Redesign of science education in the Covid-19 emergency from university students' perspective

La riprogettazione della formazione in ambito scientifico durante l'emergenza Covid-19 dal punto di vista degli studenti universitari

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ABSTRACT COVID-19 started spreading in Latin America amidst the beginning of academic year (March, in the Global South). In response, the Faculty of Science within the Universidad de la República de Uruguay rapidly switched to Emergency Remote Education. As part of this strategy, specific support was provided to students with connectivity and equipment needs. However, teachers' different levels of pedagogical and digital skills resulted in diverse efficacy in students' emergency learning experiences. This work explores the Universidad de la República's science education provision from the students' perspective as expressed in accordance to their learning experience. The results show a positive direct association between the clarity of the tasks the students were set and positive feedback. Moreover, while the provision of educational resources was key to supporting emergency education assessment, technological aspects had little or no impact. Finally, the results also indicate greater critical digital literacy on the teachers' part would improve science education.

KEYWORDS Higher Education; Science Education; Learning Design; Emergency Remote Education (ERE).

SOMMARIO La pandemia di COVID-19 ha iniziato a diffondersi in America Latina intorno all'inizio dell'anno accademico (ossia Marzo 2020). In risposta a ciò, la facoltà di scienze dell'università della Repubblica Uruguaiana ha rapidamente trasformato la propria didattica adottando una modalità emergenziale (Emergency Remote Education – ERE), accompagnata da supporto specifico per gli studenti con difficoltà di connettività e carenza di strumentazione tecnologica. Tuttavia, i diversi livelli di preparazione dei docenti in termini di capacità pedagogiche e digitali hanno avuto effetti ben diversi ben diversi per quanto riguarda le esperienze formative degli studenti. Questo studio presenta l'offerta

formativa messa a punto dall'università sopra citata in ambito scientifico e, in particolare, il punto di vista dell'esperienza di apprendimento vissuta dagli studenti. I risultati mostrano una associazione diretta tra la chiarezza dei compiti assegnati agli studenti e la loro valutazione positiva dell'esperienza di apprendimento. Inoltre, mentre la disponibilità di risorse educative è stata è stata di importanza basilare per la valutazione degli apprendimenti nell'emergenza, gli aspetti tecnologici hanno avuto un impatto scarso o nullo. Infine, I risultato indicano anche che una maggior preparazione dei docenti sul fronte della digital literacy gioverebbe alla formazione in ambito scientifico.

PAROLE CHIAVE Formazione Universitaria; Formazione Scientifica; Progettazione Didattica; Didattica Emergenziale.

1. INTRODUCTION

The COVID-19 pandemic started spreading among Uruguayan citizens in mid-March 2020, at the same time that academic courses were expected to start. The Universidad de la República (UdelaR), the biggest higher education (HE) institution in Uruguay, responded rapidly with the purpose of ensuring continuity of learning processes. The prevailing context challenged teachers and educational authorities to guarantee quality distance teaching during the public health emergency. UdelaR had no hesitation in suspending face-to-face activities to comply with the health emergency, striving to achieve educational continuity by moving to Emergency Remote Education (ERE) and thereby reduce the negative consequences of the pandemic on learning.

UdelaR adopted a Contingency Plan (ProEVA, 2020) on the basis of what was denominated a "pedagogy of care". This approach was intended as a way to help students cope with the difficulties of facing the public health emergency, but also to leverage the advantages of offer in doing so. It also considered the teachers' different ability levels in managing educational technologies. Overall, the pedagogy of care conceived students and teachers as subjects undergoing a stressful situation, generated by the pandemic (Myers, 2020). As a result, the Contingency Plan drawn up comprised: online teaching and learning in emergency conditions; redesign of online teaching and learning; leveraging of infrastructure; and coordinated institutional communication strategies.

In this regard, adoption of UdelaR's Virtual Learning Environment (VLE), which was previously a mere complement to face-to-face instruction, acquired unprecedented relevance. It was widely used throughout 2020, with 85% of UdelaR's students participating in ERE online courses (DGPlan, 2020). Amongst the students' initial comments, the benefits of not having to travel to the university and the opportunity to follow lectures at any time were highlighted. However, the students also identified difficulties such as being emotionally overwhelmed and being overloaded by the workload.

At this point it is worth considering the situation of UdelaR within the Latin American context. In this geopolitical area, universities are considered fundamental for addressing growing social inequality, and they play a significant role in knowledge democratisation. Thus, broadening access to and use of knowledge became the main foundation of the University as a means of social development (Arocena, 2018). It is worth noting that UdelaR covers 90% of the entire Uruguayan university system, and hence can be deemed a huge university. Moreover, it is an autonomous, co-governed institution; it offers students unrestricted, free public access. The university also embraces an approach to the quality of education based on the need to carry out deep institutional transformations. The ultimate goal in this respect is to place the student at the centre of the educational process and as the protagonist of active learning across different disciplinary areas for professional development (UdelaR, 2014). These characteristics should support student diversity

at motivational and social levels (Diconca, Santos, & Egaña, 2011).

Accordingly, while Science Faculty (SF) education traditionally focuses on theoretical and disciplinary aspects, current trends emphasise the importance of active learning (Cabrera & Collazo, 2017). This approach to learning includes working on problem-solving and encouraging students' to learn through focus on their professional and scientific development. These new methodologies also include diversification of teaching methods, paving the ways for strategies such as cooperative learning and learning from student error as valuable forms of input (Waldrop, 2015). In any case, technologies play a crucial role in learning processes. Indeed, in recent decades, the use of digital technology has spread across to the whole of society and in doing so challenged teaching and learning at all educational levels (Cobo, 2009). Technological immersion is no longer considered the exclusive preserve of education. Whether or not teachers have explicitly intended to integrate technology use in the classroom, it has become pervasive all the same. Accordingly, the use of technology for education at UdelaR preceded institution-wide adoption of the VLE. Most importantly, the affordances of digital technology have shown it to be a powerful tool for creating educational resources. In this regard, the various functions for generating and gathering educational resources have been considered the pillar of quality technology use in Uruguayan HE. Moreover, UdelaR's VLE was developed to strengthen learning communities' capacity to create, use, and reuse open digital content as a sort of learning ecosystem (Rodés et al., 2013). Nevertheless, while the UdelaR VLE was generally open (Toledo, 2017), student access to educational resources remained a matter of concern, aligning with the international situation. Indeed, both local (Rodés, Díaz, Gemetto, & Fossatti, 2015) and international authors (Czerniewicz, 2016) have investigated the difficulties of HE students to access educational resources. They agree that the lack of open or sharable educational resources has led to student confusion about the legitimacy of certain practices in view of copyright law, hence limiting students' potential enhancement of educational resources. As a result, use of the VLE increased teachers' responsibility to mediate the pedagogical relationship between students, activities, and educational resources. It was considered that this pedagogical mediation might result in stronger support for student enhancement of educational resources and the learning environment per se, thereby facilitating flexible and inclusive learning. Nevertheless, it was also considered that teachers' level of critical digital literacy (Pangrazio, 2016) might influence further the appropriation, use, and promotion of educational technology and use of the VLE. Indeed, technology integration requires careful design to impact on education quality (Hodges, Moore, Lockee, Trust, & Bond, 2020).

In the context described herein, educational practices adopted during the COVID-19 pandemic emerged as a temporary solution to an immediate problem. Hence, they bore different characteristics from consolidated distance teaching, imposing a further element of complexity to be handled by teachers and students alike. Indeed, prior distance teaching was based on specific theoretical and practical knowledge based on support for face-to-face teaching and learning activities. ERE was different, in the sense that its focus was on maintaining education continuity during the emergency with all available resources (Bozkurt et al., 2020). Overall, ERE was a temporary and sudden change from the traditional way of teaching. Its main goal was not to recreate a robust educational ecosystem but to provide quick access to learning. For this reason, it should not be considered suitable as a long-term solution (Hodges, Moore, Lockee, Trust, & Bond, 2020).

Moving to the students' perspective, it goes without saying that continuing their education through the public health emergency posed a particular challenge, especially in their being required to exercise (or acquire) the necessary skills for self-regulating learning (Zimmerman & Schunk, 2011). At the same time, they were having to cope with the extra challenges of dealing with disruption to the family and social lives (Chang & Fang, 2020). As Beaunoyer, Dup, and Guitton (2020) have pointed out, this public health emergency exasperated existing digital inequalities, which also generated health risks: for example, the most vulnerable students were exposed to the virus because of the need to travel to reach internet connection access points

or a place to study.

Therefore, ERE not only involved effective design of technology enhanced teaching and learning, but also careful holistic design, taking external contingencies into consideration. So evaluation of such a strategy could only be achieved through a participatory approach, namely, by taking adequate account of the students' perspective.

2. AIM OF THE STUDY AND GUIDING RESEARCH QUESTIONS

Set against the above-described context, this work aimed to study teaching and learning processes at the university level in an emergency context. More specifically, we sought to characterise the learning experience within the ERE context from the students' point of view. Furthermore, we explored what course redesign measures were required to achieve an effective ERE approach. Finally, we investigated the strengths and weaknesses of learning in this context. As a final result, our work could contribute to promote new institutional strategies to attain quality education based on the experience gained in ERE. The specific questions proposed, which this work addressed, were the following:

- Did the students find elements in ERE more attractive face-to-face courses?
- If so, what is the nature of these distinctive elements?
- What aspects do students consider significant in supporting their learning continuity within the ERE context?
- How did technological issues influence ERE?
- What strengths and weaknesses did the students find in ERE?

3. METHODOLOGY

3.1. *Context and framework for the study*

On 15 March 2020, the Science Faculty (SF) approved strategies to redesign teaching approaches, considering the broad diversity of lessons, students, and teachers. After surveying difficulties students and teachers faced in accessing technology, the institution supported those in need, either by loaning equipment or by facilitating access to a reliable internet connection. To ensure access to online educational platforms, the institution adjusted access restrictions, carried out emergency professional development for teachers, and adapted the technological infrastructure itself.

Taking into account institutional guidelines and considering the peculiarities of science teaching, the SF re-evaluated the 109 courses it ran in order to understand the feasibility of redesigning them for the online context. Six could not be redesigned, mainly due to the high degree of experimental activities they involved, but the remaining 103 were offered remotely within a few weeks. This redesign required considerable administrative and teaching effort, with some teachers needing to be trained to improve their digital competencies. In response to this need, the Teaching Support Unit (TSU) promptly offered workshops in March and April to help teachers from diverse pedagogical backgrounds develop skills in education and technology; hence the TSU made a significant contribution to the collective support effort in a stressful time.

3.2. *Instrument, sample and data collection*

To report the methodology used, the GRAMMS (Good Reporting of A Mixed Methods Study) framework was used (O'Cathain, Murphy, & Nicholl, 2008). GRAMMS provides a series of guidelines for the reporting of mixed methods research. The results were obtained from qualitative and quantitative methods.

Once the highest and lowest rated courses (quantitative approach) were identified, the qualitative method dug into the strengths and limitations of course characteristics and the ERE learning experience. Hence the mixed-methods approach brought new and complementary findings to the distinct quantitative and qualitative results. Through integration, it was possible to contrast the qualitative ratings with the quantitative data and identify the limitations, potentials, and strengths of the ERE implementation.

A survey was designed based on the previous experience of the research team in designing, processing and working on students' opinion surveys since 2016 as part of the institution's teaching evaluation. For the design of the data collection instrument, it was considered that the qualitative and quantitative components were complementary and thereby connected.

The survey featured two closed questions to characterise student profile. These were followed by five closed-response items and one open-response item. This second section constituted the block of questions about the learning experience and the courses, and was repeated for each course the specific student attended. Finally, the survey had a final open-ended question for additional comments about the respondent's experience of learning in the context of ERE. The questions included items about the number of hours dedicated to study (low/medium/high), perceived clarity of instructions (low/medium/high), adequacy of educational resources (low/medium/high), preference for activities in other modalities (yes/no), a question about the number of study hours dedicated to the course, and a yes/no question about whether the nature of ERE was more attractive than face-to-face lessons. Two optional open-ended questions were included to gather qualitative results. The first asked about which ERE features, if any, were considered more engaging than face-to-face learning, and an open-ended question about the overall experience. This set of questions allowed us both to conduct course evaluation and to investigate the perceived learning experience.

The survey was anonymous and self-administered through the VLE. A two-week response window was opened in May. Response confidentiality was guaranteed by the TSU, who had exclusive access to raw anonymised data and performed all data processing; therefore there could be no repercussions on student grades or faculty members' relations with students.

3.3. *Analysis*

The quantitative part of the survey was based on descriptive and bivariate analysis. For each question and course, the analysis included descriptive statistics such as the mean and the standard deviation of responses. These options included the portion of students who reacted favourably to the number of hours dedicated to study, the clarity of instructions, the adequacy of educational resources, the teaching strategies implemented, and the presence of attractive ERE features when compared with face-to-face activities. All in all, for each course the average number of students who responded favourably to each question was determined. These results were expressed on a scale from zero to one, where values closer to one indicate stronger agreement. These results obtained for the courses were coupled with analysis of correlation coefficient computation for the paired questions, revealing a statistically significant correlation ($n = 61$, $p > 0.05$). Quantitative data analysis was carried out using PSPP 1.2.0 software.

As for the qualitative part of the survey, the open responses were subject to content analysis. This simplification enabled us to answer our questions rigorously, with the limitation that some information may have been lost. The content analysis required that category generation be carried out in a mixed-mode, combining deductive and inductive methods. As new elements arose during study of the responses, new classifications were adopted and incorporated. The nominal categories were assigned labels, which were later used to perform quantitative analysis of the qualitative component, with words or phrases conceptually linked to the text citations identified in the responses, as reported in Table 1 below.

CATEGORY NAME	DESCRIPTION
TEACHING	Pedagogical aspects related to teachers' mediation in distance education, clarity, the educational climate, teacher availability, and communication with the students.
LEARNING	Students' processes, the possibility of watching videos at their own pace, the usefulness of proposed resources, the diversity of learning strategies.
LABORATORY PRACTICES	Activities that include tacit knowledge such as experimentation or activities within a laboratory, manipulation, visualisation, field trips.
ASSESSMENT	Tests and certification, or self-evaluation.
EDUCATIONAL RESOURCES	Recorded lectures, videos, texts, or any similar material generated or used by the teaching team.
TECHNOLOGY	Connection, equipment, and internet access.
FLEXIBLE SCHEDULES	Possibility for students to organise their own study time and manage learning load.
PROSPECTIVE	Projection in time of the ERE learning experience.
COMMUTE TIME	Travel times to the institution.
WORK	Implications for the students' work activity, either in terms of time availability or simultaneous schedules.
APPRECIATION*	Student awareness of the limits imposed by availability of instruments and other factors, as well as teacher and institution effort.
PANDEMIC CONTEXT*	Aspects of this public health emergency.
RESIDENCE*	The possibilities or advantages for those students who live at a great distance from the SF.

Table 1. Categories generated for the quantitative study of the qualitative responses. * Indicates the categories used exclusively for determining response to the global ERE learning experience.

In order to assure coding reliability, double and triple cross-checks of the coding performed by different members of the research team were carried out. Through consecutive stages of the dialogue, agreement was reached for categorisation of all units. The classification proved successful for assignment of text citations in all categories. Subsequently, to determine each category's frequency, the number of mentions in the responses were counted. Some texts mentioned more than one category, causing the text citations to outnumber the number of responses.

The research team integrated qualitative and quantitative results, based on the conceptual contributions of Fetters, Curry, and Creswell (2013). The two datasets (qualitative and quantitative) were brought together for analysis and comparison based on the design and then through the methodology. Working with both datasets together allowed the integration of results via a method merge approach. The integration also occurred at the interpretation and reporting levels. Integration occurred through narrative, data transformation, and joint displays. The interpretation and reporting of the results levels were carried out through a contiguous focus on the narrative and qualitative data transformation, combining the two with quantitative data for joint analysis.

Additionally, a fraction of the qualitative and quantitative results were visually integrated, seeking to explore the

nature of the strengths and weaknesses of the ERE identified by the students. Consequently, quantitative data contributed to grasp the extent to which elements of the ERE were perceived as more desirable than face-to-face activities. Qualitative methods also contributed to exploring the nature of these elements. Still, integration with mixed methods made it possible to reveal the main strengths and weaknesses of the ERE implementation in the SF.

4. RESULTS

The results derived from the above-reported investigation are reported in three sections respectively devoted to different study areas and methods. The first section reports quantitative results obtained from the survey concerning the student learning experience. Subsequently, the qualitative results are reported, including data transformation in the content analysis framework for the ERE evaluation. Finally, the student evaluation of teaching and courses is presented. This last section focuses on the strengths and weaknesses found in this experience, derived by integrating qualitative and quantitative results.

The survey collected responses from SF students attending courses during the first semester in 2020. Six hundred and sixty-eight (668) students voluntarily responded to the survey, out of the nearly 3000 students enrolled in all SF degree courses. The open question about the ERE's more or less attractive elements yielded 146 responses, and the last question about the experience of learning in ERE received 166. Given the survey required individual students to respond about all the courses they were enrolled in, 1316 discreet course responses were obtained. Sixty-one of the 103 courses were analysed, applying a threshold of at least 30 respondents (or over 20% of students) per course to qualify it for analysis. Cronbach's alpha was 0.75, representing an acceptable value and indicating that the set of results is reliable (Chaves & Rodríguez, 2018).

4.1. Students' learning experience

Findings on the students' learning experience regarded the hours dedicated to the study, the perceived clarity of instructions, and adequacy in the number of educational resources available. Given that the proportion of students who agreed (yes/no) was determined for each question, the result is expressed as a measure between zero and one for each course and the overall responses. The analysis grouped by course showed the different courses' particular characteristics and the relation among parameters or questions.

Regarding the clarity of task instructions, the global level was 0.51, which indicates a mixed result (Table 2). The remaining aspects investigated (the adequacy of educational resources and the time dedicated to studying) yielded mean scores close to three-quarters of student agreement (Table 2). These results indicate that apparent difficulties in understanding what was expected of them in ERE activities (clarity in instructions) had the strongest negative impact on student experience.

	MEAN	STD. DEV
CLARITY OF INSTRUCTIONS	0.51	0.24
TIME TO STUDY	0.74	0.16
ADEQUACY OF EDUCATIONAL RESOURCES	0.76	0.21

Table 2. Descriptive statistics of student responses on learning experience in 61 undergraduate UdelaR courses.

The correlation coefficient between the clarity of instructions and studying time or adequacy of educational

resources showed a significant relationship (r2 = 0.55 and r2 = 0.54, respectively). This correlation means that these parameters are related to each other from the students' point of view: in other words, students' perception that task instructions were clear is linked to a sense that the volume of educational resources and the time dedicated to studying was appropriate.

When the results were grouped in first-year and more advanced courses, some interesting results emerged. While there were no significant differences in both course groups regarding hours dedicated to study and adequate number of educational resources, there were significant differences in terms of clarity of tasks. Figure 1 shows the distribution of responses for both groups. The average for advanced students was 0.56, while for first-year students it is 0.39 (n = 61, p <0.05), revealing that students attending first-year courses had a lower tendency to understand how to carry out the activities to follow theirs courses.
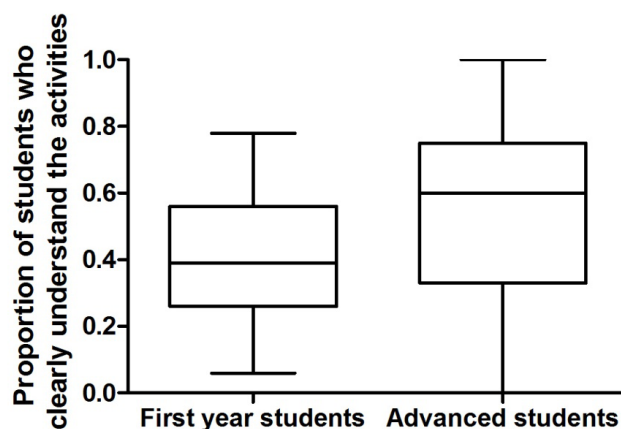
Figure 1. Box Plot representing students' perceived clarity of tasks in first-year and advanced courses.

4.2. *Students' general evaluation of the ERE*

The first qualitative aspect examined refers to the evaluation that students made of the ERE in general. The first noticeable aspect here was the length of the comments, 50 words being the mean number employed. This reflects the need students have for support. As described above, content analysis yielded quantitative data from qualitative results. Figure 2 shows the number of mentions of the different categories in the general comments. These results showed an emphasis on *Educational Resources,* and the students' need to have these for the ERE. These were mainly created or made available to students to meet the demands of the current teaching conditions. Besides the increase in the number of available resources, students highlighted the variety of formats and the new interaction possibilities. This consideration was also associated with *Teaching* and *Learning*, commonly mentioned by students. The mentions about *Teaching* referred to the teachers' actions during ERE, i.e., how they taught and explained the activities, and the educational climate teachers were able to establish. In this sense, pedagogical reflection included interaction and communication among students and teachers and the educational resources available. Comments relating to *Learning* revealed students' positive response to the possibility of watching the videos at their own pace, any time they wanted or were able to.

Additionally, students reported a noticeable level of usefulness in the proposed resources, and the diversity of learning strategies they could follow as a result of resource variety. In addition, *Prospective* and *Work* were relevant, often associated with each other as a basis for adopting distant teaching as an alternative for those who face restrictions to attend university onsite, regardless of the public health emergency. In another

sense, the feeling of gratitude was relevant; appreciation for the institution's actions in an emergency and teaching teams' efforts in this situation.
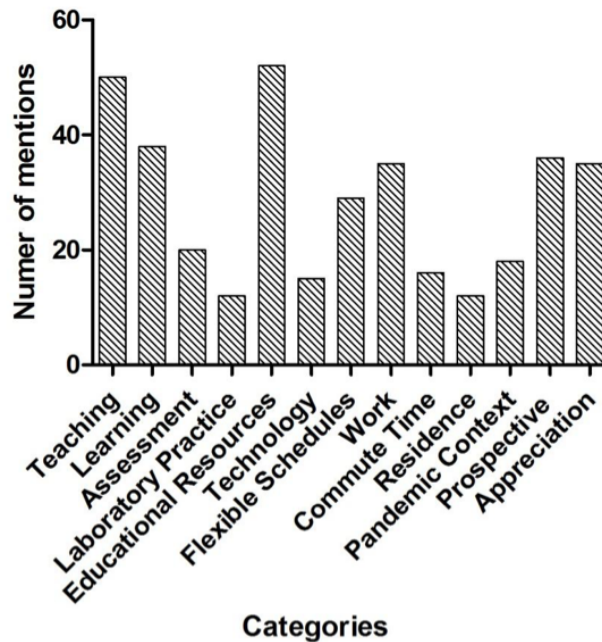
Figure 2. Graph of category instance frequency as part of the content analysis applied to the global response on ERE.

Figure 3 focuses on the most often repeated words in open-ended global responses. In general, the most commonly mentioned words are closely related to the most mentioned categories. The comments refer to the characteristics of the ERE's modalities. The most frequently repeated expressions are related to face-to-face instruction, lectures or courses, and remote modality as a substitute for face-to-face learning. Furthermore, there are plentiful references related to the category of *Flexible Schedules,* for example.

Figure 3. Word cloud obtained from responses about students' general evaluation of their ERE experience.

The students' global assessment shed light on the learning experience in an emergency. *Educational Resources* played an essential role in the redesign process. Moreover, students highlighted access to education-

al resources. Students also evaluated positively the teachers' effort to create and distribute these resources during the emergency. In general, the teachers' attitude supported the ERE, reflected in the generation of educational resources and the promotion of new teaching and learning strategies.

4.3. *Students' evaluation of teaching*

Students' evaluation of teaching was determined by analysis of responses to the quantitative questions about their reaction to the ERE, and regarding qualitative results, from the open-response question about elements in the ERE they prefer over the those in face-to-face education. Besides that, qualitative and quantitative were integrated through joint analysis.

Opinions about teaching showed variations for the different courses. While the global mean was 0.39 in response ERE, the proportion of students who agreed with ERE goes from zero in some courses to others. Statistical analysis showed a strong relationship between the agreement with the ERE and elements of the students' learning experience, described in the previous section. More precisely, it was positively correlated with the clarity of tasks ($r2 = 0.50$). Figure 4 shows the dispersion graph of the current teaching agreement versus the clarity of each course's tasks.
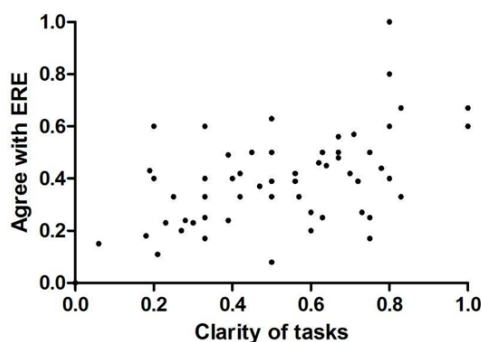
Figure 4. Graph representing, for each course, the proportion of students who agree with the ERE versus the proportion of students who consider that the tasks are clear.

The learning experience variables grouped (the average of the clarity of tasks, the agreement in time to study, and the agreement in the adequacy of educational resources) represent the Positive Learning Experience (+LE) new variable. The +LE shows a significant relationship with the agreement with the ERE ($r2 = 0.53$), Figure 5 shows the dispersion of +LE variations and the students' agreement with the ERE.
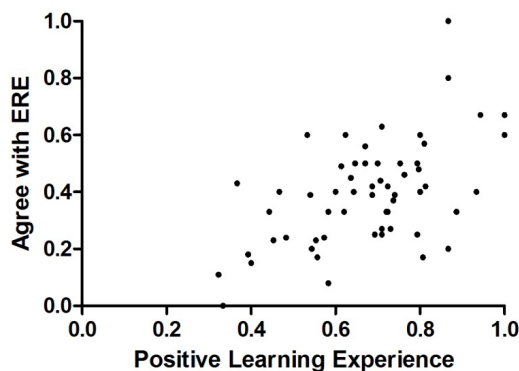
Figure 5. Graph representing each course the proportion of students who agree with the ERE versus the proportion of students who respond having had a positive learning experience.

The students' preference for ERE elements, rather than pre-pandemic face-to-face teaching, showed a wide range of answers, with a global mean of 0.57. In this case, the relationship with the students' learning experience was not significant. This lack of association may reflect that either the students' evaluation of the virtual elements of the ERE or the fact that this teaching model is exclusively remote are effects that cannot be directly linked to their learning experience. Thus, the students' evaluation of the learning experience is not related to the clarity of tasks, the time to study, or the adequacy of educational resources. In sum, there was no relationship between the evaluation of the learning experience and the new elements derived from the transformation towards ERE.

Content analysis of answers about the teaching modality were also explored using a qualitative approach. Figure 6 presents the number of mentions for each of the defined categories. These open responses displayed an emphasis on *Educational Resources*. The next most commonly mentioned category is *Teaching*, followed by *Learning*. This order is equivalent to that described on the students' evaluation of ERE. Moreover, text citations clustered around similar aspects regarding the quality of the teachers' actions and internal learning processes. The least mentioned category was T*echnology*.
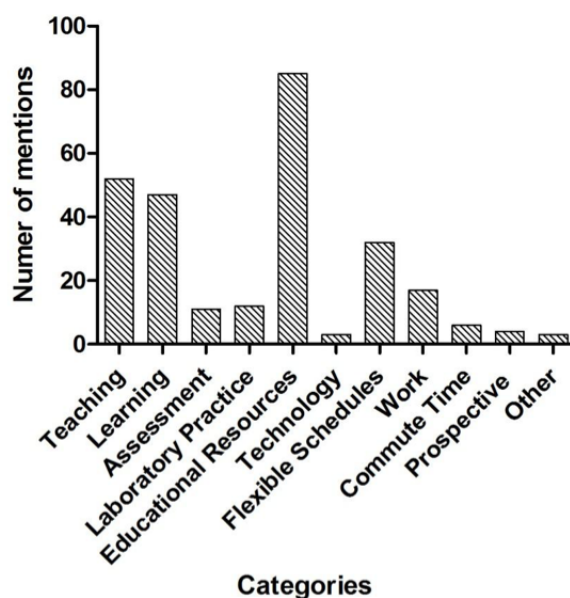
Figure 6. Graph representing the number category instances corresponding to the ERE elements in the modality question.

To further explore the elements that influenced the evaluation of ERE, we combined the qualitative results from the open and closed responses. For this purpose, the text citation in each category were distinguished according to whether the students had found ERE more or less attractive (Figure 7). Sorted by the number of mentions (qualitative content analysis) and attractiveness, *Educational Resources* is rated highest, with most responses associated with ERE attractiveness. Notwithstanding this, *Teaching*, in general, is mentioned negatively (less attractive), which implies students' discontent. Regarding *Learning* and *Flexibility,* the comments are strongly positive (ERE more attractive). Both in *Assessment* and *Laboratory Practices*, negative responses predominate.
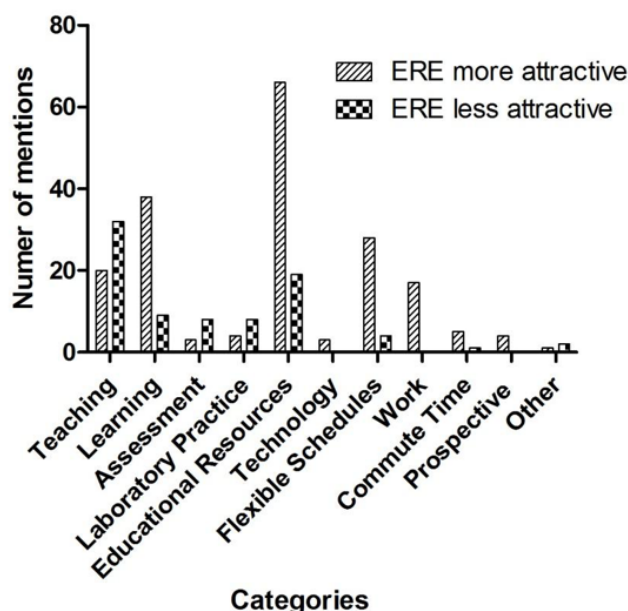
Figure 7. Graph representing the number of category instances according to students' ERE attractiveness rating.

Digging further down into the more attractive elements found for *Educational Resources*, the students suggest that the ERE resources provided greater flexibility and associated them with *Work or Commute Time* comments. For example: "*In my case, I have a significant workload; the remote mode and having recorded classes and online material allows me to go on with the lessons*". When exploring the disagreement found for Teaching actions, issues emerged connected with how the contents were evaluated and the quality of the theoretical and practical classes. One example of this disagreement is summed up thus: "*There is a lack of theoretical classes, and the demands increased in a way that does not seem appropriate to me in a situation that is already difficult in itself*".

5. DISCUSSION AND CONCLUSIONS

Undoubtedly, student performance is relevant in any educational institution, but new dimensions may be needed in the COVID-19 pandemic context to evaluate education. Hodges *et al.* (2020) propose that the students' learning achievements become less relevant in ERE. Meanwhile, evaluating the learning environment and how it has supported the education redesign could be deemed of greater significance.

In this challenging scenario, HE institutions play a fundamental role in facilitating the learning process and guaranteeing educational continuity for all the students who are, or have just started, studying at the institution. In supporting students, the improvement in teaching strategies, technological and social aspects at all levels stand out. UdelaR, through its central support programs relying on TSU, generated frameworks to address academic educators' approaches to online teaching. These programs provided strategic support for faculty transition to ERE and consequential impact on the students. As our study demonstrated, it was essential to keep on providing support strategies to neophyte students, in a cascade.

Moreover, it was indispensable to strengthen the connection between peers and the teachers and hence, with

the institution. In this regard, it is crucial to target these support mechanisms to those in vulnerable social and economic situations (Bozkurt et al.). Providing this type of support to those who do not have enough material and cultural resources to get access to virtual learning environments might be the best way, in pandemic times, to pursue the goal of knowledge democratisation and dissemination, with a view to increasing graduation levels.

As shown in this study, one of the faculty's most significant actions was education redesign. The students' diversified perspective and finding teaching less attractive points to the difficulties academic staff face in repurposing their courses for ERE. Indeed, technological support and learning environments, besides technological and pedagogical aspects, are vital combinations and central axes for redesigning for ERE (Chang & Fang, 2020). In addition to providing technological support, the SF focused on teachers as immediate reference points for students. Therefore, institutional support for teachers was also essential. Teachers' education proposals were redesigned for the emergency, allowing them to work directly on students' and teachers' needs. The latter group expressed the priority for troubleshooting and training connected to technological issues. Therefore, it was possible to focus on pedagogical aspects. This approach of the pedagogy of care, focusing the teachers' and learners' needs as a priority, placed students and teachers as focal points in an emergency scenario.

Virtually all the teachers ended up redesigning their teaching towards ERE, regardless of their affinity with, or ability to use, technology. However, if institutions analyse the educational practices and experiences being developed in various contexts as part of the current emergency response, the gained knowledge would support all stakeholders to improve education (Hodges *et al*., 2020). Doubtlessly, deploying ERE brings with it a consideration that the teaching experience at hand is exceptional, so ERE cannot endure once the public health emergency ends. However, we can learn new strategies from the experience. In that sense, in this study it proved valuable for raising student voice, a fundamental input for institutional reflection.

Students' opinions regarding courses were diverse. When exploring beyond this diversity, quantitative results showed a correlation between the clarity of tasks and the learning experience, revealing positive response to the ERE; the appropriate amount of hours for studying and the adequacy of educational resources also influenced positively response to the experience.

Students considered that the ERE was pertinent and well executed. These positive views of learning conditions aligned with current trends towards active learning in sciences, which places the student at the centre of their learning process to promote quality in HE (Waldrop, 2015). The position students took towards their learning, and how teaching endowed them to become more autonomous, helped to foster educational continuity. Evidently, until autonomy is acquired, support for first-year students is critical. The results suggest that these students found the teachers' instructions and expectations of them more difficult. In this sense, it is essential to continue and deepen the institutional programs that support initial steps in students' university careers, both from the point of view of the specific disciplinary fields and faculties, and adaptation to the dynamics of university life. Examples of useful measures are peer tutoring and introductory courses.

From the qualitative point of view, students' global assessment stressed the significance of *Educational Resources*, *Teaching*, *Learning*, and *Flexible Schedules*. In other words, students highlighted these as determining factors in the ERE. Furthermore, there were new dimensions of learning after the pandemic which were deemed relevant: *Appreciation*, *Assessment*, and *Prospective*. These could be interpreted as the students' awareness of being in a dynamic stage. Indeed, students called for the consolidation of the changes that emerged in learning and teaching.

Regarding current teaching elements, students most frequently mentioned *Educational Resources*, followed by *teaching*. Clearly, the concepts were blurred for the students, but also generated doubts and misgivings

among the teachers. In this regard, the importance students placed on *Educational Resources* suggests institutional policies should support appropriate access to open educational resources among students. In line with Scolari (2019), T*echnology* was not the most significant factor. This author states that the young are immersed in multimodal platforms and digital networks, informally learning and coexisting with digital technologies. Therefore, transmedia literacy influences students' technological evaluation.

The qualitative content analysis found the students' positions were divided on *Educational Resources* and *Teaching,* according to the type of connotation (more attractive or positive, and less attractive or negative). Such analysis highlighted the significance of both mentioned categories. Furthermore, the students positively evaluated *Flexible Schedules* and the *Learning* process. The discourses around the categories *Educational Resources*, *Teaching*, and *Learning* are consistent with prior UdelaR surveys: the students underlined the attractiveness of not having to travel and the opportunity of viewing classes at any time, at their own pace and as many times as they need (DGPlan, 2020). This flexibility also provided elements that allowed the students to develop different learning strategies. In this regard, diverse teaching strategies could promote new learning modalities and improve science education (Waldrop, 2015).

Negative aspects concerning *Educational Resources* and *Teaching* also emerged. This was related to the lack of appropriate resources or poor teacher mediation during the ERE experience. Educational resource access has been deemed a decisive element to mitigate digital inequities (Beaunoyer et al., 2020); in the current context inequalities may require some student mobility to libraries, which increases the risk of COVID-19 contagion. As Toledo found (2017), the UdelaR learning ecosystem mitigated the problem of accessing physical libraries. Nevertheless, its adoption might not be optimal. The generation of new strategies and support mechanisms that guide teaching efforts towards generating new educational resources and proposals to deploy online learning were central issues, though these aspects were positively evaluated by the students in our study.

Reflecting on ERE experiences to improve education is of paramount importance. For years, the need has been pointed out to move from an approach focused on theoretical lectures to pedagogical strategies such teacher and student collaboration to construct knowledge, develop skills, and competencies. However, the ERE experience was spotlighted the little progress that has been made in mainstreaming such approaches in university teaching. This study has also provided further proof that teachers' digital literacy is crucial to conceptualise and design active learning successfully. Doubtlessly, ERE provided a key opportunity to generate and consolidate alternative teaching designs. The students' opinions highlighted the attractiveness of distance teaching and digital resources as part of their future learning. As has been reported in the literature (Rodés et al., 2013), active hybrid learning might enable students to build their curriculum, empowering them to design an educational path according to their interests. At the same time, our study highlighted that students appreciate strategies for enhancing their learning through the adoption of digital environments and resources. The ERE has brought to the fore that there is a long way to go. More than ever, it was clear that we must begin by positioning education as a process involving teachers and students as human-beings who experience difficulty in changing traditional habits, but for whom disrupting situations, with all the difficulties they entangle, might be regarded as an opportunity to trigger reflection and collaboration towards such a process.

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