete than its online version (Alonso Diaz & Blazquez Entonado, 2009). It seems that face-to-face learning often prioritizes the explanation of the concepts instead of the practical issue.

Factor 3: Assessments

Factor 3 applies the following saturation levels to the variable values in the questionnaire: *grading practices have been clearly explained* with 0.725; *grading practices have been fair* with 0.717; *student learning has been correctly assessed* with 0.713; *The exams/exam sessions have showed a fair assessment of students' knowledge* with 0.635; *the exams/projects have shown the knowledge gained by students during the course* with 0.635; *teachers have explained the grading criteria to the students and have discussed the mistakes made by the students during the seminar activities* with 0.604.

Other studies on assessment and evaluation, such as Atwa et al. (2022), indicated students' preference for face-to-face assessments, particularly pointing out longer time to complete the tasks and the possibility to go back and correct previous answered questions.

Factor 4: Interaction between peers

Finally, Factor 4 applies the following saturation levels to the variable values in the questionnaire: *students have learnt better during the semester* with 0.823; *students have learnt better during the exam session* with 0.811; *students have been given more free time* with 0.777; *the students' teamwork efficiency has been much better* with 0.707; *the interaction between students has worked better* with 0.629; *the students' research skill has become better* with 0.622.

Numerous studies showed that in face-to-face educational environments, interaction among peers provides the opportunity to discuss directly in order to obtain and exchange ideas, insights, and suggestions (Gülmez & Ordu, 2022; Wut & Xu, 2021). Students favour face-to-face learning for better understanding of concepts and building interpersonal relationships (Paechter & Maier, 2010). All things considered, the four factors resulting from the factor analysis show that the students under investigation were guided in their face-to-face activity by the teachers' role, the courses and teaching materials, the assessments and the interaction between peers.

Table 6. Correlations between the factors found for the face-to-face education

Component Transformation Matrix				
Component	Teachers' role	Courses and teaching materials	Assessments	Interaction between peers
1. Teachers' role	.614	.514	.456	.388
2. Courses and teaching materials	-.424	-.307	.217	.824
3. Assessments	.150	.276	-.858	.406
4. Interaction between peers	-.648	.752	.092	-.078
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				

Table 6 presents the following correlation coefficients between the factors:

- Factor 1 and Factor 2 have a correlation coefficient of 0.514;
- Factor 1 and Factor 3 have a correlation coefficient of 0.456;
- Factor 1 and Factor 4 have a correlation coefficient of 0.388;
- Factor 2 and Factor 3 have a correlation coefficient of 0.217;
- Factor 2 and Factor 4 have a correlation coefficient of 0.824;
- Factor 3 and Factor 4 have a correlation coefficient of 0.406.

These correlation coefficients are also quite good and are worth analysing in further research.

Limitations

The current study, focusing on the analysis of the perceptions of students of Politehnica University of Timişoara regarding the effectiveness of online education in comparison to traditional education presents certain limitations that should also be taken into consideration. The sample, consisting exclusively of students of Politehnica University of Timişoara, although varied and comprehensive within this institution, could limit the applicability and extension of the conclusions outside the specific context of the university. The existence of differences in the experiences and views of students from other academic or cultural backgrounds is a real possibility, influencing thus the generalizability of the study results. We acknowledge that international representativeness is an important consideration. While this study is specific to a single institution, the

methodology and tools used could be applied to diverse academic contexts globally. This would allow for comparative research and broader validation of the findings across different countries and cultural settings. Furthermore, the use of a non-standardized questionnaire for data collection raises questions about the consistency and reliability of responses. Although this instrument was designed to cover relevant aspects of online education, the lack of standardization may influence the way in which the participants could interpret and answer the questions.

It is important that future research addresses these limitations to provide a deeper and more comprehensive understanding of the effectiveness of online versus traditional education. In a world where digitalization is gaining ground, an in-depth study of the long-term effects of online education versus traditional face-to-face learning methods would provide valuable insights into student satisfaction and education quality. As technology evolves, teachers are challenged to adapt their teaching techniques to improve student engagement and achievement in online and hybrid environments, exploring new ways they can use technology to enrich the learning experience. By studying the impact of technology in education, researchers can assess how new tools and platforms influence the effectiveness of the educational process and identify ways to optimize them to support effective learning. Additionally, analysing the dynamics of online collaboration could reveal how virtual interaction and collaboration affect students' social and academic development, showing how digital collaboration contributes to improved learning outcomes. At the same time, in virtual environments, feedback becomes an essential component of learning, and the way it is administered and perceived can vary significantly. Exploring the effectiveness of different forms of online feedback and their impact on student motivation and academic progress could provide important clues for optimizing didactic assessment and interaction techniques in the digital age.

Conclusions

This study has investigated the transition to online education and has assessed the students' perceptions on the effectiveness of this method of education compared to traditional methods. It has also pointed out the main factors that resulted following the factor analysis carried out for the two forms of education, i.e. the teachers' role, courses and teaching materials, assessments and interaction.

The results indicate a successful and effective adaptation of online education, suggesting that the changes enforced by the pandemic situation have accelerated the adoption of more flexible and accessible teaching techniques.

The teacher's role continues to be essential in educating and training students in both environments. Still, the way teachers work and interact with students has undergone significant changes as one of the teacher's key roles in the digital age is that of facilitator of learning (Pillay, 2022). That being said, teachers must be able to use technology and integrate it into the teaching process to help students access and use digital resources as well as to find and select relevant information and to collaborate and communicate effectively through technology (Otts et al., 2021).

Interestingly enough, online feedback is perceived as more accessible and effective than traditional feedback, highlighting the potential of digital technology to improve educational communication and support. Online teaching materials were also rated as being more in tune with students' learning needs, underlining the importance of adapting and customizing educational resources. In terms of assessment and grading, the students' preference for online practices points towards a need for flexibility and adaptability in assessment strategies.

In this context, the study highlights the necessity of integrating greater flexibility in the processes of evaluation and course organization, especially given the broader global transformations. This increased flexibility allows for adaptation to emerging challenges and helps maintain the continuity and effectiveness of the educational process in ever-changing learning environments.

In opposition with Alonso Diaz & Blazquez Entonado (2009)' conclusion, which stated that no significant differences were observed in the teacher's roles between the two teaching methods, this study's findings suggest that online education not only matches, but also exceeds in some aspects the quality of traditional education. This proves that the main educational factors do not change during the transition from face-to-face to online education, but that this transition involves a new step of "taming" the technology for educational purposes.

It should also be pointed out that the shift in education from face-to-face to online and blended learning, driven mostly by the COVID-19 pandemic, aligns closely with the broader topics of sustainability in our global society. Sustainability, at its core, means adapting to changing

circumstances and emerging needs, as well as efficiently using resources to support the long-term development. In this context, education, as a fundamental part of society, is not an exception. The changes brought to the education system in recent years, whether it is the adaptation to online education or the return to face-to-face education, reflect the flexibility and ability of the system to respond effectively to global crises, such as the pandemic. This aspect demonstrates a commitment to the principles of sustainability, an adaptation to ensure the continuity and accessibility of the education despite unforeseen challenges. Pandemic-induced changes in higher education indicate a process of sustainable transformation that incorporates new technologies and teaching methods to meet contemporary challenges. These transformations underline the importance of flexibility, resilience and innovation in education, essential elements to ensure the sustainable and inclusive development in today's modern society.

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