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The Effect of the Covid-19 Epidemic on the Self-perception of Training Needs in STEAM Lecturers

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Abstract— This work in progress research-to-practice paper presents the initial results of a study carried out at our university among lecturers, aimed at determining how the perception of training needs have changed due to the pandemic, and if this change can be used to increase enrollment in the university training program. Pedagogical training of university lecturers has usually been a self-training process guided by their own beliefs about what good teaching is, and the self-perception of one's own strengths and weaknesses with respect to teaching. The COVID-19 pandemic shook the world in many ways, but it also challenged lecturers about their own convictions regarding educational methodologies, evaluation and their own approach to teaching, so it is a great opportunity for change.

Keywords—STEAM education; lecturer training; professional competencies; self-perception and change; higher education

I. INTRODUCTION

This work in progress research-to-practice paper forms part of a project under development at our university with the objective of improving and refining a training program for our faculty and teaching staff (henceforth, *lecturers*). Over the years, the training program has been refined using the action research method, evaluating the program on a regular basis, reflecting and researching the literature to help us in the next step. When necessary, we conduct our own research for the purpose of putting it into practice in program redesign. Changes in the program were introduced gradually, but the COVID-19 pandemic obliged us to make rapid and unexpected modifications to the organization of the program, while at the same time forcing lecturers to rethink their own attitudes to teaching. Since one of the main reasons why lecturers enroll in the program is dissatisfaction with some aspect of their teaching, the authors thought it would be helpful to conduct a study to identify any changes that may have taken place in the self-perception of training needs among these lecturers. This paper presents that study and reflects on how to introduce its findings into the program.

Pedagogical training of university lecturers is not usually the result of a systematic process, but rather a voluntary self-training process based on seminars or training activities, personal readings, interaction with peers and, above all, on the reflections arising from the lecturers' own experiences as students, from former students who attended their lectures and the subject being taught. Mainly, however, it is based on the lecturers' own ideas about what constitutes good teaching and the self-perception of their own strengths and weaknesses vis-à-vis their own beliefs [1]. These beliefs are deep-rooted and difficult to change, especially if they are intuitively reasonable [2]. In order to change these convictions, it is necessary for lecturers to feel some dissatisfaction that motivates them to seek an intelligible and clearly useful alternative to enable them to connect these new beliefs with their previous ones [3].

One of the most important tools of change for those dissatisfied lecturers is the training programs offered by the universities. However, due to their voluntary nature, these training programs are subject to low levels of enrollment. This is because most universities prioritize the scientific training and the research capacity of teachers over the ability of training good professionals [4]. In the case of Spain, only published papers and grants obtained count towards recruitment and promotion in their academic careers, so the hours and effort devoted to improving education is sometimes regarded as a "waste of time", with all which that may imply [5][6][7]. How is it possible to change this?

The strategies for change in education, especially in STEAM (Science, Technology, Engineering, Arts and Mathematics) studies, has been studied by Henderson, Beach and Finkelstein [8] among others. These authors define four categories of change strategies: 1) Curriculum and pedagogy; 2) Reflective teachers; 3) Policy; and 4) Shared vision. The category that poses most difficulties is that referring to Policy, and there have been several studies devoted to the importance of institutional support, the measurement of quality education and the rewards they may entail [9][10], especially in an engineering education environment [11].

The Universitat Politècnica de Catalunya is a technical university that provides only STEAM degrees. Lecturer training workshops are undertaken by the Institute of Education Sciences (hereafter, the Institute), to which the authors of this work belong. Training is organized in courses that may range from a single session of between 1 and 4 hours, to several sessions, with weeks between each session to encourage reflection, and mandatory activities to be developed between sessions. More than 150 courses are offered with topics such as interpersonal communication, effective communication in class, flipped classroom, design thinking, educating one's voice, body language, a case study in education, mentoring, student engagement and project base learning, to name only a few. Our previous efforts were aimed at tackling the issue of low enrollment. They were focused on offering lecturers an attractive training that would help the development of their academic careers [12][13][14]. In an environment governed by the need to “publish or perish”, lecturers usually have little time to spend making innovations in their classes, but rather follow the former system consisting of traditional lectures and examinations. This is a system to which they are accustomed, requires little of their time, and is consistent with their own beliefs, but which was suddenly disrupted by the COVID-19 pandemic. Virtually overnight, the customary routine of face-to-face lectures and exams became impossible to carry out, and many lecturers found themselves in need of an accelerated and in-depth training in new educational tools and methodologies. This adaptation to emergency remote teaching was far from easy, as can be seen in the emerging literature on this topic ([15][16][17], to name a few). The Institute was required to devise new courses and workshops, especially adapted to online and blended learning methods. The number of courses on offer grew by 9%, and the number of attendees by 154%. The average number of registrants per course before the pandemic of approximately 16 lecturers, jumped to figures that in some courses reached as many as 200 lecturers enrolled during the pandemic.

In adapting to the new situation, many lecturers have discovered teaching methodologies of which they were previously unaware. Most of them have tried new ways of doing things, while becoming more aware of their own limitations as teachers. Adapting to this exceptional situation has changed their own vision of what constitutes education, as well as the way they regard the training they may require to improve the quality of their students' learning.

This paper describes how the adaptation to the COVID-19 affected the training program. It occasioned the addition of some resources and brought about a change in the enrollment of the old and new courses, which has increased dramatically. However, a new question arose as a result of these changes: is it a flash in the pan, or has there been a lasting change in the perception of our lecturers regarding the challenges and needs of higher education in engineering? An exploratory research was therefore conducted to determine whether such a profound change has really taken place.

II. ADAPTING TO COVID-19

After 15th March, 2020, a strict lockdown was ordered by the Spanish government in order to tackle the outbreak of Covid-19. All the face-to-face classes immediately switched to online, forcing many lecturers to abandon their zone of comfort and abruptly adapt to an accelerated and in-depth training in new educational tools and methodologies.

Much effort was made to adapt the ordinary functioning of the Institute to the new needs of the academic staff. Existing courses were adjusted to meet the new requirements by switching the focus to tools and methodologies necessary for online training. New courses were created, such as online teaching methodologies, extensive use of the virtual campus, creation of multimedia courses, student motivation, remote work tools and online examination, to name but a few.

At the same time, a series of newly created support elements were generated, some of the resources of which are as follows: a website with online teaching tools and examples, together with a series of regulations and resolutions published by both the health authorities and our university; a specific web repository to store all the recorded courses and training material developed by our lecturers; and finally, a podcast service, with information oriented towards helping our lecturers in this transition, fed by the questions about online teaching that the Institute was receiving.

The abovementioned strategies facilitated communication between the Institute and the academic staff and schools. The main aim was to stimulate motivation, to provide responses to the concerns of our lecturers, and especially to collect and echo the many positive online teaching actions and best practices identified by the community, for the purpose of disseminating and sharing them.

TABLE I. EVOLUTION OF ENROLLMENT

	2017	2018	2019	2020	<i>Increase 2019- 2020</i>
Total courses	92	109	161	175	9%
People enrolled	1417	1714	2594	6582	154%
Enrolled/course	15.4	15.7	16.1	37.6	134%
Certified	1061	1311	1963	4841	145%
Different lecturers (% of total lecturers)	700 (26%)	716 (26%)	1146 (40%)	1632 (55%)	42%

Prior to the pandemic, the Institute had already been working on the provision of more attractive and useful courses for the development of the academic careers of our lecturers. One of the actions taken was to expand the number of courses on offer. Table I shows the evolution of courses offered by the Institute from 2017 to 2020.

The first row (Total courses) indicates the number of courses offered each year by the Institute, and the second row (People enrolled) the number of lecturers enrolled in these courses. One may observe that in 2019 there was an increase in the number of available courses (from 109 to 161, an increase of 47.7%), and also an increase in enrollment (from 1,714 to 2,594 people, an increase of 51.3%). However, the average number of people enrolled per course (third row) barely changed from 15.7 to 16.1.

Regarding the follow-up of the courses, the fourth column (Certified) indicates how many of the enrolled lecturers completed the course, having fulfilled all the tasks required. We believe that there is a high drop-out rate in these courses, due mainly to the fact that the courses are voluntary and most of our lecturers already carry a significant workload. The last row indicates how many different lecturers enrolled in at least one course of the training program. Some teachers signed up for more than one course, so one of the indicators we wish to increase is the number of different people who enrolled in the courses. This row also indicates the percentage of lecturers compared with the total number of lecturers at our university, which varied from 2,684 in 2017 to 2,987 in 2020. We can see that the increase in courses offered in 2019 represents a 60.1% increase in the number of teachers who enrolled in at least one course (from 716 lecturers to 1146). This means that 40% of the total number of university professors enrolled in at least one course of our training program.

This increase in enrollment in 2019 was expected. It is well known that every renewal of the training program courses is accompanied by an increase in enrollment. This comes as no surprise, since we are dealing with courses for our academic staff, which is relatively stable over the years. Thus, a decline in enrollment was expected after the first year. Even so, the figures for 2020 have surpassed all historical records. Although between 2019 and 2010 the number of courses increased only by 9% (from 161 to 175 courses), the number of those enrolling multiplied by 2.5 (from 2594 to 6582 enrollments), as did the number of people who finished the courses (from 1963 to 4841 certified lecturers). The average number of enrollments per course went from about 16 to 37.5, and in some cases exceeded 200 people enrolled. Regarding the number of different people who enrolled in at least one course, it increased by 42%, from 1,146 to 1,632 lecturers, which means that 55% of the academic staff at the university enrolled in at least one course in 2020.

Lecturers receive a satisfaction survey to complete at the end of each course. Satisfaction with the courses (measured between 1 and 5, where 5 indicates "very satisfied with the course") is historically close to 4.5, which is a good result. In the 2020 surveys, the average was 4.52, very similar to the previous results.

III. LECTURERS' TRAINING NEEDS

A. Research design

COVID-19 forced lecturers to adapt to a new situation, during which many of them have questioned their beliefs about teaching and discovered teaching methodologies of which they were unaware, thereby trying new ways of doing things while realizing their own limitations as teachers. Consequently, the following research question arises: "Has the pandemic changed lecturers' vision of what constitutes education and the way they regard the training they may require to improve the quality of their students' learning?"

This takes the form of a qualitative, exploratory research. Data was acquired by mean of a focus group. One of the teachers belonging to the training program was responsible for moderating this focus group. The participants were chosen from among the people who had taken a course taught by the moderator. In the interests of gender parity, eight female and eight male participants were randomly chosen and invited to participate in the focus group, fourteen of whom accepted (8 female, 6 male). For practical reasons they were distributed into three subgroups, one of 4 members and two of 5, according to the participants own agenda restrictions.

The focus group was held in March, 2021, with the intention of studying the perception of lecturers regarding various topics including their own training needs. Participants had an average of 10.57 years of experience as teachers (standard deviation: 8.98 years), ranging between 18 months and 33 years. Five participants are at the beginning of their academic career (fewer than 5 years of teaching experience, being in their twenties); four people are in their thirties (5-15 years as lecturers), and four people are over 40 years old and have over 15 years of teaching experience. The distribution according to areas of knowledge covers all fields: there are lecturers from the science area (3), industrial engineering (5), architecture (2), civil engineering (2) and IT (2).

B. Results of the focus group

To focus the discussion, the participants were asked to think about some of their teachers in the past and to reflect on the characteristics that made them good teachers. The goal was to initiate a discussion about the competencies that defined good teachers in a normal situation.

There was consensus on the need for teachers to have an exhaustive knowledge of their subjects, to be rigorous, organized and enthusiastic, with the ability to communicate well and to explain the usefulness (application) of their subjects and provide good feedback.

A generational difference is detected. Those in their late thirties or older consider that the most important characteristics for good teaching are a good organization of the blackboard, provision of well-ordered notes, a clear and organized agenda, resolving exercises and so on. On the other hand, the younger generation clearly indicates that what defines an excellent teacher is empathy, providing useful feedback and the ability to contextualize the knowledge imparted.

In response to whether the good teachers they had in mind would have experienced difficulties in a situation similar to that of the Covid-19 pandemic, there was a division of opinion. In the case of those teachers regarded as “old fashioned”, the opinion was that they would have encountered problems due to personal characteristics (working in a new environment to which they were unaccustomed), although it was thought that their ability to explain things in a simple, clear and orderly way would not have been affected. On the other hand, the participants agreed that some communicative tools had been lost (body language, face-to-face feedback, interaction in class, informal discussion at breaks, ...), which indicates a significant loss for a generation that considers interaction as the most important factor.

When the participants were asked about what may have caused enrollment in the courses to increase so dramatically, and what might help to sustain this high level of enrollment, the answer was that the courses offered were those that were needed at that time. Some of the teachers found themselves outside their comfort zone and believed the training courses offered to be very useful for tackling the educational emergency; not only were the courses direly needed, but they were also easier to follow. The traditional system of these training courses was of a synchronous and face-to-face nature, usually offered on our main campus (a one- or two-hour drive away from other campuses). The recent pandemic has forced most of the courses to go from face-to-face to online, many of which consisted of an important asynchronous that provided more freedom in terms of scheduling and eliminating travel time. The participants believe that this new organization prompted lecturers to sign up for more courses. They requested that this format be maintained we return to a normal situation.

Participants agree that the pandemic has greatly affected both teachers and students, and that we have learned to appreciate some things that we previously took for granted. Everybody is keen to go back to class, to resume interaction and human contact. Participants comment that the pandemic forced them to ask themselves questions, such as whether it makes sense to have teachers who "repeat the same thing, year after year" (so they can be replaced by a video), or “old-fashioned teachers” who talk all the time with virtually no interaction with students, and thus do the class by video conference instead. A consensus exists to the effect that "education is not about watching videos", and the traditional classes were often based on same basic idea, but “live” and in a “theatrical format”. Lecturers have been obliged to consider what can they do to motivate students (whether face-to-face or online), so in this regard the situation has helped lecturers to realize their own limitations. The pandemic has been a “stress test” for the way they address teaching and learning, and many lecturers who have always been complacent about their teaching methods have been forced to reflect on their weaknesses.

The focus group consisted of lecturers who were open to change, and for that reason they made the most of the training courses offered by the university. They were already trying out new, such as gamification or flipped classroom, and the pandemic provided them with the opportunity to pursue the route they had already adopted. For them, there is no “way back”, although when they talk about faculty “in general” they do not expect any profound alteration, since in the opinion of the participants many people will return to the traditional system without changing anything. How they return to normal circumstances will depend on each individual, many of whom will return to the "usual" procedures because they find them comfortable and convenient.

IV. DISCUSSION

Today everyone accepts the fact that we were unprepared for a situation such as that experienced during the pandemic. The universities that based most of their teaching on face-to-face classes had to adapt overnight in order to minimize the impact on student learning.

Thus, many of the professors at our university, who had followed the same "traditional" method for decades, were unable to adapt their teaching methods to such exceptional circumstances. The increase in enrollment in the Institute's courses was due to the fact that teachers were overwhelmed by the situation. They realized that they were in need of a type of training they had never encountered before, and found that the courses made available provided them with a solution to their problems. This point, together with the change to online and asynchronous courses, thereby facilitating follow-up, go a long way to explaining the great success of the training program during these months.

A difference is detected in the perception of those lecturers who studied their degree before or after the mid or late 1990s about the most important quality in a teacher. Lecturers who studied their degree prior to these dates consider some of the most fundamental attributes of a good teacher are: organization, clarity in explanations and the resolution of many exercises in class. On the other hand, younger teachers regard feedback, empathy and motivation as being much more important. The difference probably resides in the ease of access to information and the use of technology. Those who studied the degrees for which the main source of information was the teacher believe that a good teacher is one who provides reliable, clear and organized information. However, those with access to information by other means appreciated the human quality of the teachers more than role quality as a reliable source of information.

This last point is important, since teachers' capacity for organization or the clarity of their explanations are not the features most affected by the change from face-to-face to online teaching, since under those conditions it is more difficult to maintain the same levels of interpersonal communication, feedback and, above all, emotional transmission and motivation.

In any case, it is not age but attitude that counts when it comes to lecturers who are concerned with improving teaching. Those who participate in the training program courses are more likely to modify their beliefs and experiment with new methodologies. It appears that the lecturers who are most highly motivated have not undergone a radical change in their perception of the needs in the teaching-learning process, but rather that the evolution of their educational methods has accelerated. However, there has been a change in the way in which they regard the role of the more traditional teachers, insofar as they believe that, rather than adapting, these teachers have continued to do exactly the same, but online. They may have learned how to apply

some tools, but they have neither reflected on nor changed their beliefs. It seems that these traditional teachers, who repeat the same methods year after year and who have little interaction with the students, have barely changed their vision of teaching and will revert to their usual way of working as soon as possible. However, based on their experience, this is the opinion of the more highly committed teachers who have participated in this study, one of whose limitations is the lack of participation of the less motivated teachers, an issue we hope to study in the near future.

V. CONCLUSIONS

The COVID-19 pandemic has undoubtedly led to a dramatic situation. The need to adapt to new and sometimes traumatic circumstances has changed the point of view of many people about some things that were previously taken for granted. It is our duty as those responsible for the training programs for lecturers at our university to study this impact on the lecturers and adapt our program accordingly.

This paper presents a study on the possible changes in the self-perception of training needs by lecturers at our university as a result of the urgent adaptation of education due to the pandemic. The results clearly show that the crisis has forced lecturers to see education from another point of view, thereby bringing about changes in some of their beliefs. Nevertheless, lecturers fear that some of the lessons learned may quickly be forgotten once we are back to normal. Notwithstanding, this also provides an opportunity, since it has been demonstrated that lecturers have indeed reflected on their approach to teaching and have tested new ways of doing things. A difference has also been identified in how lecturers of different ages perceive what "a good teacher" actually is. Finally, the results show that, even though it is difficult to encourage lecturers to enroll in the training activities, they are willing to participate in them when they recognize an immediate and palpable need. It is necessary to study if these findings can be used to motivate more lecturers to enroll in the program.

As future work, it is our intention to consider the findings of this paper very carefully in order to incorporate them into the organization of the program. While post-pandemic enrollment numbers will almost certainly decline, it will be of great interest to determine whether or not they remain above pre-pandemic numbers. We also wish to study whether lecturers have incorporated new methods and tools of which they were unaware before the pandemic, or whether they have returned to their traditional methods. Lastly, and with hindsight, we also intend to conduct a research on a couple of academic years to determine if the pandemic has occasioned any changes in the self-perception of the strengths and weaknesses of our lecturers with regard to their teaching.

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REFERENCES

- [1] Kagan, Dona M. "Implication of research on teacher belief." *Educational psychologist* 27, no. 1 (1992): 65-90. https://doi.org/10.1207/s15326985Sep2701_6
- [2] Prawat, Richard S. "Teachers' beliefs about teaching and learning: A constructivist perspective." *American journal of education* 100, no. 3 (1992): 354-395. <https://doi.org/10.1086/444021>
- [3] Posner, George J., Kenneth A. Strike, Peter W. Hewson, and William A. Gertzog. "Accommodation of a scientific conception: Toward a theory of conceptual change." *Science education* 66, no. 2 (1982): 211-227. <https://doi.org/10.1002/sci.3730660207>
- [4] Shulman, Lee S. "Those who understand: Knowledge growth in teaching." *Educational researcher* 15, no. 2 (1986): 4-14. <https://doi.org/10.3102/0013189X015002004>
- [5] Fink, L. Dee, Susan Ambrose, and Daniel Wheeler. "Becoming a professional engineering educator: A new role for a new era." *Journal of Engineering Education* 94, no. 1 (2005): 185-194. <https://doi.org/10.1002/j.2168-9830.2005.tb00837.x>
- [6] Smeyers, Paul, Doret De Ruyter, Yusef Waghid, and Torill Strand. "Publish yet perish: On the pitfalls of philosophy of education in an age of impact factors". *Studies in Philosophy and Education*, 33(6):647-666, 2014. <https://doi.org/10.1007/s11217-014-9404-9>
- [7] Aprile, Kerry Therese, Pammie Ellem, and Lisa Lole. "Publish, perish, or pursue? Early career academics' perspectives on demands for research productivity in regional universities", *Higher Educ. Res. & Development* 2020. <https://doi.org/10.1080/07294360.2020.1804334>
- [8] Henderson, Charles, Andrea Beach, and Noah Finkelstein. "Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature." *Journal of research in science teaching* 48, no. 8 (2011): 952-984. <https://doi.org/10.1002/tea.20439>
- [9] Winstone, Naomi, and Lynne Millward. "Reframing perceptions of the lecture from challenges to opportunities: Embedding active learning and formative assessment into the teaching of large classes." *Psychology Teaching Review* 18, no. 2 (2012): 31-41. Available at <https://www.semanticscholar.org/paper/Reframing-Perceptions-of-the-Lecture-from-to-Active-Winstone-Millward/a1eb2680f397d776223ac74f5cf4787793730475>
- [10] Borrego, Maura, and Charles Henderson. "Increasing the use of evidence-based teaching in STEM higher education: A comparison of eight change strategies." *Journal of Engineering Education* 103, no. 2 (2014): 220-252. <https://doi.org/10.1002/jee.20040>
- [11] Kinchin, I. M., E. Alpay, Katherine Curtis, J. Franklin, C. Rivers, and N. E. Winstone. "Charting the elements of pedagogic frailty." *Educational Research* 58, no. 1 (2016): 1-23. <https://doi.org/10.1080/00131881.2015.1129115>
- [12] Lopez, David, A. Adam, María J. Delgado., Enric Mayol, and Marc Alier. "A design pattern for skills based lecturer training programs." In *Proceedings of the Research in Engineering Education Symposium 2015: Dublin, Ireland*, pp. 1-9. 2015. Available on line: <http://hdl.handle.net/2117/86121>
- [13] Lopez, David and Antoni Perez-Poch. "Detecting which teaching competences should be reinforced in an engineering lecturer training program." In *SEFI 2016 Annual Conference: full papers*, pp. 1-11. European Society for Engineering Education (SEFI), 2016. Available on line: <https://core.ac.uk/reader/81572105>
- [14] Lopez, David and Antoni Perez-Poch. "Design of a STEM lecturer-training programme based on competencies." *The International journal of engineering education* 34, no. 5 (2018): 1495-1503. Available on line: https://www.ijee.ie/latestissues/Vol34-5/07_ijee3659.pdf

- [15] Hodges, Charles, Stephanie Moore, Barb Lockee, Torrey Trust, and Aaron Bond. "The difference between emergency remote teaching and online learning". *Educause review*, 27, 1-12. 2020 Permant link: <https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning>
- [16] Trust, Torrey, and 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), 189-199. 2020. Retrieved June 21, 2021 from <https://www.learntechlib.org/primary/p/215995/>.
- [17] Rapanta, Chrysi, Luca Botturi, Peter Goodyear, Lourdes Guàrdia, and Margueritte Koole. "Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity". *Postdigital Science and Education*, 2(3), 923-945. 2020 <https://doi.org/10.1007/s42438-020-00155-y>