Peruvian Professors respond for teaching from virtual context. Key Success Factors in Engineering.

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***Abstract*— This article describes the main challenges faced by Peruvian Professors in terms of the methodological change originated as a result of the confinement situation for Covid-19, which has forced the face-to-face academic processes to shift to digital face-to-face academic processes, in which changes have originated significant in the pedagogical component, digital skills, work rationalization, among others. A structured questionnaire is applied to Peruvian Professors with the aim of knowing the opportunities for improvement to strengthen the faculty. This study contrasts with Peruvian Professors in the field of engineering and the level of advancement or delay with respect to the rest of the Professors studied.**

Keywords—digital presence, professors training, pandemic, engineering education.

I. INTRODUCTION

As a result of the health emergency situation in the whole world in 2020, due to the pandemic caused by Covid-19; In addition to the irreparable loss of human life, many sectors of society have suffered seriously as a result of the confinements declared by the countries as a measure that minimizes the probability of contagion. In this sense, the education sector has not been oblivious to these problems and in many institutions around the world it has gone from mostly face-to-face academic work to schemes that try to respond from digital presence, remote assistance or virtuality. Community transmission represents a particular challenge for Higher Education Institutions and the activities they develop within a Campus [1]. According to UNESCO reports, as of March 30th, 166 countries had closed their schools and universities. Globally, 87 percent of the student population was affected by these measures; that is to say, about 1,520 million students. Furthermore, around the world, around 63 million Professors stopped working in classrooms [2]

However, it is necessary to point out that a large part of the institutions were not fully prepared to face a challenge of such magnitude, despite the fact that during the last 20 years the incorporation of information technologies has been working from various institutional discourses and communication to support academic processes. Covid-19 will have an impact on the quality of the educational public service. Thus, there will be a drop especially in student performance on state census tests. [3]. This critical situation reveals many concerns, such as the deterioration in the quality of education and the future of students [4]. In addition, many times students, if they have a guaranteed internet connection, must share the devices and have to deal with the possible effects of the pandemic on health, emotions, physical activities and those of youth [5].

Regarding technological adaptation, it is pointed out that people resist change without understanding the need and importance of it and when a situation arises, everyone must adapt to change willingly and reluctantly [6]. The compulsory suspension of classes at all educational levels, with the home confinement of students and Professors, has created a network of multiple effects on all actors in the educational process. In the case of universities, they have had to take a series of measures to comply with government instructions, while trying to provide Professors and students with the information technology and technology infrastructure that allows them to continue their academic activities at a distance. It is stated that the pandemic produced by the coronavirus, by closing educational institutions as physical spaces, canceled its creative side; that is, its liberating potentialities. What remains is part of its basic regulatory function: certifying and creating age cycles [7].

Virtuality is based on the existence of virtual environments for learning, which allow the student to achieve learning results from the incorporation of both synchronous and asynchronous tools. However, the emergency situation has led to virtuality being understood in most cases as the way to connect Professors and students in real time during normal class hours, many times to work on the same contents as if they were It was a conventional teaching-learning environment. This has raised a significant juncture since it has given rise to a series of hybrids that still have to be evaluated to know the effectiveness in the learning process of students. Higher education institutions should take advantage of these opportunities to strengthen data monitoring, documentation, and evidence-based practices of the services and programs offered to students [8].

Along these lines, it is imperative to recognize the fundamental role of Professors in the acquisition of learning by students. A Professor is a natural mediator between skills and knowledge and their acquisition by students. Various studies have pointed out the importance of focusing actions on teacher training, not only on pedagogical aspects but also on aspects that tend to strengthen the digital skills of Professors. The transfer from school to home has made it clear that teaching processes require training and professionalization, thereby claiming the teaching function [7] Equipping Professors with standardized home teaching equipment across the country, especially standardized electronic devices to meet the needs of online teaching and individual tutoring in the home setting. The students' need for basic learning equipment should also be considered [9] [10].

It is therefore absolutely necessary to know the main challenges faced by Peruvian Professors, given that the contexts are totally different, and perhaps aspects that in other countries are the basic level of the teaching-learning process mediated by CIT should be strengthened. The challenges faced by Professors to use information and communication technologies and transform their purely technical use to the management of pedagogically useful tools have been widely studied at the global and institutional level [11].

It is important to note that teacher training can enhance student learning in educational programming for instructors to facilitate objectives aligned with the learning objectives of higher education institutions [12]. This is accompanied by the strengthening of remote supervision systems (e-proctoring), which are conceived as an attempt to equalize vigilance on the incidence of academic dishonesty between online and face-to-face assessment tests [13]. In the same way, it is suggested that the online education format can be useful in the post-pandemic period, especially in the case of students with special needs [14].

Another obligatory reflection is on the ability to adapt depending on the disciplinary fields, since there are fields in which presumably it will be much more difficult to carry out the academic process, some studies document this situation. For example, it is more difficult to switch to online teaching in engineering courses or courses that require hands-on training (for example, dealing with hardware or physical components in a computer engineering program) than courses only offer theoretical concepts [15] [16].

In South America there are some important gaps with respect to developed countries, since the social, economic and cultural context limits the possibility of access to technologies, with more emphasis on rural sectors. That is why this study tries to determine what is the perception of Peruvian Professors about the development of classes in digital, remote or virtual presence in order to identify opportunities for improvement that constitute action plans. In the same way, the study makes a parallel with engineering Professors and their preparation based on pedagogical and digital skills to face the current crisis.

II. METHODS

In times of pandemic crisis, various studies have been carried out with the aim of identifying the situation of higher education [6], addressing variables such as: technological adaptation, teaching and learning, student commitment and the experience of the student. Professors towards virtual classrooms. The methodological elements of the research carried out are summarized below:

- **Population and sample:** The population under study corresponds to Professors of the Peruvian university system who usually carry out their academic work in the face-to-face mode. A simple random sampling is developed. In this case, Peru has 201 records of Professors who meet the inclusion criteria.
- **Type of study:** Descriptive.
- **Procedure:** Hetero-evaluation and self-evaluation are used through questions formulated to the actors.
- **Technique:** Survey.
- **Instrument:** Opinion questionnaire for Professors about Higher Education in times of Covid-19. This instrument has completed the conceptual validation phase by experts. The survey consists of 19 closed and open questions that account for 5 variables.

Variables addressed:

• **Pedagogy:** It inquiries about the level of pedagogical preparation of the teaching staff and the possibility of meeting the objectives of the subject.

• **Rationalization of work:** It investigates the intensification of the hours of dedication to the subject as a consequence of the digital presence.

• **Digital competences:** It inquires about the preparation around the digital competences of Professors and their effectiveness to face the current crisis.

• **Technology and resources:** Inquire about what kind of technological tools and digital resources Professors have at their disposal and the use they make of them.

• **Evaluation**: Inquires about the type of evaluation carried out and if it corresponds to an evaluation of virtual learning environments.

III. RESULTS

The results are presented according to the variables:

A. Pedagogy

Regarding their preparation at the pedagogical level to face the classes remotely, Peruvian Professors consider that they were prepared to a high degree (36%) and very high degree (15%). For their part, 42% consider that they had a medium degree of preparation and 7% low. It is highlighted that, by areas of knowledge, the best-prepared Professors are in their order: a) of economic, administrative and related sciences, b) of engineering, architecture, urban planning and related, and c) of mathematics and natural sciences. It is noted that these areas are a systemic part of the engineering curricula of Peruvian universities.

It is also evidenced that there is no behavior or trend according to the years of experience of the professor, that is, greater trajectory in the teaching profession, does not necessarily imply greater preparation to approach education in virtual settings. In general, Peruvian Professors consider that they had a medium and high level of preparation, however, it is striking that those Professors with an undergraduate level feel better prepared than Professors with a Ph.D. and younger ones (in a range between 36 and 45 years), feel better prepared than those over 46 years.

In terms of training, the presentation of content is the aspect in which Professors feel best prepared. On the other hand, they consider it necessary to strengthen the development of methodologies, discussion strategies and the evaluation of learning.

Regarding the level of fulfillment of the learning objectives set at the beginning of the semester, the areas of knowledge such as economic, administrative and related sciences and the social and human sciences stand out. In the case of engineering companies, the majority are in medium (55%) and high (35%) compliance with their objectives. The foregoing is possibly related to the need to continue working on the incorporation of virtual scenarios for practices and laboratories used in the course of professionalizing subjects.

In general, Professors from private institutions in Peru consider that they have fulfilled the objectives better than those of public universities.

B. Rationalization of work

The results show a significant increase in work. In more than half of the cases of the Professors under study, it increased by more than 5 hours, a trend consistent with the Professors in the engineering area who have increased their

work per week by more than 5 hours (52%) and between 2 and 4 hours (43%).

Around half of the Professors in the sample consider that the work assigned to students has increased and less than 15% that it has decreased.

On the other hand, in 80% of the cases, the classes are held at the usual time and with the same duration as in face-to-face conditions.

C. *Digital skills*

About 80% of professors evaluate the application of virtuality to their courses with the highest marks: 4 and 5 and only 2% give an assessment of 2 points or less. This trend is similar in the engineering area, with a 75% average high and high valuation.

In general, Professors, including engineering Professors, feel the need to strengthen their digital skills regardless of their age range. Although 80% of engineering Professors have received previous training on this subject, it is an opportunity that Professors from private universities claim to have had, who also state that the usefulness of these training has been average and it is striking that more than 10% consider that their utility has been low or none.

D. *Technology and resources*

During the time of digital presence, Peruvian Professors have used mainly: a) email (95%), b) applications for virtual meetings such as Zoom or Meet (85%) and c) learning management systems -LMS- such as Moodle or Classroom (78%). In the case of engineering, the behavior is similar, with greater use of email and less use of LMS: a) applications for virtual meetings such as Zoom or Meet (87%), b) learning management systems -LMS- such as Moodle or Classroom (72%) and c) email (71%).

They are less used and remain to be explored, both for Peruvian teachers in general, and for those of engineering: social networks, video platforms and especially pedagogical tools to promote interaction such as Kahoot, Socrative, Quizlet, among others, remain to be explored. In general, the Professors agree or partially agree with having sufficient electronic bibliographic resources for the development of remote academic activities, however, 60% only use them to a medium or low degree.

E. *Evaluation*

A percentage of Professors (36%) consider that the evaluation they carry out corresponds effectively to virtual environments, a lower percentage than the general total of teachers studied. More than half say that it partially corresponds and 12% consider that the evaluation does not correspond to virtual environments; showing a scenario in which the evaluation would not be carried out optimally according to the current learning environment.

Likewise, more than half of the engineering Professors consider that they have carried out a feedback process to a high or very high degree and almost 40% to a medium degree.

Difficulties and challenges

More than 30% of the Professors who participated in the study consider that the situation of digital presence derived from the health emergency caused by Covid19, has led to a decrease in the quality of higher education. In the case of engineering Professors, this consideration represents 31.6%. In this area of knowledge, the greatest difficulties identified have been of a technological nature, related to connectivity and access to equipment and resources (41%); psychological, associated with stress, exhaustion and predisposition to virtuality (24%); pedagogical in relation to the use of tools and methodologies in digital environments (18%); and of a curricular type, which mainly obey the adaptation of content and evaluation processes (16%).

In general, the concerns of Peruvian Professors in the engineering area about the situation of digital presence have to do with the imperative need for practical classes and work in the laboratory or field in some topics or subjects, and in general, the adaptation of the curriculum to virtual environments with the adoption of methodologies and tools that promote the teaching-learning process and evaluation. Likewise, they express as a challenge the need to guarantee connectivity conditions and basic technological resources for students and to address the psychological stress generated by the emergency and the low willingness of participation and active interest on the part of some students in the educational process.

IV. DISCUSSION

The approach made to higher education in times of digital presence, allows to contrast and confirm some relevant contributions in the matter and identify key success factors in relation to engineering in facing the situation faced by the education sector at the level world. Consistent with other studies [15] [16], adaptation to virtual education differs according to areas of knowledge. Therefore, if we do not return to face-to-face scenarios fully, it will be necessary to comprehensively address the incorporation of partial face-to-face schemes, or the development and adoption of robust virtual educational tools that allow optimal simulations and laboratory and field work, especially for areas of knowledge such as engineering, which for the most part, do not consider themselves to be fully meeting their learning objectives. This, however, is a scenario that clearly implies maturity and a long and costly development process for institutions and a challenge for Professors.

As specific aspects, the study makes it possible to show the need to review the associated workload that has implied the transition to virtual environments of Peruvian Professors and the specific need for training in the use of digital tools, electronic resources, pedagogical strategies, and even, in line with other contributions [5], a psychological approach for Professors that allows its proper exercise and accompaniment to students.

Although it will be the object of later studies to specify the performance of students in tests and if the possible variations are due to an effective decrease in educational quality, or to ethical misconduct by students; it can be evidenced, although not a drop in performance [3], if an important alert from the Professors' perspective is not doing evaluations optimally adapted to virtual settings, this being one of the main challenges manifested, as well as, In agreement with other countries [4], the perception of decrease in the quality of higher education according to an important group of academics in the engineering area.

Despite the fact that some affirm that confinement leads to the loss of creativity and liberating potential in education [7], the results of the study are considered positive, while the

perception of Professors in general, if it poses great challenges but also shows important results, being the situation of digital presence an opportunity to advance in the improvement of teaching skills and in the use of different tools that will enrich even face-to-face education. This, however, requires a whole effort and process of institutional, academic and individual development. There are open questions about the conception of virtuality by Professors, who in general consider that they are making an adequate application to their courses, however it is evident that the usual schedule and duration of classes in face-to-face, has been maintained. that could explain the effect of workload, stress and mental and physical exhaustion; in addition to the little use that is observed of pedagogical tools other than virtual meetings, remote presentation of content, email and traditional class managers (LMS).

In relation to the above, as well as the effectiveness of teacher training and evaluation processes, it will be necessary to contrast these results with the appraisals of students and to delve into later comparative research.

V. CONCLUSIONS

Once the study was carried out, it was possible to know the Professors' perception regarding pedagogical preparation, work rationalization, digital skills, resources and technology and evaluation, identifying ways still to be traveled. Great efforts by Professors are evident in trying to establish effective teaching-learning processes, however, the emergency has generated certain levels of autonomy that cause them to respond from what is believed to be virtual education. In practical terms, most Professors use synchronous tools for the development of their classes, which shows a digital presence rather than a strictly rigorous virtuality.

In the same way, when investigating the engineering faculty, there are two aspects to be highlighted that should be studied in future studies in more detail: 1) It is a disciplinary field that has a prevalent practical approach (laboratories, applied cases, etc.) , requires a fine task of transforming face-to-face classes into virtual classes and 2) Professors have had a significant relationship with information and communication technologies compared to Professors from other areas of knowledge, which could be termed as an advantage when trying to incorporate digital components in your courses.

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