Tuning Journal for Higher Education

Educational Journeys in times of uncertainty:
Weathering the storms

Emerging strategies and challenges faced by professors during Emergency Remote Teaching (ERT) at a Colombian university

Lina Sofía Valenzuela, Yeny E. Rodríguez, Henry A. Taquez, José Roberto Concha, Ana M. Ayala Román, and Laura Romero-García

Emerging strategies and challenges faced by professors during Emergency Remote Teaching (ERT) at a Colombian university

Lina Sofía Valenzuela, Yeny E. Rodríguez, Henry A. Taquez, José Roberto Concha, Ana M. Ayala Román, and Laura Romero-García*

Abstract: This paper analyzed the relationship between emergent teaching strategies and the challenges professors at Universidad Icesi (Cali, Colombia) faced when transitioning to Emergency Remote Teaching (ERT) during the COVID-19 pandemic. A survey with open-ended questions was used to conduct a content analysis, followed by a correspondence analysis. The main findings were that most professors described submitting information and interaction as the most common teaching strategies. The challenges were primarily emotional and technical in nature. There were differences in discipline, gender, and age. Furthermore, there was no

* **Lina Sofía Valenzuela** (corresponding author, lsvalenzuela@icesi.edu.co), PhD, is an Assistant Professor in the Department of Management at Icesi University, Colombia.

Yeny E. Rodríguez (ye.rodriguez395@uniandes.edu.co), PhD, is an Associate Professor at University of the Andes, Colombia.

Henry A. Taquez (hataquez@icesi.edu.co) is a full-time professor in the Department of Language and Pedagogy at Icesi University, Colombia.

José Roberto Concha (jrconcha@icesi.edu.co), PhD, is a full-time professor and the Chair of the Department of Marketing at Icesi University, Colombia.

Ana M. Ayala Román (amayala@icesi.edu.co), PhD, is a member of the Dean's Office in Educational Innovation and Strengthening of the PEI and Full-time professor in the Department of Humanities and Citizenship of the Faculty of Human Sciences at Icesi University, Colombia.

Laura Romero-Garcia (laura.romero3@u.icesi.edu.co) is a Psychologist with a Master's Degree in Social and Political Studies and works as a Research Assistant at Icesi University, Colombia.

More information about the authors is available at the end of this article.

alignment between the challenges and the proposed strategies. Finally, this research has significant implications for future teacher training programs that emphasize faculty diversity.

Keywords: Faculty; emergency remote teaching; teaching challenges; teaching strategies; Colombia.

I. Introduction

COVID-19 has posed a challenge to education institutions' teaching efforts. The World Economic Forum (2020) estimates that approximately 1.5 billion students from universities, colleges, and schools could not physically attend classes in 2020. Universities have had to make sudden changes to stay afloat despite the challenges occasioned by the pandemic (Smalley 2021). The sudden need for change, and face-to-face teaching strategies had to be replaced with virtual classes, which adopted an Emergency Remote Teaching (ERT) approach (Hodges et al. 2020). This shift was abrupt and particularly challenging in developing countries, where only 47% of the population has access to the Internet (International Telecommunication Union 2019).

At Icesi University in Cali, Colombia, this unprecedented phenomenon occurred in the second half of March 2020, when course processes were in the middle of the first semester. The change was abrupt and sudden. Over 7500 undergraduate and graduate students transitioned from "face-to-face" to ERT within a week. The University has a pedagogical model based on active learning methodology and constructivist principles. It also maintains a social inclusion policy, with more than 60% of its students coming from households with low-income levels. This condition presents a more significant challenge with the abrupt shift to remote education, where access to transmission networks and computer equipment is necessary.

Furthermore, it is important to identify the professors' strategies and challenges during this time of abrupt and necessary changes to improve the quality of the teacher training programs, considering the differences found regarding discipline, gender, and age. This means improving the training and support received by faculty, understanding the diversity of professors and the need for flexibility.

This study explores the challenges faced and the strategies adopted by faculty during ERT. It presents professors' descriptions of the challenges they experienced and their strategies to counter them. The research question is as follows: What relationship exists between emergent strategies and challenges identified by faculty during ERT implementation considering demographic variables?

This question will be answered by categorizing the professors' responses depending on the challenges and strategies after the first week of an abrupt change from face-to-face teaching to remote teaching. The categorization was based on the existing literature regarding strategies and challenges experienced during ERT. In addition, a correspondence analysis was conducted to establish how emerging strategies and challenges were associated. The main contribution of this study is to identify differences in discipline and age in the emergent strategies used and the challenges faced by faculty. The findings contribute to identifying needs– in terms of faculty training–that could be used to design training curricula that consider the heterogeneity of a faculty member in terms of emergent strategies and challenges compared by demographic variables such as discipline and age.

II. Literature review

Teaching online usually comes along with the implementation of new teaching strategies. The existing literature shows that the strategies adopted for online teaching depend on the aim or objective pursued, such as enhancing student interactivity (Durrington, Berryhill, and Swafford 2006), achieving or fostering student engagement (Angelino, Williams, and Natvig 2007; Heilporn, Lakhal, and Bélisle 2021), improving time management (Shi, Bonk, and Magjuka 2006) or creating a collaborative online learning environment (Duncan and Young 2009).

Additionally, transitioning to online teaching poses several challenges. Various authors have identified online teaching issues, concerns, and challenges (Bower and Hardy 2004; Duncan and Young 2009; Xu and Mahenthiran 2016). These challenges are often related to technical or support problems (Bower and Hardy 2004; Xu and Mahenthiran 2016), concerns regarding student engagement and enhanced learning (Duncan and Young 2009; Xu and Mahenthiran 2016) and changes in the interaction dynamics and roles inside virtual classrooms (Xu and Mahenthiran 2016).

However, the emerging teaching strategies used and challenges faced during remote or online teaching might differ during times of crisis, such as the COVID-19 pandemic.

II.1. Strategies and challenges during ERT

As a result of this situation, a new concept emerged in education called ERT. According to Hodges et al. (2020), this concept refers to a temporary

shift of instructional delivery to a different one due to emergencies. It involves using remote teaching solutions that would have otherwise been delivered through face-to-face teaching (Hodges et al. 2020). It is important to note that ERT, by its nature, faces various challenges, such as a lack of adequate support resources and insufficient teacher training.

Moreover, a growing number of studies have used the concept of ERT to explain or understand the new common ground in education–a form of educational delivery that removes face-to-face interaction by incorporating remote solutions and various virtual resources (Al-Maroof et al. 2020; Ferri, Grifoni, and Guzzo 2020; Greenhow and Galvin 2020; Mishra, Gupta, and Shree 2020; Mohmmed et al. 2020; Rahim 2020; Ramlo 2021; Safi, Wenzel, and Spalding 2020; van der Spoel et al. 2020).

According to some authors, one of the most recommended strategies to use during ERT is the implementation of asynchronous activities (such as discussion forums and document creation through notetaking) as an opportunity for students who could not attend the synchronous session (Greenhow and Galvin 2020; Mohmmed et al. 2020), including the integration of social media into ERT (Greenhow and Galvin 2020). Other strategies include the flexibilization of assignments and due dates and development institutional policies (Mohmmed et al. 2020). In addition, various authors recommend a smooth and monitored transition to ERT. For instance, Rahim (2020) compiled some guidelines for online assessment strategies and discussed them, considering the ERT concept. In summary, the main strategies proposed or recommended by the authors reviewed were I) incorporating asynchronous activities along with synchronous activities, II) being flexible with the demands of students, III) ensuring that the statement of learning objectives is aligned with the evaluations, IV) addressing students' diverse and challenging situations and V) establishing clear communication with students while giving quality feedback.

The most frequent challenges highlighted by professors during ERT were related to technical or support problems and difficulties experienced in the use of tools or resources (Ahmed and Opoku 2021; Dorfsman and Horenczyk 2021; Ferri, Grifoni, and Guzzo 2020; Jung et al. 2021; Kovacs, Pulfrey, and Monnier 2021; Mishra, Gupta, and Shree 2020; Safi, Wenzel, and Spalding 2020; Talidong 2020; Whalen 2020). Other concerns were regarding students' engagement and participation (Ferri, Grifoni, and Guzzo 2020; Heilporn, Lakhal, and Bélisle 2021; Safi, Wenzel, and Spalding 2020; Talidong 2020) and social problems related to community building and lack of spaces to learn and teach from home (Ferri, Grifoni, and Guzzo 2020; Safi, Wenzel, and Spalding 2020). As described by Ferri, Grifoni, and Guzzo

(2020), these challenges can be classified as I) technological challenges, II) pedagogical challenges, and III) social challenges.

Last, according to some authors, the adoption and acceptance of this new form of instruction delivery are influenced by the personal or demographic characteristics of faculty (Ramlo 2021; van der Spoel et al. 2020) and students (Aristovnik et al. 2020).

II.2. *Professors' technology adoption and usage by disciplines*

Various authors have found differences in adopting instructional technologies in classrooms during well-planned online education (Anderson, Varnhagen, and Campbell 1998). The authors used Roger's Diffusion theory (Rogers 2010). They described the "early adopters" as more likely to be from the School of Sciences and Engineering and less likely to be from the faculty of Arts (Anderson, Varnhagen, and Campbell 1998). Moreover, according to an investigation of technology adoption among medical school faculty members, one significant barrier to developing technology-based applications is carrier-related. This barrier discourages young medical faculty from spending time and effort implementing new technology, although they are more familiar with it than senior faculty (Zayim, Yildirim, and Saka 2006).

II.3. *Professors' technology adoption and usage by age*

Some studies have stated that age is important in understanding behaviors and attitudes toward technology usage and adoption (Chung et al. 2010; Gibson, Harris, and Colaric 2008; McFarland 2001; Tarhini, Hone, and Liu 2014). Furthermore, Tarhini, Hone, and Liu (2014), using the Technology Acceptance Model (TAM), found that age moderates the effect of perceived ease of use and perceived usefulness, among other components of TAM. Moreover, Chung et al. (2010) found a negative relationship between age and internet self-efficacy, which could discourage technology usage in older participants.

III. Research methodology

III.1. *Participants*

The present study used secondary data from a private university in Colombia, South America. The authors received authorization from the university to use the data in an aggregate way, so individuals cannot be identified. An online survey was conducted involving 725 university

professors. These professors belonged to five different schools. The directors from each department invited the professors to answer questions about their ERT teaching experience. There were 935 answers, out of which 178 were repeated, 78 were partially repeated, 349 were incomplete, 28 were incoherent responses, and 302 were complete, representing 295 professors (some professors responded to questions from more than one course, and they provided different responses to each course). Table 1 presents the demographic characteristics of the professors in terms of age and years of experience at the university by faculty and gender.

Table 1

Demographic characteristics

School	Number of Professors			Experience at Icesi University (years)			Average Age (years)		
	Women	Men	Total	Women	Men	Total	Women	Men	Total
Law & Social Sciences	19	35	54	3,6	2,9	3,1	43	40	41,1
Economics & Business Administration Sciences	47	41	88	4,5	4,5	4,5	48	50	48,9
Natural Sciences & Medicine	31	43	74	2,1	2,2	2,2	38	43	40,9
Education Sciences	17	29	46	2,1	2,8	2,5	43	47	45,5
Engineering	3	30	33	9,1	5	5,4	36	45	44,2
Total	**117**	**178**	**295**	**3,5**	**3,4**	**3,4**	**44**	**45**	**44,6**

III.2. Instrument

The questionnaire inquired about the teaching strategies used and the challenges faced: technical, academic, emotional, or affective (see annex 1). The teaching strategies were described as the professors' planning and evaluation for the online classes. However, this definition was not in the questionnaire. As a result, each professor responded depending on how they understood the questions and what they interpreted as teaching strategies and challenges. Professors were free to write any strategies that they believed could be effective.

III.3. Content analysis

Data analysis was performed following the qualitative research model Creswell (2009) and Lee and Lee (1999) proposed. This analysis presented an opportunity to examine the narratives (Lee and Lee 1999) written by the professors regarding their specific experiences with ERT. First, the raw data was organized. Then, the professors who responded several times to the same questions (evaluating the same course) were identified. Finally, the completed entries and those that had missing responses were also identified. Only the responses with complete and non-repetitive answers were used for subsequent analyses.

A senior author then reviewed all the data to obtain a general sense of information and emerging topics. First, the responses underlying topics were recorded, and similar topics were clustered and abbreviated. Next, the topics were labelled with categories. Finally, the senior researcher tested the categories on the data back and forth until most responses could be coded into one or more categories. The researcher corroborated or changed the categories during this process without coding the responses.

Next, the coding process continued with two researchers assigning all the responses to the categories. Tables 2 and 3 show the qualitative code tables used for coding the data with the description of each category and some examples from the coding process that the researchers identified. One response could have one or more categories, so the different categories were coded in each response. For example, the first category was assigned to the first theme, and the second category to the second theme. An intercoder agreement was achieved by cross-checking by two researchers. The responses with coding differences were re-evaluated until an agreement was achieved, and the responses that did not fit into any categories were coded as others. At this point, the researchers developed the hypotheses to be tested.

Table 2

Strategies code table

Strategies		
Category	Category Description	Examples
Content Submit	The content exchange between professor and student before/after class (asynchronous).	Videos, PowerPoint presentations, blogs, audios, lectures, workshops, photos, quizzes, exams, evaluations, conceptual maps, homework, deliverables, infographics, flowcharts, podcasts.

Strategies		
Category	Category Description	Examples
Interaction	Real time interaction (synchronous) or in "quasi-real-time" (delayed synchronous) between the professor and student.	Zoom, Teams, Google Meet, virtual whiteboard, virtual session, Kahoot, discussions, in-class workshops, discussion forums, Skype, debates, Go To Meeting, seminars, chat, WhatsApp, email, Discord, Slack, feedback, pedagogical support, permanent communication with students, answering questions, personalized advice, follow-up, guidance.
Planning and Groups	Planning the redesign of the course to adjust it to Emergency Remote Teaching.	Redesign classes, planning, defining the agenda, detailed schedule, design per week, activity scheduling, class route, weekly work, digital guides, course restructuring, specific objectives, guidelines, datasheet, group workshop, practical workshop, divide the group and assign roles, organization of small groups, virtual round tables.
Other	Strategies that are unique to a few professors.	Collaboration between professors, collaborative work to motivate the students, opening other communication channels, strengthening student autonomy, visual thinking, project-based learning.

Table 3

Challenges code table

Challenges		
Category	Category Description	Examples
Emotional	Perception of the professor in terms of workload, emotions, and problems he faces or perceived on the students.	Strong increase in workload, greater effort, and dedication for the preparation of classes, increase in the time dedicated to students, virtual classes generate anxiety, virtual shyness, work takes much time, which was previously used for other activities, conditioning the workplace at home, efficient communication, difficulty interacting with students, change in the relationship with students. In addition, students have expressed feeling overwhelmed by the number of academic tasks to which they must respond; this causes an environment of stress, many students seem distracted, some students are discouraged by their process, financial problems, sharing resources with the family, some must collaborate with other activities in addition to their burden.

Challenges		
Category	Category Description	Examples
Technical	Technical problems perceived by the professor related to ICT knowledge or connectivity.	Learning new tools, technology usage, searching for ICT to meet specific needs, use of Moodle, failures with the internet, unavailability of resources, connection problems.
Academic	Challenges related to the evaluation, feedback, activities, or course quality.	Evaluation, avoiding fraud, follow-up and feedback, control over who participates, developing compelling content that promotes skills development, maintaining quality, redesigning the course and its content to the remote environment.
Group Work	Challenges related to the timing for classes and the course size in the virtual environment.	Working synchronously with large groups, difficulties for teamwork for the students, problems to coordinate sessions, class time is not enough to address the concerns of the students, some students do not connect to the zoom sessions.
Other	Challenges that are unique to a few professors.	No challenges, sabotage by students, time management, being more efficient.

III.4. *Analysis method*

The data were analyzed using correspondence analysis. The purpose of data analysis was to identify the emergent teaching strategies used by the professors of Icesi University and the challenges each faculty experienced when transitioning into ERT while considering the demographic characteristics to obtain comparative results.

Correspondence analysis is a multivariate statistical method used to analyze categorical data summarized in a contingency table (Greenacre 2017). A contingency table, called cross-tabulation, presents non-negative entries and shows the frequency distribution of one variable in rows and another variable in columns (Greenacre 2000). This technique allows the transformation and interpretation of numerical data into a graphical display, generally in a two-dimensional space (Greenacre 2017).

The number of dimensions for a correspondence analysis is defined using two critical measures: inertia and mass values. Inertia statistics measure the level of explained variance for the dimensions involved, while mass value is a proportion value that indicates the importance of a particular dimension (Greenacre 2000).

IV. Findings

IV.1. Strategies used

The professors were asked to describe the teaching strategies implemented to adjust the teaching-learning process. Table 4 presents a summary of the frequencies for the four strategies identified.

Table 4

Strategies

ID Strategy	Description	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5
Content Submit	Frequency	232	102	12		
	Participation (%)	76,8%	41,0%	6,9%		
Interaction	Frequency	42	109	114	51	34
	Participation (%)	13,9%	43,8%	65,5%	55,4%	85,0%
Planning and Groups	Frequency	10	23	32	37	5
	Participation (%)	3,3%	9,2%	18,4%	40,2%	12,5%
Other	Frequency	18	15	16	4	1
	Participation (%)	6,0%	6,0%	9,2%	4,3%	2,5%
Total		**302**	**249**	**174**	**92**	**40**

In 76,8% of the courses, professors' teaching strategies focused on submitting information ("content submit"), either by the professor or the student. These activities were related to professors sending content to the students, such as videos, and students delivering content to the professors, such as developing a workshop and uploading it to the corresponding platform. The second teaching strategy with the highest frequency was the interaction between professors and students, either in real-time or quasi-real-time, by 13,9% of the professors. The teaching strategies with the lowest frequency were "planning and groups" and "other".

In 82.5% of the courses, the professors used a second teaching strategy to complement the first. On average, in 84,7% of the courses, professors' strategies focused on submitting content and interacting with professors and students.

In 57.6% of courses, the professors used a third teaching strategy to complement the first and second strategies. On average, in 65.5% of the courses, the strategies were related to the interaction between professors and students. On the other hand, professors used the "planning and groups" strategy in 18,4% of the courses. The "planning and groups" strategy focused

on redesigning class activities, particularly those related to group conformation. In 30.5% of the courses, the professors employed a fourth teaching strategy focused on "interaction" and "planning and groups". Finally, on average, the professors used a fifth teaching strategy in only 13.2% of the courses. These results imply that professors focused on interactions with students in 85% of the courses.

IV.2. *Identified challenges*

The professors were asked to highlight the challenges (emotional, technical, and academic) that they encountered in developing their academic activities. Table 5 presents the professors' responses regarding the challenges faced.

Table 5

Challenges

ID Challenge	Description	Challenge 1	Challenge 2	Challenge 3	Challenge 4	Challenge 5
Emotional	Frequency	137	48	7	8	6
	Participation (%)	45,4%	30,0%	10,3%	25,0%	46,15%
Technical	Frequency	73	53	28	2	
	Participation (%)	24,2%	33,1%	41,2%	6,3%	
Academic	Frequency	51	33	24	11	2
	Participation (%)	16,9%	20,6%	35,3%	34,4%	15,4%
Group Work	Frequency	17	16	6	9	3
	Participation (%)	5,6%	10,0%	8,8%	28,1%	23,1%
Other	Frequency	24	10		2	2
	Participation (%)	7,9%	6,3%		6,3%	15,4%
Total		**302**	**160**	**68**	**32**	**13**

Professors identified emotional challenges in 45,5% of the courses. These challenges were related to feelings or emotions that the teachers identified in the students or within themselves and the perception of a more significant workload from both ends. Contrastingly, professors identified technical challenges in 24.2% of the courses, related to connectivity problems on behalf of the professors or the students and the professors' ICT skills. Academic challenges, which refer to the professors' evaluation, monitoring and feedback processes and the new activities they propose in classrooms, were recorded in 16.9% of

the courses. Finally, the professors identified "group work"-related challenges in 5.6% of the courses and "other" kinds of challenges in 7.9% of the courses.

On average, in 52,9% of the courses, the professors identified a second challenge. In this second challenge professors mainly identified four aspects: "technical" (33,1%), "emotional" (30,0%), "academic" (20,6%) and "group work" (10,0%). The central aspect identified as a technical challenge is connectivity problems, while academic challenges are mainly related to developing strategic planning in search of quality.

The professors identified the third challenge in 22.5% of the courses. On average, 95.6% of professors focused mainly on four challenges: "emotional" (10.3%), "technical" (41.2%), "academic" (35.3%) and "group work" (8.8%). The central aspect of the technical challenges was related to connectivity problems. Emotional challenges were associated with problems outside the academic field, while academic challenges were associated with developing of strategic planning in search of quality. Finally, on average, the professors identified the fourth and fifth challenges in 10.6% and 4.3% of the courses, respectively.

IV.3. Correspondence analysis

The professors' first two strategies in 82.5% of the courses and the two first challenges that 52,9% of the professors faced were incorporated in the correspondence analysis. Table 6 presents the proportion of inertia for each dimension.

Table 6
The dimensionality of correspondence analysis

Dimension	Principal Inertia	Percentage	Cumulative Percentage
dim 1	0.06	33.61	33.61
dim 2	0.04	22.81	**56.42**
dim 3	0.02	11.55	36.97
dim 4	0.00	3.67	71.64
dim 5	0.00	1.99	73. 63
Total	0.18	100	

The first and second dimensions, put together, explain 56.42% of the inertia. Therefore, the two-dimensional model is appropriate for these data.

Table 7 shows the contingency table between the first two strategies and the first two challenges.

Table 7
Contingency table of strategies and challenges

	Category	Challenge 1						Challenge 2					
		Emotional	Technical	Academic	Group W	Other	Total	Emotional	Technical	Academic	Group W	Other	Total
Strategy 1	Content Submit	114	60	30	14	14	232	40	47	27	12	9	135
	Interaction	15	6	12	2	7	42	6	4	6	2	1	19
	Planning and Groups	3	2	5	0	0	10	1	0	0	1	0	2
	Other	5	5	4	1	3	18	1	2	0	1	0	4
	Total	137	73	51	17	24	302	48	53	33	16	10	160
Strategy 2	Content Submit	61	23	11	4	3	102	23	23	18	3	2	69
	Interaction	45	31	15	6	12	109	13	23	7	7	5	55
	Planning and Groups	9	6	3	4	1	23	5	1	3	2	2	13
	Other	7	3	2	0	3	15	6	1	0	1	0	8
	Total	122	63	31	14	19	249	47	48	28	13	9	145

According to Table 7, the 232 professors who used "content submit" as their first strategy mainly faced "emotional" (114), "technical" (60) and "academic" (30) challenges as their first challenges and "technical" (47) and "emotional" (40) as their second challenge for this same strategy. On the other hand, one hundred nine professors used "interaction" as their second strategy, complementing it with the first strategy, and they experienced "emotional" (45) and "technical" (31) challenges. In addition, 102 professors used "content submit" as their second strategy, and they equally faced "emotional" (23) and "technical" (23) challenges.

Table 8 shows the contribution of strategies 1 and 2 and challenges 1 and 2 to each dimension as explained variance and cumulative variance. Dimension 1 explains 33.61%, and dimension 2 explains 22.81% of the variance. Thus, both dimensions account for 56.42% of the total variance.

The researchers found that each dimension's contributions presented mass values higher than 0.10. Dimension 1 can be named "faced challenges" because the categories that contribute to the existence of the challenges are centered on "emotional" and "academic" aspects in challenge 1 and "group work" and "other" in challenge 2. Dimension 2 can be named "implemented strategies" because the strategies that significantly contribute to its existence are "interaction" and "planning and groups" for strategy 1 and "other" for strategy 2.

In addition, figure 1 represents the graphical output developed by correspondence analysis from table 8 data.

The perceptual map explains the underlying structure and positioning of the courses' strategies, the professors teaching the courses, and the challenges they face. The professors' characteristics are also included based on their gender, age, and school. The closer the strategy and challenge categories are located on the map, the more positive the association.

The professors who used the submitting content strategy (i.e., the content was submitted by either a professor or a student before or after class) and the interaction strategy identified emotional and technical challenges as the main issues they faced. However, their responses varied depending on age and gender. For example, in the Law and Social Sciences School, male professors under 35 identified increased student workloads as the main challenge. In contrast, female professors over 50 identified technical challenges as their main concern, which made them realize that they need to acquire more knowledge in ICT. In the Economics and Business Administration Sciences School, male professors aged between 35 and 50 identified a more significant workload as the main challenge when their first strategy focused on submitting content by students. They also stressed the need to have greater knowledge in ICT. This last challenge was also identified by female professors aged over

Table 8
Contributions by dimension

	mass	overall quality	%inert	dimension 1 coord (X)	sqcorr	contrib	dimension 2 coord (Y)	sqcorr	contrib
Strategy 1									
Content Submit	0.23	0.72	1.1%	0.03	0.1	0.3%	0.07	0.62	2.9%
Interaction	0.02	0.67	8.9%	-0.37	0.18	4.9%	-0.6	0.48	18.8%
Planning and Groups	0	0.67	6.0%	0.96	0.14	2.5%	-1.87	0.53	13.9%
Strategy 2									
Content Submit	0.12	0.58	3.9%	0.12	0.24	2.8%	0.15	0.34	5.8%
Interaction	0.1	0.25	2.1%	-0.1	0.22	1.4%	0.03	0.03	0.2%
Planning and Groups	0.02	0.64	6.0%	-0.44	0.38	6.8%	-0.36	0.26	6.9%
Other	0.01	0.76	8.7%	0.32	0.09	2.3%	-0.9	0.67	25.6%
Challenge 1									
Emotional	0.17	0.68	5.5%	0.2	0.66	10.9%	-0.04	0.03	0.6%
Technical	0.04	0.64	3.8%	-0.24	0.32	3.6%	0.24	0.32	5.3%
Academic	0.03	0.68	11.0%	-0.67	0.66	21.5%	-0.12	0.02	1.0%
Group Work	0.01	0.14	8.5%	-0.49	0.13	3.3%	0.11	0.01	0.2%
Challenge 2									
Emotional	0.08	0.75	5.3%	0.2	0.32	5.1%	-0.23	0.43	9.9%
Technical	0.08	0.62	5.5%	0.24	0.44	7.2%	0.15	0.18	4.4%
Academic	0.05	0.37	6.0%	-0.26	0.28	5.0%	0.15	0.09	2.4%
Group Work	0.02	0.62	6.7%	-0.57	0.58	11.5%	-0.15	0.04	1.2%
Other	0.02	0.36	11.0%	-0.68	0.34	11.1%	0.14	0.02	0.7%
Cumulative Variance			100.0%			100.2%			99.8%
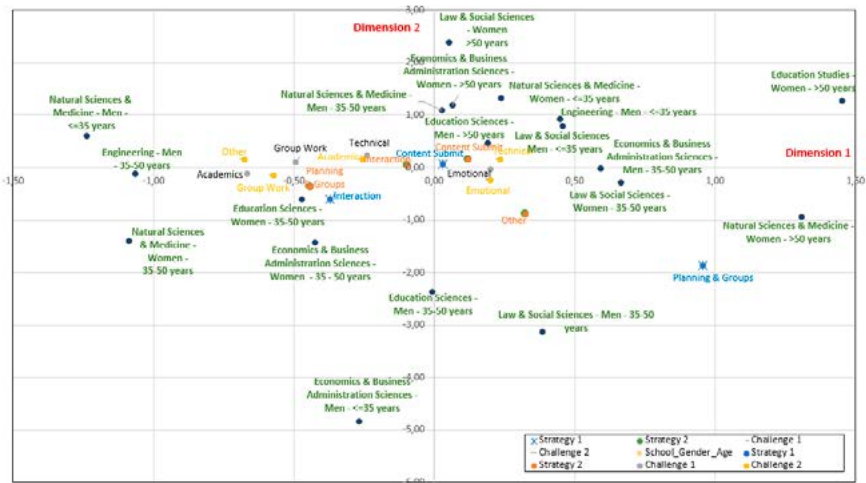
Figure 1

Perceptual map

50 years. In the Natural Sciences and Medicine Schools, male professors aged 35 and 50 identified the main affective challenge related to the feelings or emotions that emanate from within themselves. The technical challenges were related to the connectivity problems experienced by professors and students and the need to improve their ICT knowledge.

When the strategy is related to the "content submit", the identified challenge is related to problems outside students' academics. For example, in the Education Sciences School, male professors aged 50 years and above identified increased workload from both sides as the main challenge. They also had challenges with their feelings or emotions, experienced problems unrelated to academics and their role as professors, and endured inconveniences occasioned by their students' inability to connect to the virtual sessions.

Regarding the strategies related to "interaction" and "planning and groups" as a second strategy, differential challenges arose depending on the gender, age, and the school to which the professors belonged. For example, in the School of Law and Social Sciences, male professors aged between 35 and 50, who decided to divide the classroom into smaller groups as an activity that is part of redesigning the class, identified challenges related to the quest to maintain the quality of the course through strategic planning. On the other hand, female professors within this age range chose the planning

course as a strategy in its new virtual modality. They identified other problems unrelated to academics as the main challenges from the students' perspective. In the Economics and Business Administration Sciences School, male professors under 35 who chose interaction in quasi-real-time or planning the course as strategies identified communication between students and professors as the main challenge.

The female professors aged between 35 and 50 who chose the classroom division strategy identified academic challenges related to the professors' evaluation, monitoring, or feedback process with students. In the Natural Sciences and Medicine Schools, while the professors chose the interaction in real-time strategy, male professors under 35 considered communication between both parties the main challenge. The female professors in this School within 35 and 50 years identified working virtually with large groups as the main challenge. In the Education School, male professors aged between 35 and 50 who chose interaction with students as a strategy, particularly resolving doubts and support for students, identified effective communication with students as the main challenge. Given the new virtual modality, these male professors also used a second strategy related to course planning. They identified an academic challenge related to the quest to maintain the quality of the course. On the other hand, the female professors at this School, who are within this same age range, identified students' inability to connect to virtual sessions as a challenge for this last strategy. Finally, in the School of Engineering, male professors under 35 who used the quasi-real-time interaction strategy as a secondary strategy identified the connectivity challenge.

V. Conclusions

This study reveals that most professors associated the teaching strategies implemented during the ERT process with the resources or tools used to submit information and exchange content with students. This assimilation can happen because only some teachers have a pedagogical background (the strategy concept needs to be clarified), and ERT adopted an unplanned ICT implementation. In addition, the exchange of content was related to audio-visual content. Although this research did not consider whether audio-visual content was widely used before ERT, the results show that ERT offers professors the opportunity to explore different resources.

Along with this first strategy, the category of "interaction" (in real-time and quasi-real- time) also emerged as a second strategy. Students´ and professors´ interactions are guided by clarifying doubts and monitoring students' learning processes and feedback. Communication is vital in any

teaching-learning process. It is necessary in virtual teaching since the teacher and students are not physically in one place and must maintain communication, mostly asynchronous or quasi-real time. Due to the implementation of remote learning, these changes in human interaction and the usage of different communication channels between professors and students are consistent with the literature (Khan, Kambris, and Alfalahi 2021; Kovacs, Pulfrey, and Monnier 2021).Consequently, alternative communication channels are innovative because these platforms and resources were unpopular in face-to-face teaching. Furthermore, according to Cahyadi and Widyastuti (2021), teaching under ERT must be guided by three main principles: flexibility, simplicity, and empathy.

Regarding challenges, nearly half of the professors reported concerns and issues related to their feelings and emotions and their students. This challenge can be attributed to the abrupt change to virtual classes and all the transformations that professors and students faced when they answered the questionnaire. By the time the ERT was implemented, the movement had been restricted, and the population had been directed to quarantine at home. This confinement has an impact on the educational process and life in general. The psychological implications for professors and students of ERT implementation have been studied and proven in other recent studies (Ahmed and Opoku 2021; Cahyadi and Widyastuti 2022; Meishar-Tal and Levenberg 2021). In this sense, challenges were inscribed in the professors' subjectivity (i.e., their fears, shyness, etc.), the lack of delimitations between work and personal environment (since they had to work from home) and changes in the interactions they were used.

Technical aspects, such as connectivity and ICT knowledge, were also critical challenges. Other studies have found these technological challenges (Ferri, Grifoni, and Guzzo 2020; Dorfsman and Horenczyk 2021; Khan, Kambris, and Alfalahi 2021; Ahmed and Opoku 2021; Kovacs, Pulfrey, and Monnier 2021). These challenges can be attributed to the short period within which the transition to virtual classes was affected–it was done within one week. As a result, neither the professors nor students had enough time to make the technical adjustments required to impart and receive knowledge (e.g., computer and internet). In another study, developed by Dorfsman and Horenczyk (2021), the authors found that one factor that strongly influenced the possibility of making pedagogical changes was the digital literacy of the professors.

An important finding is how the strategies and challenges could be more congruent because the professors who described the strategy of submitting information faced affective and emotional challenges. This strategy is defined as short-term solutions for delivering and receiving content. In

contrast, the challenges related to emotions require strategies for planning how to engage students. Differences emerged among professors from different schools based on their genders and age.

The fact that the two most frequent strategies present among faculty were content delivery and real-time interaction implies that the continuation of classes was prioritized because of the ERT modality's abrupt change. The latter means substituting physical media with digital media without necessarily implementing significant changes at didactic or pedagogical levels. In addition, the planning strategy had a low frequency of implementation. This situation triggers the need to implement a more substantial teacher training curriculum for a pedagogic-technical knowledge component. This way, moving from a substitution model to redesigning learning activities that take advantage of digital technologies' potential will be possible. According to Svrcek et al. (2021), educators must move to remote instruction beyond enhancing learning and redefining and creating transformative teaching experiences for students by purposely incorporating technological tools.

Notably, the feeling of increased workload, acknowledged by some teachers (primarily young women and men over 50), can be attributed to a need for prior knowledge and training in ICT use. This feeling meant that these teachers had to consult about technological tools, choose the most effective tools for the learning objectives, and learn how to use them. Consistent with these findings, the challenge identified by (older) female teachers relates to greater ICT literacy. Most professors who presented this challenge belong to social sciences, administrative and economic sciences, medicine, and natural sciences. This challenge was presented to a lesser extent in engineering areas.

Furthermore, the concern for increased work overload was stronger in women, which informs the recommendation for future studies to analyze the balance between household chores and professional work in female professors. Although ICT tool implementation is not the main challenge, it is still necessary for both men and women. This fact can help to eliminate the prejudice that women have more difficulties than men in this aspect. However, age is a factor to consider in teacher training programs for digital skill development.

Moreover, from the correspondence analysis, it can be established that the emotional challenge was identified in most of the strategies used, specifically in content delivery and real-time interactions. Therefore, teacher training courses should include developing skills to manage emotions and facilitate time management to harmonize work and daily life. This finding suggests that future studies should explore emotional skills and comprehensive and harmonious teacher professional development.

References

Ahmed, Vian, and Alex Opoku. 2021. "Technology Supported Learning and Pedagogy in Times of Crisis: The Case of COVID-19 Pandemic." *Education and Information Technologies*, 1–41.

Al-Maroof, Rana Saeed, Said A Salloum, Aboul Ella Hassanien, and Khaled Shaalan. 2020. "Fear from COVID-19 and Technology Adoption: The Impact of Google Meet during Coronavirus Pandemic." *Interactive Learning Environments* 31 (3): 1–16. https://doi.org/https://doi.org/10.1080/10494820.2020.1830121.

Anderson, Terry, Stanley Varnhagen, and Katy Campbell. 1998. "Faculty Adoption of Teaching and Learning Technologies: Contrasting Earlier Adopters and Mainstream Faculty." *The Canadian Journal of Higher Education*, 71–98.

Angelino, Lorraine M, Frankie Keels Williams, and Deborah Natvig. 2007. "Strategies to Engage Online Students and Reduce Attrition Rates." *Journal of Educators Online* 4 (2): 1–14.

Aristovnik, Aleksander, Damijana Keržič, Dejan Ravšelj, Nina Tomaževič, and Lan Umek. 2020. "Impacts of the COVID-19 Pandemic on Life of Higher Education Students: A Global Perspective." *Sustainability* 12 (20). https://doi.org/https://doi.org/10.3390/su12208438.

Bower, Beverly L, and Kimberly P Hardy. 2004. "From Correspondence to Cyberspace: Changes and Challenges in Distance Education." *New Directions for Community Colleges* 2004 (128): 5–12. https://doi.org/https://doi.org/10.1002/cc.169.

Cahyadi, Ani, and Sri Widyastuti. 2022. "COVID-19, Emergency Remote Teaching Evaluation: The Case of Indonesia." *Education and Information Technologies* 27 (2): 2165–79. https://doi.org/https://doi.org/10.1007/s10639-021-10680-3.

Chung, Jae Eun, Namkee Park, Hua Wang, Janet Fulk, and Margaret McLaughlin. 2010. "Age Differences in Perceptions of Online Community Participation among Non-Users: An Extension of the Technology Acceptance Model." *Computers in Human Behavior* 26 (6): 1674–84. https://doi.org/https://doi.org/10.1016/j.chb.2010.06.016.

Creswell, John W. 2009. "Mapping the Field of Mixed Methods Research." *Journal of Mixed Methods Research*.

Dorfsman, Marcelo, and Gabriel Horenczyk. 2021. "The Coping of Academic Staff with an Extreme Situation: The Transition from Conventional Teaching to Online Teaching." *Education and Information Technologies* 27: 267–89. https://doi.org/https://doi.org/10.1007/s10639-021-10675-0.

Duncan, Heather E, and Suzanne Young. 2009. "Online Pedagogy and Practice: Challenges and Strategies." *The Researcher* 22 (1): 17–32.

Durrington, Vance A, Amy Berryhill, and Jeanne Swafford. 2006. "Strategies for Enhancing Student Interactivity in an Online Environment." *College Teaching* 54 (1): 190–93. https://doi.org/https://doi.org/10.3200/CTCH.54.1.190-193.

Ferri, Fernando, Patrizia Grifoni, and Tiziana Guzzo. 2020. "Online Learning and Emergency Remote Teaching: Opportunities and Challenges in Emergency

Situations." *Societies* 10 (4): 86. https://doi.org/https://doi.org/10.3390/soc10040086.

Gibson, Shanan G, Michael L Harris, and Susan M Colaric. 2008. "Technology Acceptance in an Academic Context: Faculty Acceptance of Online Education." *Journal of Education for Business* 83 (6): 355–59. https://doi.org/https://doi.org/10.3200/JOEB.83.6.355-359.

Greenacre, Michael. 2000. "Correspondence Analysis of Square Asymmetric Matrices." *Journal of the Royal Statistical Society: Series C (Applied Statistics)* 49 (3): 297–310.

———. 2017. *Correspondence Analysis in Practice*. CRC press.

Greenhow, Christine, and Sarah Galvin. 2020. "Teaching with Social Media: Evidence-Based Strategies for Making Remote Higher Education Less Remote." *Information and Learning Sciences* 121 (7/8): 513–24. https://doi.org/https://doi.org/10.1108/ILS-04-2020-0138.

Heilporn, Géraldine, Sawsen Lakhal, and Marilou Bélisle. 2021. "An Examination of Teachers' Strategies to Foster Student Engagement in Blended Learning in Higher Education." *International Journal of Educational Technology in Higher Education* 18 (1): 1–25. https://doi.org/https://doi.org/10.1186/s41239-021-00260-3.

Hodges, Charles, Stephanie Moore, Barb Lockee, Torrey Trust, and Aaron Bond. 2020. "The Difference between Emergency Remote Teaching and Online Learning." *EDUCAUSE Review* 3.

International Telecommunication Union. 2019. "Measuring Digital Development."

Jung, Insung, Sawa Omori, Walter P Dawson, Tomiko Yamaguchi, and Seunghun J Lee. 2021. "Faculty as Reflective Practitioners in Emergency Online Teaching: An Autoethnography." *International Journal of Educational Technology in Higher Education* 18 (1): 1–17. https://doi.org/https://doi.org/10.1186/s41239-021-00261-2.

Khan, Sarah, Mona El Kouatly Kambris, and Hamda Alfalahi. 2021. "Perspectives of University Students and Faculty on Remote Education Experiences during COVID-19-a Qualitative Study." *Education and Information Technologies* 27: 4141–69. https://doi.org/https://doi.org/10.1007/s10639-021-10784-w.

Kovacs, Helena, Caroline Pulfrey, and Emilie-Charlotte Monnier. 2021. "Surviving but Not Thriving: Comparing Primary, Vocational and Higher Education Teachers' Experiences during the COVID-19 Lockdown." *Education and Information Technologies* 26 (6): 7543–67. https://doi.org/https://doi.org/10.1007/s10639-021-10616-x.

Lee, Thomas W, and Thomas Lee. 1999. *Using Qualitative Methods in Organizational Research*. Sage.

McFarland, Daniel J. 2001. "The Role of Age and Efficacy on Technology Acceptance: Implications for E-Learning."

Meishar-Tal, Hagit, and Ariella Levenberg. 2021. "In Times of Trouble: Higher Education Lecturers' Emotional Reaction to Online Instruction during

COVID-19 Outbreak." *Education and Information Technologies* 26 (6): 7145–61. https://doi.org/https://doi.org/10.1007/s10639-021-10569-1.

Mishra, Lokanath, Tushar Gupta, and Abha Shree. 2020. "Online Teaching-Learning in Higher Education during Lockdown Period of COVID-19 Pandemic." *International Journal of Educational Research Open* 1: 100012. https://doi.org/https://doi.org/10.1016/j.ijedro.2020.100012.

Mohmmed, Abdalellah O, Basim A Khidhir, Abdul Nazeer, and Vigil J Vijayan. 2020. "Emergency Remote Teaching during Coronavirus Pandemic: The Current Trend and Future Directive at Middle East College Oman." *Innovative Infrastructure Solutions* 5 (3): 1–11. https://doi.org/https://doi.org/10.1007/s41062-020-00326-7.

Rahim, Ahmad Fuad Abdul. 2020. "Guidelines for Online Assessment in Emergency Remote Teaching during the COVID-19 Pandemic." *Education in Medicine Journal* 12 (2): 59–68. https://doi.org/https://doi.org/10.21315/eimj2020.12.2.6.

Ramlo, Susan. 2021. "The Coronavirus and Higher Education: Faculty Viewpoints about Universities Moving Online during a Worldwide Pandemic." *Innovative Higher Education* 46 (3): 241–59. https://doi.org/https://doi.org/10.1007/s10755-020-09532-8.

Rogers, Everett M. 2010. *Diffusion of Innovations*. Simon and Schuster.

Safi, Farshid, Taylar Wenzel, and Lee-Anne Trimble Spalding. 2020. "Remote Learning Community: Supporting Teacher Educators during Unprecedented Times." *Journal of Technology and Teacher Education* 28 (2): 211–22.

Shi, Min, Curtis J Bonk, and Richard J Magjuka. 2006. "Time Management Strategies for Online Teaching." *International Journal of Instructional Technology and Distance Learning* 3 (2): 3–10.

Smalley, Andrew. 2021. "Higher Education Responses to Coronavirus (COVID-19)." 2021. https://www.ncsl.org/education/higher-education-responses-to-coronavirus-covid-19.

Spoel, Irene van der, Omid Noroozi, Ellen Schuurink, and Stan van Ginkel. 2020. "Teachers' Online Teaching Expectations and Experiences during the Covid19-Pandemic in the Netherlands." *European Journal of Teacher Education* 43 (4): 623–38. https://doi.org/https://doi.org/10.1080/02619768.2020.1821185.

Svrcek, Natalie Sue, Logan Rath, Kathleen Olmstead, and Kathleen Colantonio-Yurko. 2021. "'We Are Still Putting out Fires': Considering Educator Intentionality in Remote Instruction during the COVID-19 Pandemic." *Education and Information Technologies* 27 (1): 407–28. https://doi.org/https://doi.org/10.1007/s10639-021-10679-w.

Talidong, Karen Joy. 2020. "Implementation of Emergency Remote Teaching (ERT) among Philippine Teachers in Xi'an, China." *Asian Journal of Distance Education* 15 (1): 196–201.

Tarhini, Ali, Kate Hone, and Xiaohui Liu. 2014. "Measuring the Moderating Effect of Gender and Age on E-Learning Acceptance in England: A Structural Equation Modeling Approach for an Extended Technology Acceptance Model." *Journal*

of Educational Computing Research 51 (2): 163–84. https://doi.org/https://doi.org/10.2190/EC.51.2.b.

Whalen, Jeromie. 2020. "Should Teachers Be Trained in Emergency Remote Teaching? Lessons Learned from the COVID-19 Pandemic." *Journal of Technology and Teacher Education* 28 (2): 189–99.

World Economic Forum. 2020. "How COVID-19 Is Driving a Long-Overdue Revolution in Education."

Xu, Hongjiang, and Sakthi Mahenthiran. 2016. "Factors That Influence Online Learning Assessment and Satisfaction: Using Moodle as a Learning Management System." *International Business Research* 9 (2): 1–18. https://doi.org/https://doi.org/10.5539/ibr.v9n2p1.

Zayim, Nese, Soner Yildirim, and Osman Saka. 2006. "Technology Adoption of Medical Faculty in Teaching: Differentiating Factors in Adopter Categories." *Journal of Educational Technology & Society* 9 (2): 213–22.

About the authors

DR LINA SOFIA VALENZUELA (corresponding author, lsvalenzuela@icesi.edu.co) is an Assistant Professor in the Department of Management at Icesi University, Colombia. She is the Program Director of Business Administration bachelor's degree. She has a PhD in Organizational Behavior from Tulane University in the United States. Her research engages education innovation, family business and safety climate in organizations.

DR YENY E. RODRÍGUEZ (ye.rodriguez395@uniandes.edu.co) is an Associate Professor at the University of the Andes, Colombia, from which she received a PhD in Management. Her research interests are focused on finance at two levels: market and corporative, and on education. In education, she is interested in professors' perceptions of virtual learning environments.

HENRY A. TAQUEZ (hataquez@icesi.edu.co) is a full-time professor in the Department of Language and Pedagogy at Icesi University, Colombia, where he is the Coordinator of the Education and ICT area. He leads educational projects mediated by ICT. His current research interests are active learning, virtual learning environments, management of educational innovation and teacher professional development.

DR JOSÉ ROBERTO CONCHA (jrconcha@icesi.edu.co) is a full-time professor and the Chair of the Department of Marketing at Icesi University, Colombia. He has a Ph.D. in Marketing at the Tulane University in the United States. His main research fields are marketing, international commerce, and consumer behavior.

DR ANA M. AYALA ROMÁN (amayala@icesi.edu.co) is a member of the Dean's Office in Educational Innovation and Strengthening of the PEI and Full-time professor in the Department of Humanities and Citizenship of the Faculty of Human Sciences at Icesi University. She has a Ph.D. in Philosophy from the Pontifical Catholic University of Valparaíso, Chile. Her main research fields are pedagogy, didactics, ethics, and teacher training.

LAURA ROMERO-GARCIA (laura.romero3@u.icesi.edu.co) is a Psychologist with a Master's Degree in Social and Political Studies and works as a Research Assistant at Icesi University, Colombia. Her main research interests are to related to engagement and perceptions in higher education.

Annexes

A) *Open-ended questions of the study*

Open-ended questions about strategies and challenges during ERT	
1. What teaching strategies have been defined and implemented to adjust the teaching and learning process?	
2. What challenges have you encountered, (technical, academic, emotional, and affective), in the development of your academic activities?	