Profile of the participants in a STEAM Lecturer-Training Program Based on Competencies. Lessons for the future.

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ABSTRACT

This paper presents the results of a research study on the profile of the participants in a postgraduate lecturer training program (15 ECTS) based on competencies in a STEAM (Science, Technology, Engineering, Arts and Mathematics) University. The study research questions are: (1) "In which competences do the participants perceive a personal improvement during the programme?", and (2) "Can we identify a profile of the candidates most suited to take better advantage of the training?" . The study includes current participants and students who have completed the program in the last 5 years. A mixed research methodology was used including both quantitative and qualitative analysis. Data from the program alumni and current candidates have been quantitatively analysed to identify common personal and background features among them. Structured interviews and focus groups have been conducted to find out how their initial expectations matched with their perception of what was offered in the program. The qualitative interviews include a discussion about their experiences along the programme and their ambitions for their further professional development, and put in context with their specific background. This research has important implications for the future, such as the need for increased training in digital skills. The majority of the teachers surveyed have a positive impression of the training and are in the middle of their careers. However, because of the pressure to satisfy other Academia requirements, many potential applicants in their early career stages do not complete or even contemplate participating in the program.

1 INTRODUCTION

Teacher's training is particularly challenging in the particular context of engineering studies, which traditionally have one of the highest dropout rates in higher education. Patricia Cross [1] stated that teaching will not acquire status until teachers do consider their classes as laboratories for research and innovation. The problem probably comes from the fact that the innovation and research that are conducted at our technical universities do not use the same methods as those traditionally used in the social sciences, which are precisely the ones that would apply to education. Thus, it is necessary for a faculty also to acquire competencies related to these issues.

Hence, we focus our work on the pedagogical training of university teachers in higher education, in a technical university. Lecturers' opinions of their day-to-day teaching practice usually arise from their culture or previous background as former students, and mainly on their own beliefs, which induce them work as if these beliefs were true. Such beliefs are usually very resistant to change, as well as being consistent with the teaching style of each lecturer [2].

Competency-Based Education (CBE) is increasing its role in Higher Education worldwide. The *KoKoHs* project in Germany, for instance [3], has revealed significant deficits in student competencies, proposing different ways to address them, among others, to promote lecturers' training in pedagogical competencies. However, few studies can be found about teachers' competencies. A positive effect was found, for

instance, by Muzenda [4] who has described how lecturers' competencies improved students' academic performance. Some authors have proposed CBE programs for training lecturer's competencies in particular fields: Schina et al. [5] outlined some lecturers' training programs in robotics education, while Ulubey and Basaran [6] have reviewed existing lecturers' initial training programs in Turkey. However, which competencies should be trained in a STEAM university is still a matter of discussion, and as far as these authors know no similar programs as the one introduced herein have been analysed in European Universities.

In order to tackle these points which are common to many European STEAM universities, we herein introduce and analyse a teachers' training program designed at our university,(*Universitat Politècnica de Catalunya – BarcelonaTech*) and promoted by its *Institut de Ciències de l'Educació*, to which the authors of this work belong. This training is non-mandatory for the participants, because, no specific pedagogical background is required for teaching at our universities, other than knowledge of the subject to be taught. Since the training programme is voluntary, lecturer enrolment in the program is usually rather low when compared to the total number of lecturers in the university. A matter of concern is how this participation in teacher training programs in higher education can be raised.

The University in which this program is proposed is a technical one, specialized in technology, mathematics, architecture, science and engineering (STEAM). There are no schools and departments of psychology or education within our institution, or any tradition of using social science methods aside from the Economics department. Moreover, our lecturers have the technical competencies required for teaching, but it cannot be taken from granted that they have the professional competencies required for conducting this teaching.

Our previous training programme followed the pre-Bologna pattern: it measured on-site hours and was based on course content rather than on the competencies to be acquired by the teachers participating in the training activities. Degrees have moved from content-based learning to competencies-based learning, the focus being on learning rather than on teaching [7]. Many authors [8 - 12] have discussed the relevance of teachers training in the quality of the teaching received by higher education students, particularly in challenging studies such as those related to STEAM studies. Hence we proposed a training program whose objectives were:

- To design a training itinerary for lecturers based on the competencies they must acquire as teachers, as well as providing a qualification certifying to that fact. This training should also cover lecturer evaluation and promotion.
- To increase the number of lecturers enrolling in our training programme.
- To use this training programme to promote a scholarship in engineering education research, a field of scientific inquiry that has usually been ignored by our teaching staff.

The following six competencies were identified as part of the curriculum training: 1) Interpersonal; 2) Methodological; 3) Communicative, 4) Planning and Management; 5) Teamwork; and 6) Innovation. A final 7) "Digital Training" competency was added in the year 2020/21 as it was perceived that there was an important need for this training during the outbreak of the pandemic.

- Interpersonal: to be able to help participants to develop critical thinking, motivation, confidence and diversity recognitions; by creating a framework of empathy and that includes ethics in their professional practice as well as interacting with other individuals.
- Methodological: to be capable of applying appropriate strategies and evaluation tools in accordance with each educational context.
- Communicative: to be able to conduct appropriate and efficient communication processes in the teaching context which means reception, performance, production and transmission of messages through various media channels. These channels include face-to-face or online interactions as well.
- Planning and management: to know how to design, guide and develop content, training and evaluation so that the results are measured and suggestions for improvement are made.
- Teamwork: this skill is not about teachers leading a group of students working together, but rather about teachers being able to collaborate among themselves. It deals with the topic of taking responsibilities and commitments according to the common objectives, agreed procedures and considering the educational resources available.
- Innovation: to be able to create and apply new knowledge, perspectives, methodologies and resources in the different dimensions of their teaching.
- Digital Training: to be able to use telematics tools, new technologies and software tools to conduct semi-presential or online teaching.

The program has a total of 15 ECTS to be conducted in different courses and workshops including training in all the previous competences. All the courses include, as a general framework a general introduction and an overview of the pedagogical principles. However, a practical approach is enforced. Active methodologies are proposed by the trainers of the courses and workshops which specifically aim to make the participants reflect on their own teaching. Individual and group practical work is proposed in order to discuss whether their teaching day-to-day duties include the principles which motivate good practice teaching in higher education. For example, in the course of Interpersonal training, participants learn to develop an electronic teacher's portfolio which is aimed to reflect and discuss their day-to-day practice and interactions with both students in class and their staff colleagues.

A final project is mandatory to complete the degree with a real innovation being conducted in the class by the participant in the program [13]. Active methodologies and student engagement are intended to be implemented by participants during this

training [14]. The final project includes a final memo and is finally presented and discussed after an evaluator board of experts.

2 METHODOLOGY

2.1 Description of the participants sample

Two focus groups were included for this research. Group A was specifically organized for this work with only alumni of the program, while Group B was added as conducted before in 2021 but with the same aim as the first one. Focus Group A included only alumni from the program, and Group B included only participant candidates.

Regarding Group A, five former participants from different departments who have finished their degree in the last five years were interviewed with a structured script. One of the participants was in the initial stage of his career when he was a participant of the STEAM program, aged 27 years old. The other four belonged to a middle stage (Associate professor) aged between 32 and 43 years old. None of the subjects who could be interviewed belonged to the advanced stage (Professor). Three were male and two female. Two belonged to the Management department, 1 to the Physics department and 2 to the Information Technologies (IT) area.

Focus group B was held in 2021, with the aim of answering this Research Question 1. One of the teachers in the training program was in charge of moderating the focus group, and the participants were lecturers chosen from among those who had attended a workshop taught by the moderator. Eight men and eight women were randomly chosen to achieve gender parity, and of the sixteen people invited to participate in the focus group, fourteen accepted (8 female, 6 male). Finally, for practical reasons they were grouped into three subgroups, one of 4 and two of 5 people. The participants in Focus Group B had a wide range of teaching experience from between one and a half and 33 years. Five participants were at the beginning of their academic career, with 5 years of teaching experience or less (many of them were teaching assistants while doing their doctorate) and an age range of between 20 and 30. Four people were in their thirties, and four people were over 40 years old, all of them with over 15 years of teaching experience. The distribution in areas of knowledge in Focus Group B covered all groups at the university: lecturers from the science area (3), industrial engineering (5), architecture (2), civil engineering (2) and IT (2).

With respect of the whole group of participants in the STEAM program, 68% of the students enrolled belong to the middle-stage career teachers (associate professor), with less than 5% of Professorships and a remaining 27% are on the initial-stage teaching career. Lecturers enrolled in the program belong to a wide variety of departments and knowledge areas. The most represented areas are Management, Architecture and Computer Science. This data was used for quantitative and qualitative analysis as described in section 2.3.

2.2 Improvement as perceived by the participants

We used a qualitative approach to answer to this research question ("In which competences do the participants perceive a personal improvement during the programme?") with semi-structured interviews and focus groups.

All five participants have successfully finished their degree with excellent marks and they all found that their involvement in this training program had a significant positive impact in their careers. The semi-structured interview was focused on finding what specific part of training had a real impact on their teaching, how their training was influential in their advancement (if any) in their professional careers, and specifically, which particular competences were perceived by the participants as having improved because of their training. Computer Assisted Qualitative Data Analysis Software (CAQDAS) such as NVivo 11 was used for text analysis.

2.3 Profile of the candidates

A mixed methodology, both quantitative and qualitative was used in order to find out the answer to the second research question (“Can we identify a profile of the candidates most suited to take better advantage of the training?").

Regarding the quantitative analysis, data from the program alumni and current candidates have been quantitatively analysed to identify common personal and background features among them. Previous background, current stage of their professional career, age and gender, as well as time to complete the degree (or credits remaining to obtain it) were taken into account. A multifactorial analysis was performed using SPSS version 25. Correlations between the independent variables and indicators of their success when completing the program were computed.

Qualitative analysis was used to find clues on which are the best indicators from the professional practice of the participants that best correlate with their success, and in which specific parts of the training have they focused on. Again, both the aforementioned structured interviews and focus groups were used.

3 RESULTS

3.1 Research question 1

The participants in the semi-structured interviews all were very satisfied with their participation of the program. Regarding its specific impact on their professional career the results were mixed. Four of them showed that they perceived that their day-to-day teaching was improved, while the remaining participant, the one in his initial stage of his career argued that, while little impact could he perceive on the quality of his teaching, the awarded degree was something valuable that added to other merits to achieve a promotion in his academic status. Four of them noted that the final project was meaningful for their reflection skills on their teaching. Regarding the question on which specific competences the program can be accounted as a booster for them, 3 of them mentioned “Innovation”, 2 of them mentioned “Communicative” and “Methodology” and only one included “Teamwork” in their comments in the interview.

The text analysis showed that “Innovation” or “research” was the most frequently mentioned theme, with “active methods” leading the second place and “qualifications” being third. The results may reflect the impact of their training on the perceived new innovation capabilities as well as the importance of the active methodologies being introduced in their day-to-day teaching and their related impact on the qualifications obtained by their students.

Participants in the focus groups believed that the workshops offered were both interesting and useful. The opportunity to include these workshops, and especially the postgraduate degree in the education section of their CVs, is advantageous for young teachers seeking to obtain a `promotion. It is also interesting for teachers in a more advanced stage of their academic career to hold a postgraduate degree when applying for positions as a senior reader or Professor. However, for promotion and recruitment, research experience prevails over teaching and training experience. A consensus exists about the advantages of completing these workshops as a means of distinguishing oneself from other applicants, although it is believed that universities do not value these workshops to the extent that they should. This is the reason why participants think that most teachers do not sign up to these workshops (in a normal situation), since it is more profitable for their academic careers to spend this time publishing papers or securing a project than devoting it to workshops on education. Lecturers found themselves overnight in a pressing situation requiring an accelerated and in-depth course of training in new educational tools and methodologies, to which end they enrolled in the workshops provided. Even so, participants are of the opinion that many lecturers have tried new ways of doing things and have become aware of their own limitations as teachers, so it is likely that a considerable number of newcomers will continue in the program.

3.2 Research question 2

After a multifactorial analysis of the data from the participants in the program and alumni in the last five years was performed, some interesting results can be noted.

Regarding knowledge background areas, 38% belong to Foundation Sciences (Mathematics, Statistics, Physics, Chemistry, Biology, Economics), 18% belong to Industrial Engineering, 21% to IT (Information Technologies), 18% to Architecture and 5% to Civil Engineering. Some of the knowledge areas are overrepresented in the program, such as Economics (usually linked to Engineering and Applied Management topics) and Civil Engineering, which is due to the existence in their departments of a tradition and interest groups on innovation and teaching topics. Most participants and alumni were in their middle stage of the program (62%), many of them were in their initial stage (35%) and very few in the upper stage as Professors (3%). The differences in gender (63% male and 37% female) may reflect the presence of more men than women in STEAM universities staff such as the one herein analysed. Most of the participants (73%) had more than 10 years of experience as university teachers while less than 13% had less than 3 years of experience with only 14% between 3 and 10 years of teaching experience in higher education. Only the combination of Middle-

stage career with an Economics ($r=0.85$, $p<0.05$) or Civil Engineering ($r= 0.78$, $p<0.05$) background was positively correlated with finishing the degree.

In the semi-structured interviews it was interesting to find out that all five participants in the interview mentioned their vocational interest in pursuing a training for their teaching. They unanimously perceived, even in strong terms, that their promotion in Academia will not be the result of this training but rather, from their research results in their specific fields of knowledge. This impression was also found in the focus groups. Another significant finding was that during and after the pandemic, they realized that a better training in digital tools and skills was needed to better serve their students.

4. CONCLUSIONS

All participants having been surveyed had a positive perception of the training they had received during the program. The inclusion of active methodologies in their day-to-day practice as teachers, and innovation skills was the competence that stands out to be the best improvement in their teaching practice they could mention after completing this postgraduate program. We could not find a particular background that was most suitable for completing this degree as most teachers did not come from a pedagogical or social sciences undergraduate training. There was a positive correlation with Economics and Civil Engineering backgrounds for a positive completion of the degree, but this fact could be probably due to more tradition in teaching, learning and innovation in their departments in this particular University. Both participants and alumni were particularly satisfied with the practical approach of the program. Some of them reflected that the tools and methodologies proposed to them had a turning point effect on the effectiveness of their teaching. However, organizational restrictions were also often noted as a strong limitation for change. These conclusions can be easily generalized to other STEAM Higher Education institutions in Europe.

This research has important implications for the future. As it has been outlined, no similar studies specific to teacher's training in competencies in Engineering Faculties had been proposed. Among our findings, we remark the need for increased training in digital skills. There is also a significant lack of initial stage participants, who are the teachers who might most likely benefit from such a teaching training program. This is probably due to a small number of full-time professors being hired by this STEAM university (due to economic lack of funds for new hiring) and also to the pressure they are facing to meet research requirements to be promoted. Although economic constraints may vary throughout European Institutions, the problem of being promoted mostly because of research merits and not competencies training is fairly common. Many potential applicants in their early career stages do not complete or even contemplate participating in this program, therefore we suggest that universities may contemplate this teaching training as a merit, or even as a requisite in order to be further promoted in their careers. The potential for improving students' effective learning is of paramount importance.

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