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Perception of engineering students on patenting technological innovations: An Analysis of the Problem.

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Abstract:
This article investigates the level of understanding of engineering students at a Northern University Center in relation to the process of patenting technological innovations. The main objective is to show the level of understanding of engineering students at a Northern University Center in relation to the process of patenting technological innovations. The proposal aims to contribute to the dissemination of essential information about intellectual property and entrepreneurship, areas in which students demonstrate little or no knowledge. By applying a questionnaire and evaluating the results, it will be possible to identify specific areas in which students present difficulties and lack of knowledge. Based on this information, an appropriate educational strategy will be developed, aiming to provide students with the necessary knowledge to understand and deal effectively with the process of patenting technological innovations. This approach seeks not only to fill students' knowledge gaps, but also to promote a culture of entrepreneurship and intellectual protection, essential for the development of innovative technologies and products.

Key Word*: Innovation; intellectual property; patents; entrepreneurship; engineering; Manaus, Amazonas.*

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I. Introduction

"The commercialization of innovative products without proper patent registration represents a considerable risk for entrepreneurs, leaving them vulnerable to unauthorized imitations and the loss of opportunities in the market" [1] This reality turns the commercial environment into a minefield for individuals presenting innovative ideas, both inside and outside the academic environment, especially when there is a lack of understanding about the patenting and intellectual property process.

A patent, a privilege granted by the government to inventors or holders of specific innovations, plays a crucial role in protecting intellectual property rights. In Brazil, this privilege extends for 20 years for Invention patents and 15 years for Utility Model patents, aiming to limit the use, production, sale and distribution by third parties without due authorization [2]. This protection system is essential to promote an environment conducive to technological and creative development, encouraging innovation in various areas.

However, the patent registration process in Brazil is complex, costly and time-consuming, taking months or even years to complete. The number of patent applications in the country, compared to other nations, reveals a significant disparity. While in 2020 Brazil registered a total of 28,353 requests, the United States, in the same period, reached around 644,003 registrations [2].

This discrepancy not only reflects the lack of stimulus and investment in technological innovation in Brazil, but also highlights an unequal distribution in technological progress between the country's regions. While states such as São Paulo and Rio de Janeiro lead in the number of registrations, other regions, such as Amazonas, have significantly lower numbers

Lack of knowledge about patenting practices limits the ability of entrepreneurs and innovators to protect their creations effectively. This scenario highlights the urgent need for awareness and education about the value

of patents and intellectual property, especially among future entrepreneurs such as engineering students. The intrinsic connection between innovation and entrepreneurship must be explored and promoted more vigorously.

This initiative will be a fundamental step to assess students' familiarity with the concepts of intellectual property and its implications for entrepreneurship, analyze students' perception of the importance of protecting intellectual property for technological and economic development, and, in the end, verify and propose educational strategies that can promote greater awareness about patents and intellectual property among engineering students at a University Center in Manaus.

II. Material And Methods

This study adopted a quantitative approach to investigate the level of knowledge of engineering students at Centro Universitário de Manaus about patents and intellectual property. An online questionnaire based on the Likert scale was applied to collect data on students' understanding and familiarity with the patenting process, as well as their perception of the importance of protecting intellectual property for entrepreneurship and innovation.

The participants in this study were students enrolled in engineering courses (civil, electrical, production, computing and mechanics) at a University Center in Manaus selected for convenience.

To present a safe confidence level, a sampling statistics calculation was applied to verify the minimum number of respondents, in this calculation, the confidence level (Z) was added at 80%, for a population of 870 engineering students from a University Center of Manaus, for a margin of error of 5%, it was concluded that the questionnaire should be applied to 119 students, which corresponds to approximately 13.67% of the population of students enrolled in the Institution's engineering courses.

The data collection instrument used a structured questionnaire with a total of 16 questions, two of which focused on the period in which the respondent is enrolled, and which course the student is enrolled in. The questions addressed questions focused on entrepreneurship, innovation, intellectual property and patents and the questions were presented in a multiple-choice format using Likert scale items (I completely agree, I agree, I cannot give an opinion, I disagree, and I completely disagree). No sensitive personal information was collected in the questionnaire.

The collected data were analyzed using descriptive and inferential statistical techniques. Measures of central tendency, such as mean and standard deviation, were used to describe the students' level of knowledge. Furthermore, correlation and regression analyzes were carried out to explore possible relationships between variables.

This article was guided by the doctoral dissertation developed in 2022 at the Pontifical Catholic University of Rio Grande do Sul, developed by Giovana Fernanda Justino Bruschi, with the title Innovative university: the perception of the public involved in relation to the strategic orientation for innovation.

It is important to recognize that this study could be subject to some limitations, such as participant selection bias and limitations inherent to the use of self-reported questionnaires. Furthermore, the results of this study may specifically reflect the understanding of engineering students at a University Center in Manaus and may not be generalizable to other populations or contexts.

III. Result and Discussion

The form was applied from March 22, 2024, to April 17, 2024, to 4th to 10th engineering students at a University Center in Manaus, and at the end of April 17, a total of 120 responses were collected/ person, which corresponds to 80% confidence in the statistical calculation made by the team. To begin the analysis, one question per theme was chosen and applied in the questionnaire. The questions were selected according to their level of difficulty regarding the subject. The first question chosen was from the Innovation theme, the question chosen was: "Can the implementation of new technologies stimulate innovation?"

In this question the following percentages were obtained: of120 responses, 67.5% completely agree, 30% agree, 0.83% of respondents, I cannot give an opinion and 1.67% disagree (Table 01).

Table 01 – analysis of the question "can the implementation of new technologies stimulate innovation?" applied percentages to assess students' knowledge on the topic of innovation Source: Own authorship 2024

Can the implementation of new technologies stimulate innovation?	
I fully agree	67.5%
I agree	30%
I can't give an opinion	0.83%
I disagree	1.67%
I completely disagree	0%

Transforming these percentages into quantities of responses, 81 people fully agree, while 36 people agree, 1 person could not give an opinion and 2 people disagree. This presents a positive scenario regarding knowledge on the topic among undergraduate students at the college. A survey that is similar to that carried out by [3] on "The Perception of the Public Involved Regarding Strategic Orientation for Innovation", where a form was applied to measure the agreement of a percentage of the academic population regarding innovation, in his questions are applied to situations that can be points of improvement for innovation in the university environment, as in the dissertation, there is a positivity among academics on the subject, presenting a question that may be similar to the question in this article "Does the university promote disruptive innovations (very differentiated) that impact society" which received approval from 57% and disapproval from 18% in its application. [3] Completes his analysis with the following sentence taken from one of his interviews: "We have a network of technological incubators and in this network, we have companies created from incubation, we have a set of training, training and dissemination programs for entrepreneurial education, of entrepreneurial training, this whole group, the entire internal innovation ecosystem, I think there is a lot of activity".

Another article necessary for this comparison is "Facilitators and hinderers of entrepreneurship: the perception of students on the administration course at a university in Rio Grande do Norte", from [4] in this article, addresses the knowledge of students on the administration course at a University in Rio Grande do Norte, and there is a question asked to the students that directs to the topic addressed in this discussion: "I have a innovative idea and I believe I would make money from it", in this article, 129 students answered the questions, and out of 129, 11.6% strongly disagree, 14.7% disagree, 22.4% cannot give an opinion, 31% agree and 20 .1% fully agree, the article also adds "Although the previous questions showed that the respondents have technical knowledge, skills and interest in opening their own business, many of them do not have knowledge about the entrepreneurship laws in the country, that is, they do -it is necessary for them to seek more specific knowledge about the laws and aspects of entrepreneurship, before starting their first business and/or developing an idea." [5] highlights that, to be able to do something in common, it is necessary to build the conditions of time, be it the time to elaborate the questions to which answers are sought, or the time to investigate a problem that leads to the search for new knowledge. The university needs to be the place to think about things that cannot be thought about elsewhere. This is the mark of its distinction.

Within this comparison, it is important to inform that on the one hand, we have a university with an initial structure to foster innovation and on the other, we have a university that does not develop this ecosystem, which means that students from the northern university center only need guide to continue the path of innovation.

The second topic covered in the research was entrepreneurship, but in this context, we preferred to present a question that linked entrepreneurship with innovation, the statement applied in the questionnaire was: "I understand that entrepreneurship and innovation are closely linked and are essential for boost economic growth." In this question, the following percentages were obtained: of the 120 responses, 53.33% completely agreed, 40% of respondents agreed, 5% were unable to give their opinion and 1.67% disagreed (Table 02).

Table 02 – analysis of the question "I understand that entrepreneurship and innovation are closely linked and are essential to boost economic growth." applied percentages to assess students' knowledge on the topic of entrepreneurship and innovation Source: Own authorship 2024

I understand that entrepreneurship and innovation are closely linked and are essential to driving economic growth.	
I fully agree	53.33%
I agree	40%
I can't give an opinion	5%
I disagree	1.67%
I completely disagree	0%

Transforming these percentages into number of responses, 64 people responded that they completely agreed, 48 agreed, 6 were unable to give an opinion and 2 disagreed with the statement. Comparing with the research carried out by [3] we have a question that is similar to the theme of entrepreneurship and innovation aimed at the university environment: "The university has a strategic and innovative and entrepreneurial vision of the future." The responses were collected as follows: 14% completely agreed, 50% agreed, 18% neither agreed nor disagreed, 16% disagreed and 3% completely disagreed.

To conclude, on the topic of entrepreneurship, we continue with a question from the article by Gomes, [4] where the following question was applied: "Do I have the technical knowledge to manage my own business", of the 129 students, 2.3% completely disagree, 9.3% disagree, 25.5% do not can give their opinion, 48.8% agree and 13.9% completely agree.

In the statement applied at the University Center of Manaus, the answers were less dissolved, in the other statements/questions applied in the dissertation and article it is possible to verify that there are necessary points that must be addressed in the courses, regardless of the course, as entrepreneurship must be applied by all in their respective areas, and the university/university center must be the necessary watershed for academics.

The third question addressed was Intellectual Property, the question evaluated here in this article was the following: "Intellectual property is legal protection, it is important to protect creations and innovations. How much do you agree with the statement?"

Table 03 – analysis of the question "Intellectual property is legal protection; it is important to protect creations and innovations. How much do you agree with the statement?" applied percentages to assess students' knowledge on the topic of intellectual property Source: Own authorship

Intellectual property is legal protection, it is important to protect creations and innovations. How much do you agree with the statement?	
I fully agree	47.5%
I agree	43.34%
I can't give an opinion	7.5%
I disagree	0.83%
I completely disagree	0.83%

According to Table 3, it can be seen that 47.5% of respondents fully agreed with the statement, while 43.34% agreed, 7.5% were unable to give their opinion, 0.83% disagreed and 0.83% strongly disagreed. Transforming these percentages into numbers of respondents, we have the following numbers: 57 people fully agreed, 52 agreed and 9 did not know how to give their opinion, 1 disagreed and 1 completely disagreed. It is noted that there is an increase in the percentage of the option I cannot give an opinion compared to the other two topics discussed previously (entrepreneurship and innovation), it was also noted that we have two answers in disagree and completely disagree.

This statement aims to begin the analysis of knowledge about patents, and to compare with the question asked, there is an article entitled "Study on the Knowledge about Intellectual Property with Design Graduates in a Bachelor's Course in Pernambuco", in its translation "Study on Knowledge about Intellectual Property with Design Graduates in a Bachelor's Degree Course in Pernambuco" written by [6]. This article addresses the topic of intellectual property among students on the designer course, a preliminary question, in addition to two questions going into the topic, one about brands and the other about design industry. The previous question was related to the copyright of the designer's creations, whether they were affected by the rights, to this question 21% claimed that they were affected once or twice, while 92% reported that they would like to have their creations protected against illegal copies.

Assessing this scenario, of a course that creates many industrial brands and designs, it is indeed a warning that the academic community needs to give more emphasis to the themes covered in this article. Another study that highlights the need to apply knowledge in universities on the subject is "I Don't Know but I Want to Know: A Study on the Knowledge of Technical Education Students on Intellectual Property" [7], this study was applied in technical education. In the questionnaire made available, students were asked about the approach to teaching about intellectual property, or even whether the topic is covered in the course. In this question, students could choose all topics that apply.

A significant number, corresponding to 109 respondents, that is, 50.7%, indicated that they did not remember topics related to intellectual property being covered in their course. Next, 29.3% (63) of respondents indicated that intellectual property topics are covered in other subjects, 24.7% (53) indicated that the topic is covered with some instructions before a research project, 22, 3% (48) that the questions are integrated throughout the course, 13.5% (29) that in the form of some lectures/workshops throughout the course.

Comparing now with the answers to the questionnaire applied to research these articles, it can be seen that knowing about the topic is important, but going deeper is necessary. Finally, there are the questions applied on the topic of patents, in this topic, 4 statements were developed, in these statements there was a greater number of answers indicating that they did not know how to give an opinion, according to the question chosen for analysis:

"I am aware that the process of obtaining of a patent involves submission of an application, analysis by the competent authority and eventual granting or rejection of the patent."

Table 04 – analysis of the question "I am aware that the process of obtaining a patent involves submitting an application, analysis by the competent authority and eventual granting or rejection of the patent." applied percentages to assess students' knowledge on the topic of patents Source: Own authorship.

I am aware that the process of obtaining a patent involves submission of the application, analysis by the competent authority and eventual grant or rejection of the patent.	
I fully agree	46.67%
I agree	40.83%
I can't give an opinion	11.67%
I disagree	0%
I completely disagree	0.83%

In this topic, the answers were more dissolved between the options, the other questions had some answers in the disagree and strongly disagree options, but we continued to choose the question according to its level of difficulty and that is why this statement is being evaluated. Transforming these percentages into quantitative numbers, we have the following numbers: 56 people completely agree, 49 agree, 14 did not know how to give their opinion and 1 completely disagreed.

In, "I Don't Know but I Want to Know: A Study on the Knowledge of Technical Education Students on Intellectual Property" [8] students are asked about two possible scenarios, "Imagine that you created an important invention in your area of study, and you want to publish an article about what you have just invented. How do you think you should act first?" In this scenario, 73% (157) of respondents think that what should be done first is to make sure that the patent for the invention has been granted and only then publish the article. Only 24.7% (53) of respondents believe that they must make sure that the patent application request has been made, and thus, publish the article. These percentages are worrying, as it appears that there is no prior knowledge about the practice.

The data presented in the questionnaire can be evidenced at the state level. In the database of the National Institute of Industrial Property, the body responsible for analyzing and granting patents, we have the following data taken from the Resident Deposits Ranking Panel, preliminary analysis for the year 2022: Amazonas, in the year 2022 deposited in its entirety 575 types of protection, of this total, 562 trademark types were deposited, 4 industrial design types, 5 utility models, 2 computer programs and 2 invention patents, as shown in the figure below:

Figure 01 – Ranking of depositor's resident in the state of Amazonas in 2022 Source: National Institute of Industrial Property (INPI) 2024.

As shown by the results of the questionnaire, articles, compared dissertations and INPI data, there is a level of knowledge about the topics discussed in this article. However, these percentages are relatively low. This situation can be attributed to the lack of allocation of resources from the Manaus University Center to develop students in these topics.

IV. Conclusion

The analysis of the knowledge of Engineering students at a University Center in Manaus about patents, innovation, entrepreneurship and intellectual property revealed the need for tools and methods to develop and disseminate these topics. Although students have a good understanding of most subjects, their knowledge of patents is relatively lower. To support this knowledge, a booklet was formulated that guides, step by step, how to register and deposit patents at INPI.

In addition to the booklet, other ways of disseminating knowledge include holding lectures and seminars with experts, workshops and practical courses, partnerships with companies and research institutions, and mentoring programs where experienced professionals guide students on innovation, entrepreneurship and patent registration. The development of e-learning modules and online platforms can facilitate access to knowledge, while innovation fairs and startup competitions within the university encourage students to develop and present their innovative ideas. Furthermore, the integration of intellectual property, innovation and entrepreneurship topics into course curricula ensures that all students are exposed to these topics.

These initiatives, in addition to the primer, can amplify students' understanding and engagement with patents, innovation, entrepreneurship and intellectual property, better preparing them to face challenges and take advantage of opportunities in the market. Educational institutions play a crucial role in the education and preparation of students, fostering innovation and entrepreneurship as drivers of economic and technological development.

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Attachment

Qr Code that directs to the first version of the Booklet