

The profile of the graduate in environmental engineering between the years 2012 and 2017: a case study in a University of the State of São Paulo

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SUMMARY

The purpose of this work is to characterize the profile of the environmental engineer. To this end, a questionnaire was elaborated, containing 3 key questions, in addition to other questions about the academic and professional life of 220 graduates who graduated between 2012 and 2017 from a University located in the city of Sorocaba, São Paulo (SP). It was possible to observe a gradual growth in the number of environmental engineers trained per year, which may be related to the increase in the demand for courses that involve the environmental theme and the stimulation of public policies through funding and scholarships. However, it was noted that a large number of these professionals (25.8%) were unemployed, a fact that indicates a possible saturation of the labor market in the analyzed region. It was found that most of the graduates work as Environmental Analysts in private companies of the most diverse branches, a situation that is most likely related to the fact that more than 50% of the sampled engineers receive up to R\$3,000.00. In addition, most of the environmental engineers were already inserted in the job market, as technicians, corroborating the situation of promotion through the federal government and the possible opportunities. Finally, it was found that most professionals believe that the profession of environmental engineer is new, and the multidisciplinary in their training makes them a professional with a holistic and systemic view, in order to work together with other specialists. However, even so, they believe that it would be necessary to change the undergraduate curriculum.

KEYWORDS: Environmental Engineer. Profession. Insertion in the labor market.

1 INTRODUCTION

Faced with the vehement growth of negative environmental impacts from human activities and the lack of pollution control, as well as the lack of mitigating measures, in a historical context, issues involving the environment were gradually incorporated into engineering courses. However, over the years, it was noted that the responsibility for the protection of the environment, in fact, was the responsibility of all Engineering, but, given the complexity of these problems, there was a need to create a specific engineering for such (SANTIAGO et al., 2020).

Therefore, in the face of traditional engineering, environmental engineering can be considered as a recent technical modality (PRADO FILHO et al., 2012), because its concepts were proposed from the Stockholm Conference, during the 1st World Conference on the Environment in Sweden, with the purpose of creating technical professions aimed at the protection of the environment (VIANE; SILVA, 2022). It is worth emphasizing the importance of this conference for the environmental area, being the World Environment Day, adopted as the starting date of the meeting.

In the case of Brazil, environmental engineering was officially created through Ordinance No. 1,693 of 1994, of the Ministry of Education and Sports (MEC). However, as pointed out by Prado Filho et al. (2012), even before this creation, the first environmental engineering course in the country was approved, approved by the Lutheran University of Brazil (ULBRA), on the campus of Canoas, Rio Grande do Sul (RS).

As this course had its opening only in 1994, it is considered, concretely, that the current Federal University of Tocantins (UFT) was the first university to offer the course in Brazil, still called, at the time, the State University of Tocantins (UNITINS) (UFT, 2017).

As for the regularization of the environmental engineer profession, the above information was no different, since it was recently regulated by the Federal Council of

Engineering and Agronomy (CONFEA/CREA) through Resolution No. 447, on September 22, 2000, framing the respective course in the modality of civil engineering.

Bressane et al. (2021) presents that, as occurred in other engineering modalities when created, many environmental engineers have shown dissatisfaction with the recognition of their qualifications, and the engineering council itself has been questioned.

Given this, even today, the difficult scenario prevails in relation to the environmental engineer, especially in relation to his attributions, which, as mentioned by Cruvinel et al. (2014), the existence of ramifications, such as agricultural and environmental engineering, environmental and sanitary engineering and civil and environmental engineering, hinder the process of standardization of class entities. Thus, currently, the standardization of the nomination for environmental and sanitary engineering is vehemently sought.

In relation to the scenario of multidisciplinary cooperation of related areas, addressed by Souza and Milioli (2014), it is directly related to the standardization of the environmental engineering curriculum, making the student, many times, know in depth about a respective theme, only, in the labor market.

Thus, given the multidisciplinary nature of knowledge, the environmental engineer is formed through disciplines that cover the 3 areas of knowledge, as addressed by Bressane et al. (2021), called: humanities, such as economics and social sciences; biological, such as ecology and microbiology and; of exact and earth sciences, among which stands out geology, climatology and calculus. In addition, the aforementioned authors emphasize, as well as Rodrigues (2004), on the transdisciplinarity of graduation, with themes involving environmental pollution, recovery of degraded areas, assessment of environmental impacts and environmental sanitation.

Finally, Oerther et al. (2022) presents that this whole scenario could be changed if these professionals presented, in a clearer way, their peculiar contributions to the conservation and preservation of the environment. The authors suggest that greater awareness of these issues could develop and strengthen society's concerns about sustainable development and sustainability.

Given the complexity of the subject, there is a need to evaluate the current profile of the environmental engineer, which is the main objective of this article, which also aimed, in a specific way, to analyze the insertion of graduates in the labor market, as well as their salary range and their behavior after graduation, seeking to evaluate the deficiencies in professional training and the prospects of the graduate for the future of the area.

2 MATERIAL AND METHODS

For the research to be viable, it was necessary, initially, the search for means of contacts with the graduates of the environmental engineering course of some educational institution. Therefore, a partnership was made with a private University, located in the city of Sorocaba, São Paulo (SP), which was willing to carry out the questionnaire, via research management application (Google Forms), of graduates in environmental engineering between the years 2012 and 2017.

Regarding the use of the Google Forms platform as research material, Mota (2019) points out some characteristics that make it paramount for this article, namely: a) possibility of access of the interviewee at any place and time; b) agility and practicality in data collection and analysis of results and; c) possibility of organizing quantitative results in graphs and spreadsheets.

Parallel to the search for contacts, an electronic form was elaborated to be sent to the graduates, which were divided into blocks: a) personal information; (b) professional information; c) continuity of studies, as well as the reasons for this; d) the area of professional activity; and e) prospects for the future of the area.

The aforementioned instrument was approached through an access link for response, and this option is justified by the ease in the subsequent treatment of the data, given that, in this way, there is the possibility of generating a spreadsheet in .xls format, which can be used in Microsoft's Excel software, as demonstrated by Mota (2019).

With the questionnaire formulated and contacts updated, the link to access the form was sent electronically through the personal account of the authors of this research. After the submission, the deadline for answering the questionnaires was stipulated: October to December 2018.

After the deadline for replying, the process of compiling the data began. Initially, we worked with three key questions, that is, for decision-making purposes, these questions should be answered by the respondents. The questionnaires that were answered, but with these fields blank, were ignored. The key questions were: a) the city in which you currently reside; b) year of training; and c) current work sector.

Subsequently, all the answers to the questionnaire were considered, whether they were blank or not. This reason was due to the fact that there could be the possibility of an egress being unemployed and not having a salary, for example. The questions addressed were: a) current position; b) current salary; c) time to enter the labor market after graduation; d) continuity of studies after graduation; e) completion of a training course after graduation; f) if the Environmental Engineering course is considered a promising career; g) recommendations to be addressed by the curriculum of the course; and h) how graduates judge the opportunities of the environmental engineering market today.

It was possible, through the analysis of the questionnaires, to obtain the profile of the environmental engineer who graduated between the years evaluated, as well as the approaches to the labor market and professional evolution of the interviewees.

3 RESULTADOS

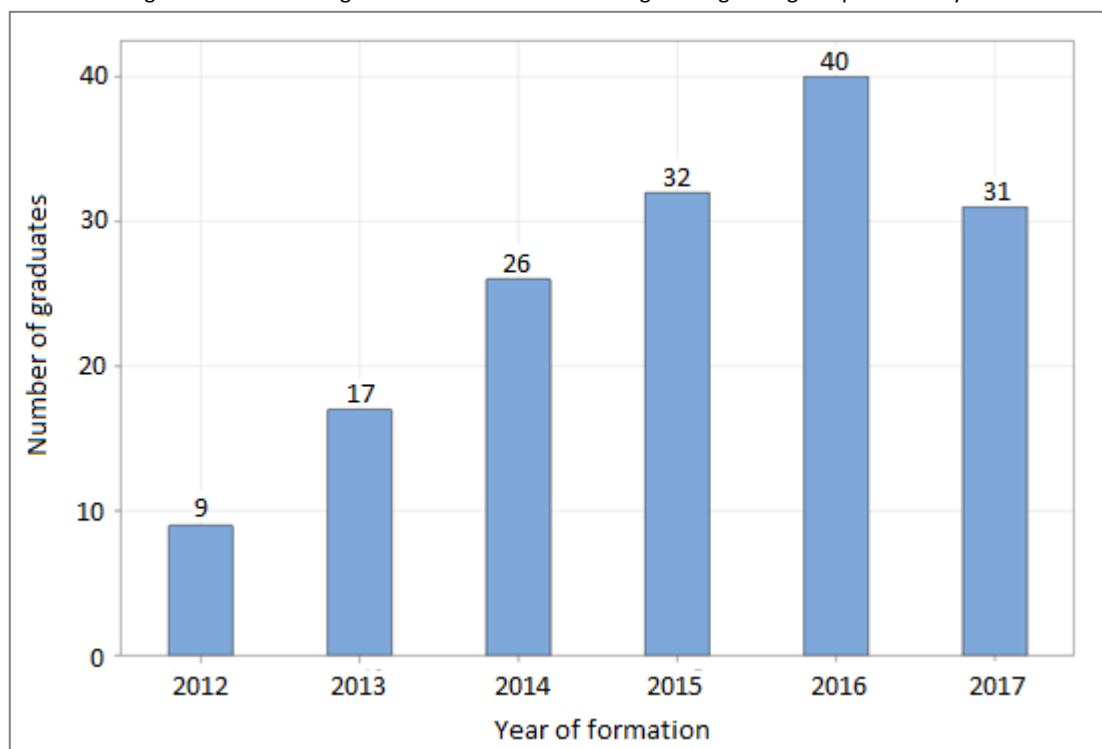
It was possible to obtain a representative sample, contemplating about 70% of the 220 graduates between the years 2012 and 2017. This sampling scenario, similar to that presented by Prado Filho et al. (2013), allows this study to be used in a comparison format with that presented by the authors, who analyzed the insertion, in the labor market, of the environmental engineer graduated from the Federal University of Ouro Preto (UFOP) until August 2011.

Regarding the first key question, which asked about the city in which the interviewee lived, it was possible to notice that only 3.20% of the graduates no longer lived in Brazil. In the case of only those who live in the country, the supremacy of the city of Sorocaba (SP) was verified, with approximately 50% of the number of professionals, followed by cities that make up its metropolitan region, especially Votorantim (SP), with 7%, followed by Itapetininga, Itu and Piedade, with 3.2% in each municipality.

This scenario indicates the importance of local private universities in the training of environmental engineers who, for some reason, cannot change their municipality, or region, to take the course in a public educational institution. However, this context demonstrates a high number of professionals trained per year in the area studied, pointing to a saturation, given that there are other universities with degrees in environmental engineering in the region.

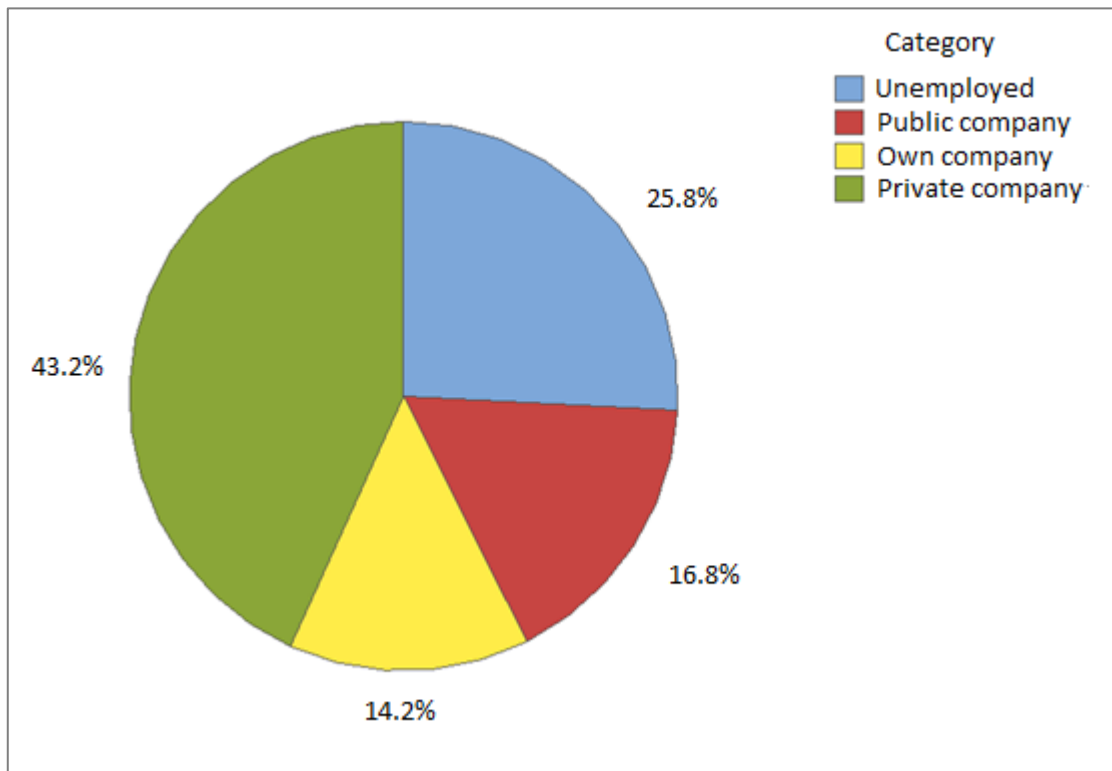
Thus, there must be a consensus between the public, private and educational institutions, in order to verify how the market, public and private, will receive the new professionals who will be graduating in that area. If this does not occur, the market becomes saturated for a given profession, directly resulting in unemployment and/or devaluation of the professional. Regarding the number of environmental engineers trained during the period analyzed, this scenario can be visualized through Figure 1. Figure 2 shows the workplace of these graduates.

Figure 1 – Number of graduates in environmental engineering during the period analyzed



Source: The Authors, 2023.

Figure 2 – Workplaces of graduates in environmental engineering between 2012 and 2017



Source: The Authors, 2023.

In general, among the graduates who answered the questions, it is possible to highlight that the majority are working in companies in the private sector of the most diverse branches of activity (43.2%), followed by jobs in public companies (16.8%) and own companies, with 14.2%. This scenario is corroborated to the study presented by Filho et al. (2013). However, in the study analyzed by the author, in graduates of the Federal University of Ouro Preto (UFOP), the number of unemployed was not present as those presented by this study.

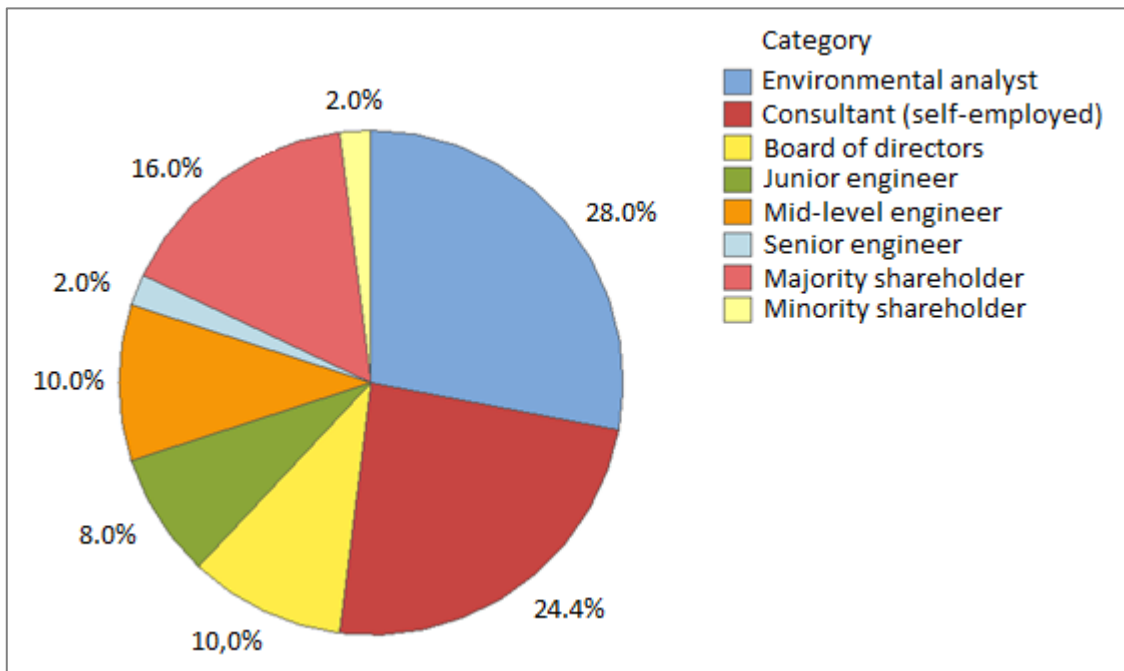
It was possible to make a comparison between the possible opportunities linked to a public and private University. As much as the labor market disagrees with such a distinction, and that a good degree is carried out by the student who so desires, it is notorious that, with regard to investment in research and science, the public University, in fact, stands out over the private ones.

Thus, and in view of the scenario exposed, it is believed that there is a difference in opportunities between students in the public and private spheres of the environmental engineering course, because, when verifying the categories of workplace of the interviewees, the scenario provided corroborates the discussion of market saturation, given that 1/4 of the sample quantity was unemployed. Also noteworthy is the growth in the number of environmental engineering graduates over the years. However, this scenario, most likely, is related to the public policies, imposed by the federal government of the referred period, to obtain undergraduate financing through the Fundo de Financiamento Estudantil (FIES) and also the gain of partial or full scholarship by Programa Universidade Para Todos (ProUni).

In addition, it is possible to consider that, as presented by Vargas (2021), the public policies of ProUni and FIES, despite the discourse of promoting the reduction of social inequalities, in fact, only exempted the federal government from its responsibility to offer new vacancies in public education, transferring resources to the private sphere and promoting the commodification of higher education. That is, in their heyday, these programs were just a way to allocate public resources to the private sector.

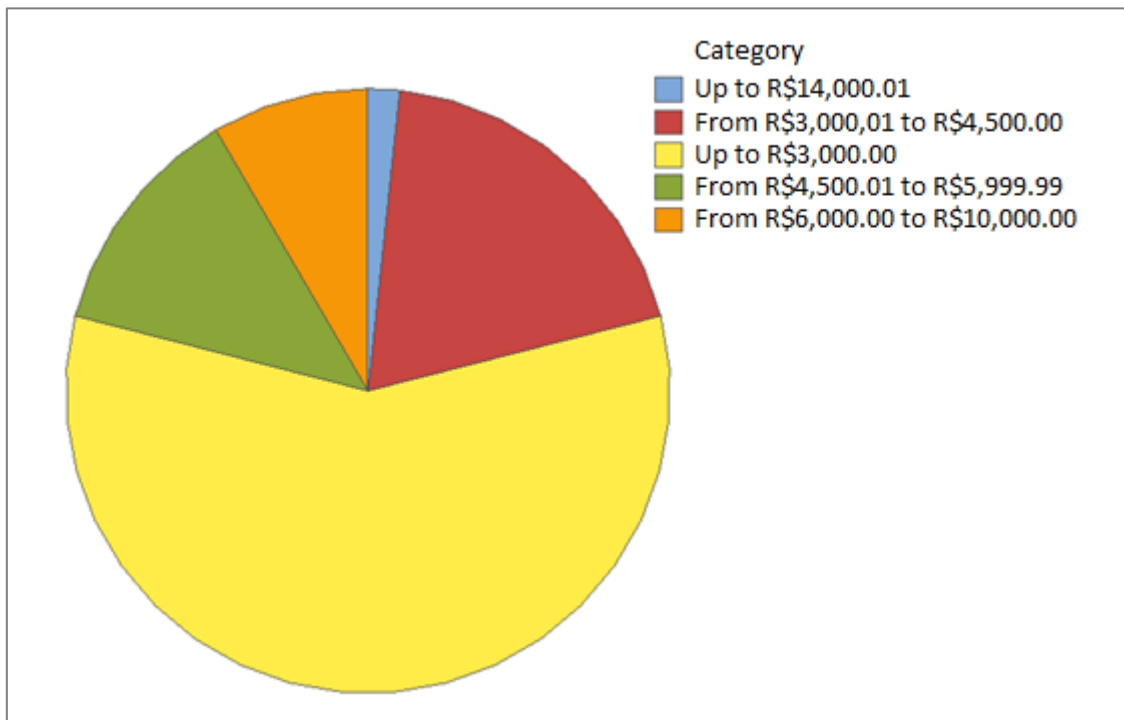
Regarding the positions occupied by the graduates, these are shown in Figure 3. It is noteworthy that, for better visualization of the data, the option 'Other position' was not considered, which is very much related to the unemployment factor, with approximately 63% of the answers. Figure 4 shows the salary range of these professionals.

Figure 3 – Position occupied by the graduates



Source: The Authors, 2023.

Figure 4 – Salary range of graduates



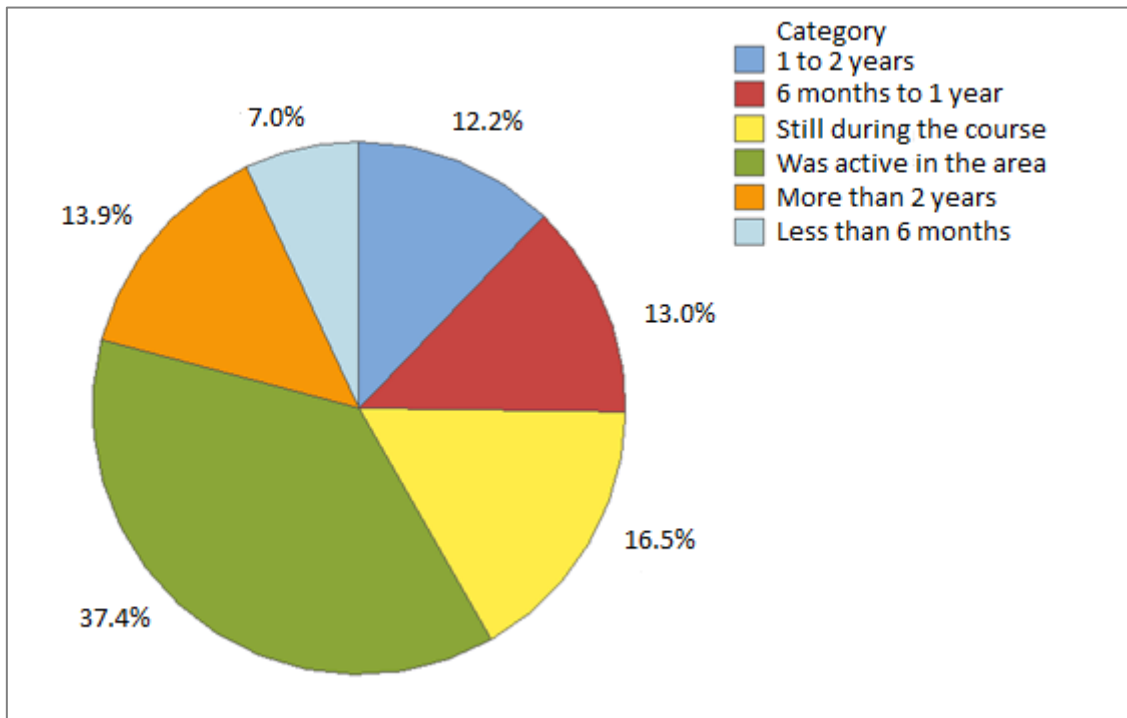
Source: The Authors, 2023.

Regarding the positions held within the company, the function of environmental analyst can be highlighted as the most exercised (28%), corroborating the study by Prado Filho et al. (2012), who believe that this position, in an organizational structure, is a reflection of the non-valorization of the environmental engineer in the professional framework of the company, which invests in this area only what is provided for by law and / or required by some desired certification. This scenario corroborates the large number of autonomous positions and majority partners occupied by the graduates, which are related to the growth in the number of environmental consulting companies.

Bressane et al. (2021) presents that the career of the environmental engineer fits as an environmental consultant by the fact that he performs a wide variety of functions, these being related to the multidisciplinary teaching in his graduation, addressing topics ranging from the collection of data in the field to the treatment and compilation of reports and plants.

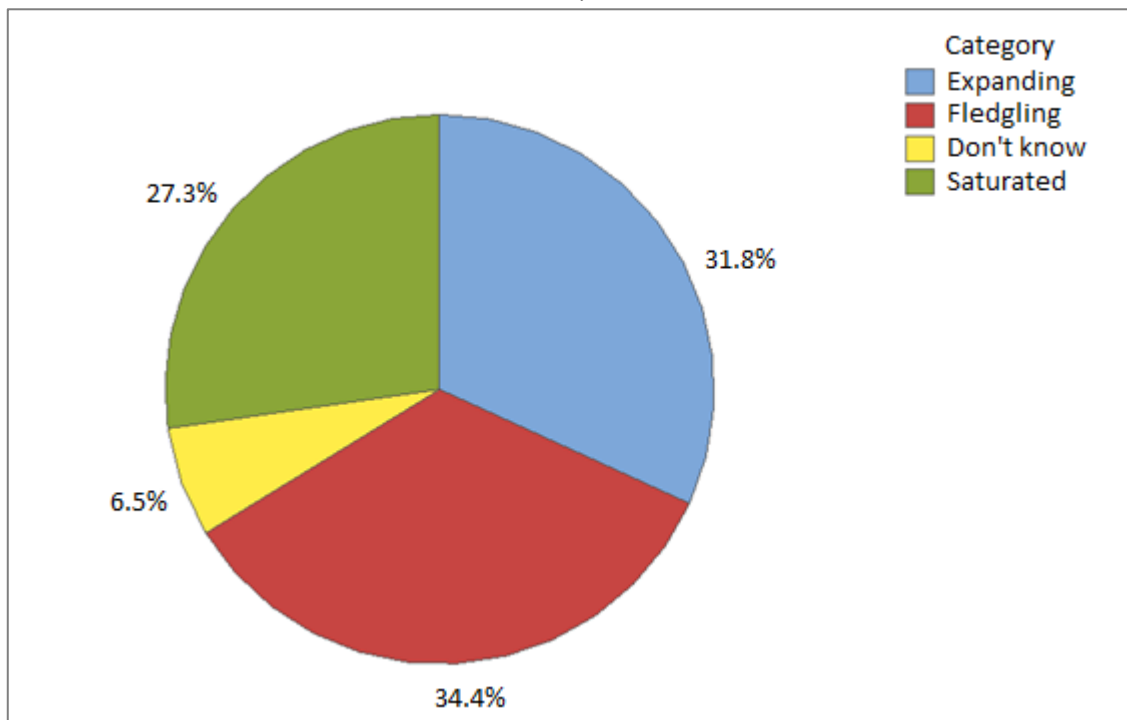
Regarding the salary range, it is noted that the vast majority of professionals receive up to R\$3,000.00. This fact, as well as those presented by Prado Filho et al. (2012), is related to the supremacy of environmental analyst positions in private companies. In addition, the highest salary ranges, as presented by the author, are provided to graduates with more time since graduation. Figure 5 shows the time taken for these professionals to enter the labor market and, in Figure 6, how they judge the opportunities according to the activities.

Figure 5 – Times spent for the egress to integrate the labor market



Source: The Authors, 2023.

Figure 6 – Vision of the graduates before the opportunities of the environmental engineering market in the present day

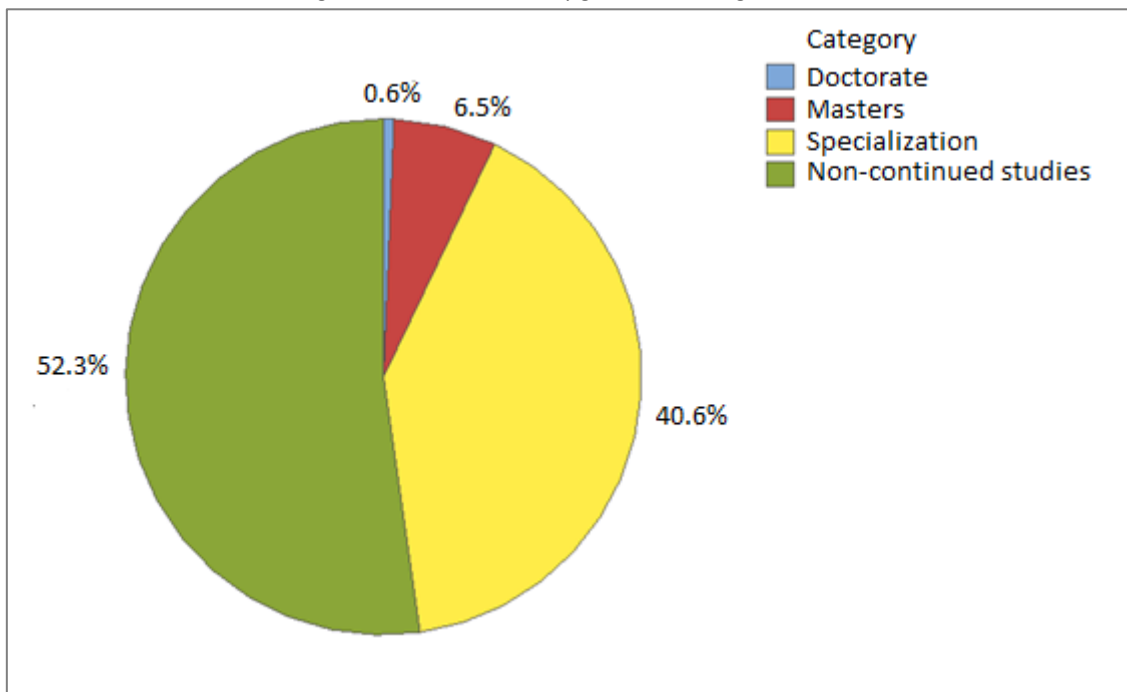


Source: The Authors, 2023.

In view of the results, it is noted that most of the professionals analyzed already exercised some activity in the area. These positions, considered as technical, corroborate the growth opportunities linked to the public policies proposed in the last decade, with new chances to leverage the career through an undergraduate degree. Thus, many professionals who were already in some kind of technical position in the environmental area in the private sector, sought, through graduation, professional improvements and career progressions.

This scenario is opposite to that of the professional who was not in the market, given that only 7% of the graduates got vacancies in the area within 6 months after graduation. Regarding the current situation of the labor market, although most professionals believe that the area is expanding, many of them (27%) classify it as saturated, and this prospection may be related to the difficulty of these professionals in finding some job in the training area. In addition, approximately 55% of the professionals mentioned above do not consider Environmental Engineering as a promising career, presenting a possible discouragement of graduates in relation to the area. Figure 7 shows the path followed by the graduates after graduation.

Figure 7 – Paths followed by graduates after graduation



Source: The Authors, 2023.

As much as the current job market requires the training of its professionals, and approximately 60% of the graduates respond to have already taken some type of short course after the end of college, when it comes to specializations, master's and doctorate, it is verified that few professionals, in fact, seek improvement in a specific area, with master's and doctoral degrees. In addition, although the number of graduates with specializations is high, many are those who, after graduation, did not seek to enter any type of specialization. That is, as much

as it is notorious that the market is increasing the demands regarding professional training, few are those who seek such improvement.

In this sense, Cruvinel et al. (2014) mentions that, in the face of major industrial and economic changes in industries, it is important that the professionals of these organizations adapt to the new globalized scenario of competitiveness, specializing and becoming multidisciplinary, because the required competencies become, increasingly, elevated. In this way, companies are shaping the profile of this professional according to their needs.

Finally, approximately 60% of the graduates who answered the questionnaire evaluated the curriculum of the environmental engineering course with suggestions for changes, given the multidisciplinary nature of the course. Thus, these professionals believe that the difficulty in entering the labor market lies in the multidisciplinary nature of the course, with low specialization in specific themes. Thus, Table 1 presents the suggestions of environmental engineers for the curriculum.

Table 1 – Greater amounts of suggestions from graduates regarding the change in the curriculum of the Environmental Engineering course

Need for disciplines focusing on:	
Botany	Environmental expertise
Sustainable buildings	Public Policies in the environmental area
Development of renewable energies	Environmental Chemistry
Geotechnics	Occupational Safety
Environmental Licensing	Public Policies in the environmental area
Environmental modeling	Water and sewage treatment
Environmental Chemistry	Treatment of agricultural waste
Occupational Safety with a focus on environmental risks and ergonomics	Treatment in contaminated areas
GIS and environmental applications	Topography

Source: The Authors, 2023.

Given the scenario exposed, it is worth noting that engineering professionals, in general, work in a range of activities. However, the environmental engineer, because it is considered as a multidisciplinary area and also encompasses other areas of training, has not yet found a foundation for its curriculum, which ends up involving other areas of science, such as geography and biology.

Thus, it is believed that the indications of the need for disciplines with more focus on a given subject are more related to the personal desire of the graduate than to the interest of changing the curriculum itself, because it is believed that the multidisciplinary nature of the course makes the profile of the environmental engineer generalist, qualifying him to work with professionals from the most diverse areas.

4 CONCLUSION

The multidisciplinary training of the environmental engineer is being directly reflected in the demands of the labor market, which seeks professionals who have a holistic and systemic view. Therefore, given the number of professionals who are graduating per year, it is believed that the number of unemployed environmental engineers is related to the requirements imposed by the labor market, so that the most prepared stand out.

The fact that short-term training courses are no longer ensuring the presence of these professionals in the market makes many of them believe that the increase of disciplines focused on the demands requested by the labor market could alter the high unemployment rate of graduates of the course.

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