The Scientific Initiation in the Graduation Courses of UEMG's Faculty of Engineering: Disparities and Challenges

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Abstract: The notoriety of the shortage of qualified professionals in the engineering segment to meet the existing projects and also the future ones is worrying the academic community. These challenges show how the lack of appropriate courses and low expenses with incentives to research and extension programs can affect the formation of the future engineer. Therefore, universities have the mission to develop teaching, research and extension, offering to the students new opportunities for diverse technical training, scientific and humanist formation. It is noted, however, that such activities in many engineering courses, especially scientific research, are not being prioritized by the universities. In light of this, the present paper aims to register measure and evaluate the participation of the students in scientific initiation in the four engineering courses of the Faculty of Engineering of the Minas Gerais State University. Sticking to the disparities presented by the four courses studied, in relation to the participation in research projects, the results showed a greater engagement of students of Environmental Engineering and Mining Engineering courses regarding the other engineering courses. In addition, a better divulgation and a greater involvement of teachers in projects were identified as the main recurring challenges to the access in scientific research by the students of this institution.

Key words: Challenges, engineering, scientific initiation, university.

1. Introduction

The current economic recession in the Brazilian market has a direct impact on the professional market, especially the engineering area. So, the most affected professionals are the newly graduate engineers who have little experience or are often unskilled. Given the difficulties and expense involved in investing in short-term labor skills, one of the main problems observed is the lack of adequate courses. Therefore, such lack of experience and qualifications can be related to the bad conduction of the courses of

engineering by the Brazilian universities, particularly with respect to the incentive to scientific initiation and extension projects. According to Gomes et al. [1] although the teaching institutions are not obliged to offer research in their curricular structures, they are aware that they must disseminate the knowledge produced, based on extensive research and extension, leading to the evolution of knowledge itself, as improvement of the services offered. Therefore, the increase in students' participation in research projects can be an ally in improving their skills and also generating new qualifications.

Scientific initiation is classified as a training instrument that allows the introduction of scientific research to undergraduate students, allowing a

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theoretical and methodological support that contributes to the professional and personal formation of the student. It aims to awaken a scientific vocation, stimulating potential talents among undergraduate students involved in research projects, guided by a qualified researcher [2]. It is this kind of research that allows the student to develop his critical posture, in general, presenting more knowledge in certain areas of science.

Scientific initiation can also be understood, in a broader perspective, is presented by Simão et al. [3] as a process that encompasses all the experiences of a student in an educational institution, with the objective of developing so-called scientific training and all opportunities for participation or student involvement with the research during graduation.

The activities of scientific research are very important in the structuring and consolidation of the knowledge in the formation of an engineer. For Tonini [4], the indissociability between the teaching, research and extension triad is paramount for the students' knowledge process, since it enables and strengthens the relationship between theory and practice, students and teachers, social, environmental and ethical commitments and development of new technologies.

In this context, the scientific initiation has become a strategic activity for the country, since the possibility of these current beginners in science became researchers in the future, providing benefits in this area for Brazil. The recognition of this importance led Brazil to create in 1951 the CNPq, National Council of Scientific and Technological Development to promote actions of incentive and foment to the research. In addition, other organs over time were created, highlighting in this area in Minas Gerais the FAPEMIG-Foundation of Support to Research of the State of Minas Gerais, created in 1985.

The campus entitled Faculty of Engineering from the Minas Gerais State University (FaEng/UEMG) is located in the city of João Monlevade, Minas Gerais,

and presents the following undergraduate courses: Mining Engineering, Environmental Engineering, Metallurgical Engineering and Civil Engineering. Since its creation in 2006, FaEng has been striving to provide and offer its students good teaching, research and extension for the development of science as a whole, in order to form qualified professionals who also promote social well-being. In this sense, a large part of the problematic context of the lack of qualification by the new graduates relies as responsibility on the universities and how they must behave for the formation of human resources in quantity and quality to supply the current demand.

Like FaEng, many Brazilian universities try to figure out how their levels of scientific development are by doing works similar to what is proposed in this project. As an example, Lopes et al.'s work [5] accomplished at the University of Ribeirão Preto pointed out the importance of the university investment in research and extension for the training of chemical engineers. Moreover, a study carried out at the Faculty of Sciences and Technology of Montes Claros by Luiz et al. [6] aimed to promote the culture of article production, stimulate the practice of scientific research in the institution and report successful experiences in it.

Therefore, this paper proposes to identify and measure the level of engagement of students in scientific initiation in the four undergraduate engineering courses present at the Faculty of Engineering of João Monlevade. Subsequently, investigate the main points that involve the problematic about this engagement by the students.

2. Methodology

The research was restricted to the undergraduate courses in Mining, Metallurgical, Environmental and Civil Engineering of the Faculty of Engineering of João Monlevade, seeing that the courses studied have a significant participation in the number of engineers graduated annually in the region. Firstly, a survey was

made to find the number of graduates who participated in scientific initiation activities from 2012 to the first semester of 2016 in the courses mentioned above. The execution of this survey was supported by the coordination of the research and extension center of FaEnge. In addition, the Lattes Platform, a Brazilian government website, has also been used for research purposes, since it offers subsidies to indirectly identify the involvement of students in scientific initiation actions.

Regarding the development of research projects by FaEnge engineering students, the following data were also investigated through the Lattes Platform: A) Number of students who developed and are developing Scientific Initiation projects; B) Publications in periodicals and journals; C) Complete publications in national and international congresses; D) Presentations at national and international congresses; E) Publications of abstracts; F) Publication of chapters of books.

In addition, a questionnaire was applied to the students of the tenth period of each of the four undergraduate courses studied in this research, in order to indicate the degree of participation of these students in research projects, since they were enrolled throughout the years when this work contemplates.

Thus, through an open questionnaire which according to Mattar [7] brings advantages as a stimulus to cooperation and potentially covers points beyond closed questions, each student was asked if they participate or had participated in scientific initiation activities, in affirmative case, pointing out what led to such involvement and, if not, discussing the possible causes that did not contribute to such involvement.

3. Results and Discussion

The graph (Fig. 1) measures the number of students that participated in scientific initiation projects in the period from 2012 to the first semester of 2016 for each of the four undergraduate courses of the Faculty of Engineering-FaEnge.

The graphs showed that students' participation in scientific initiation projects is not equivalent in the four courses studied and, over time, there is no continuous growth in some courses. For example, for Environmental and Metallurgical Engineering courses, there was a decline in the number of research scholarship students compared to 2012. Only the courses of Mining Engineering and Civil Engineering showed a continuous increase in the number of research projects carried out.

Fig. 1 Number of students that have participated in scientific initiation projects according to each engineering course.

Fig. 2 Publication in periodicals from 2012 to May 2016.

Although they are related in the same great area of study and performance, a heterogeneity was observed in the courses of this university. These variations may be directly related to the policy that the educational institution adopts in relation to the pedagogical and financial support regarding scientific research involving undergraduate students. In the last few years, the Minas Gerais State University (UEMG) has increased its investments with the help of grants, to finance scientific initiation projects and also extension projects aimed at the local community. This can be seen in the chart by the growth in the number of fellows, mainly by mining and civil engineering students, who may have been more interested or fulfilled the necessary requirements to grant these scholarships.

In addition, another point relates to the constant exchange and annual replacement of professors from the faculty of Engineering. Because many of them do not have an exclusive dedication job as teacher (this means that they work at the university and in the industry as well), this has a direct impact on the safety and development of projects conceived in the second semester. There have already been cases where some students lost their scholarship and had to undergo their scientific activities because the tutor was not hired as a

professor for the following year.

However, it is important to emphasize that the Mining Engineering and Environmental Engineering courses together hold about 60% of the total number of scientific initiation fellowships, showing a marked disparity in relation to the other courses. The fact that the Civil Engineering course started its first class in 2011, may explain the lower number of students involved in research until then.

The number of publications of the students of each course from 2012 to May 2016 is presented in Fig. 2.

In relation to the data presented in Fig. 2, there is a great disparity in the number of publications by the courses of Environmental and Metallurgical Engineering in relation to the other courses. However, it is noted that the production of articles and scientific communications among students is still small, showing that not every student prepares or publishes their works, perhaps due to the lack of support from the institution or a deficiency awareness of the importance of technical writing in the engineer's career.

In this context, the interests and motivation of the current students should be taken into account in the evaluation of the research actions in the universities, in an attempt to find the main challenges faced by both.

Through the questionnaire distributed to the students of the last year of the fourth engineering courses (2016), it was possible to indicate the degree of participation and also to outline the main motivations and difficulties related to the activities of scientific initiation in the university.

In the particular case of the students of FaEnge, the greatest motivation found in carrying out projects of scientific initiation is the extracurricular enrichment. This shows that the students of the engineering courses that carry out research projects aim to diversify their curriculum, but only few realize this desire. The main challenges identified for the greater access to scientific initiation by the students are the lack of encouragement and involvement of the professors, the lack of dissemination of the program announcement and projects already carried out.

Another circumstance that does not compete for the accomplishment of these projects and which was described by the students is the fact that many work full time, so they do not have time left to perform this type of activity. Similarly, the reality of many students who come from neighbouring cities daily to study makes it difficult to participate and develop scientific projects, which usually require time, laboratories and continuous monitoring.

4. Conclusions

The students of the engineering courses of Minas Gerais State University have the opportunity to carry out scientific projects since they started their studies, being able to apply the acquired knowledge and to integrate it better with the academic environment. In addition, when carrying out such activities integrated with teaching, the student has the possibility to develop their skills and competences for the exercise of their profession in the future, becoming more qualified, since the market is more competitive every day.

This project aimed to show the reality experienced by the university in relation to its scientific production. When analysing the number of scientific initiation

programs developed by the students and professors from the FaEnge engineering courses, it was observed that there is still a great disparity between the courses and many challenges to be faced such as the development of innovative proposals, more effective participation of students and greater interest in participation in projects especially by the teachers. In addition, greater support from the institution is needed, focusing on raising more funds, not only financial resources, but also for the acquisition of laboratory equipment in these areas.

Given this, a more effective participation in all levels of the institution will certainly result in greater efficiency of complementary activities in engineering courses and professional training of the fresh engineers.

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