

KNOWLEDGE TRANSFER AND TEACHING IN FIRST AID AND PREHOSPITAL CARE IN THE ENGINEERING COURSES

TRANSFERÊNCIA DE CONHECIMENTO E ENSINO EM PRIMEIROS SOCORROS E CUIDADOS PRÉ-HOSPITALAR NOS CURSOS DE ENGENHARIA

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ABSTRACT

This study's purpose is to present a case report, developed in a higher education institution in Brazil and centered on spreading knowledge about first aid among a group of Engineering students, offering a perspective of prevention regarding dangers and hazards in general. It analyzes a project at the Federal University of Technology - Paraná, in Brazil, involving students in engineering courses. The central modules approached are: basic concepts of first aid; clinical emergency; convulsive crisis, intoxication and sudden onset; fractures, hemorrhage control and immobilization of the injured; and burns, bandages, and transportation of the injured. Thus, in times of accidents, while specialized help goes to the place in need, these students become able to apply the knowledge acquired.

KEYWORDS: First Aid, Teaching in Engineering, Collective Health, Prehospital Care.

RESUMO

O objetivo do estudo é apresentar um relato de caso, desenvolvido em uma instituição de ensino superior no Brasil, com foco na transferência de conhecimentos sobre primeiros socorros entre um grupo de estudantes de engenharias, oferecendo uma perspectiva de prevenção em relação aos perigos e seus riscos em geral. Foi analisado um projeto na Universidade Tecnológica Federal de Tecnologia - Paraná envolvendo estudantes nos cursos de Engenharia. Os módulos centrais abordados são: conceitos básicos de primeiros socorros; emergência clínica; crise convulsiva, intoxicação e mal súbito; fraturas, controle de hemorragia e imobilização do ferido; e queimaduras, ataduras e transporte dos feridos. Deste modo, nos momentos de acidentes, enquanto o socorro especializado se direciona ao local necessitado, esses estudantes tornam-se aptos para aplicar o conhecimento adquirido.

PALAVRAS-CHAVE: Primeiros Socorros, Ensino em Engenharia, Saúde Coletiva, Atendimento Pré-Hospitalar.

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INTRODUCTION

Every day, human beings are exposed to dangers and hazards of different types and intensities in their commute from a place to another, in the work environment, at the university, among others. Danger can be defined as a potential threat to one's physical and psychic integrity and welfare, whereas hazard is the probability of adversities or accidents to occur (MARANDOLA JÚNIOR; HOGAN, 2004).

In their commute, dangers may lie on the road, urban violence, or environmental disaster. In the workplace, contact with products, machines, tasks, and operational or non-operational activities may cause them, in addition to physiological disorders. Due to the specific reasons in each of these contexts, human beings may be exposed to one or multiple hazards and have their safety and health affected.

Regardless of the danger, it is crucial to identify hazards whenever possible and manage them accordingly. Therefore, preventive actions are essential, followed by corrective actions, to minimize impacts and harms to humans or dispense the necessary care as a person, citizen, worker, or user.

With that in mind, it is possible to observe that the origin and the classification of hazard sets are multidisciplinary. Studies in anthropotechnology (science of aspects intrinsic to the collaborator in relation to how they absorb technological changes and how their physical and mental welfare is affected by those changes) (VIDAL, 2012), ergonomics (science whose purpose is to adapt the work environment to human beings consciously, safely, and comfortably) (IIDA; BUARQUE, 2016), public health (set of expertises for detecting illnesses, health conditions, treatments and procedures directed at the population) (DAHLBERG; KRUG, 2006), among others, have the purpose of benefiting human beings considering their physical and psychic limitations.

Therefore, it has been necessary to create mechanisms to minimize hazards and their consequences to human health, as well as acting adequately in situations of damage to health employing first aid procedures and prehospital care. Organizations of aid and rescue seek to meet needs, especially those related to emergency care in cases of accidents (in places like roads, households, and companies) or catastrophes. Although they are prepared to provide prehospital care, an approach of raising awareness about the prevention of hazards and the ways to act facing them or their consequences is always fundamental.

In developed countries, the knowledge about first aid practices has been introduced to not only healthcare professionals but also to basic education personnel at schools, shaping citizens who are aware of how to act in an emergency (AZHAR; CHOUDHRY, 2016). One of the reasons is the higher incidence of natural disasters, but they are not the only source of damage to human beings.

On the other hand, in developing countries like Brazil, this type of training is limited to healthcare professionals, in specific organizations of aid and rescue or at companies via basic tutorials. It is necessary to transfer knowledge, both to healthcare staff and the general populace, bearing in mind that the United Nations (UN) determines that ensuring the community's health, safety, and welfare is mandatory, especially through prevention (LEIVA et al., 2014).

The knowledge of how to act facing hazards and their consequences has become crucial, seeing that it aids people in accidents and emergencies until the arrival of the Fire Brigade, the SAMU (*Serviço de Atendimento Móvel de Urgência* - Service of Urgent Mobile Aid), or other emergency aid professionals. The more people know and prepare themselves for providing first aid, the safer the environment becomes for all.

This study's purpose is to present a case report, developed at a higher education institution in Brazil and centered on spreading knowledge among a group of Engineering majors regarding first aid, offering a perspective of prevention of dangers and hazards in general.

In higher education students contact with first aid practices and procedures occurs only in health areas, implying the lack of knowledge for students in other areas, such as Engineering. These students work mainly in productive companies, but are inserted in the various environments of society. Thus, in times of accidents, while specialized help goes to the place in need, these students become able to apply the knowledge acquired.

The scientific contributions presented by this paper include: i) No other similar studies, approaching the teaching of first aid to people who did not belong to the healthcare field, were found; ii) The adopted project, named SOS - UTFPR, is detailed and described, aiding the interested parties; iii) The study results from the diffusion of theory and practice toward knowledge transfer, teaching, training, generating information about techniques and procedures of first aid, rescue, and especially the prevention of hazards and accidents. It comprises approaches to work hazards, human physiology, and natural disasters (fires, landslides, floods, among others).

METHODOLOGY

Research methods

This research is both theoretical and practical. In terms of goals, it is exploratory and descriptive, seeing that it seeks information and attributes regarding the subject (PAGANI et al., 2018).

In terms of technical procedures, the research is bibliographical, due to the use of the databases such as ScienceDirect, Scopus, Web of Science, Emerald, PubMed, and Scielo, documentary, and a case study, considering that it analyzes a theoretical approach in a real context.

Methodological procedures

Theoretical research

The literature review employed structured protocols (PAGANI et al. 2018).

The searches on the databases ScienceDirect, Scopus, Web of Science, Emerald, PubMed, and Scielo adopted the following keyword combinations:

- i) "Teaching" AND "engineering" AND "first aid";
- ii) "Teaching" AND "prehospital care" AND "engineering academics";
- iii) "Prehospital care" AND "engineering course" AND "discipline";
- iv) "Teaching" AND "prehospital care" AND "university students";
- v) "First aid" AND "engineering academics";
- vi) "Discipline" AND "first aid" AND "university academics", and;
- vii) "*Primeiros socorros*" AND "*acadêmicos*" AND "*engenharia*".

On the six databases, the basic filtering parameters were: a) Keywords entered as "Title-Abs-Key", and, b) Period of publications "all years" ≤ May 2019.

The search, employing the seven keyword combinations on the six databases, led to a portfolio of papers, which were then read in their entirety to gather data for the discussion.

Practical research

First, this study gathered data through an unsystematic observation of the 2nd Scientific Technical Seminar on Disaster Prevention and Protection. This seminar takes place yearly and features the participation of the main national military authorities in the fields of emergency care (aquatic, terrestrial, and aerial), promoting safety against disasters and extraordinary events.

Other events observed were the training sessions offered by the PAM (*Plano de Auxílio Mútuo* - Plan of Mutual Aid) in the 2017-2019 period, at their monthly meetings organized at the Fire Station with all the participant companies. These meetings provided knowledge regarding contingency plans, chemical products and their hazards, fire drills, gas leaks, evacuation plans, care for multiple victims, among others, thus creating a group specialized in Disaster Management in the city of Ponta Grossa, Paraná, Brazil. The implementation of the PAM aims to establish an action plan to be followed by industries and public organizations nominally involved in its scope, so as to adopt coordinated procedures that allow for effective emergency control at the industrial center (MACEDO, 1994).

The process of training the individuals responsible for introducing the academic project to the university was necessary to update their knowledge. The introduction occurred in June 2017 at the Federal University of Technology - Paraná, in Ponta Grossa, and the project was named Project SOS - UTFPR.

The Project SOS - UTFPR encompasses theoretical (lectures in classroom and seminars) and practical classes (monthly training sessions, emergency drills, and technical visits to local companies). The project established partnerships between the university, companies, and public organizations like the Fire Brigade, focusing on the PAM and obeying international standards, according to the World Protocol of Prehospital Care of the American College of Surgeons' Committee on Trauma (PHTLS) and the American Heart Association.

After advertising the Project SOS - UTFPR, the enrollment was made available electronically via social networks and the university's platform of digital media. A total of 61 students enrolled in the project. They answered a questionnaire with the purpose of assessing their level of knowledge about first aid, in a micro (at home) and a macro context (at the university, workplace, and other public locations).

Utilizing the responses to the questionnaire, the project planned a textbook and an outline suitable to their reality, as well as a schedule defined by the demand from the students, the available resources, and the requirements of the lectures and training sessions, over a period of 12 months.

RESULTS AND DISCUSSION

Bibliometric analysis

This step analyzes the data from the papers about the theme at hand, the teaching of first aid and prehospital care.

Teaching of first aid

In order to better present the data, the years of publication of the papers were sorted into six-year intervals, as shown in Figure 1.

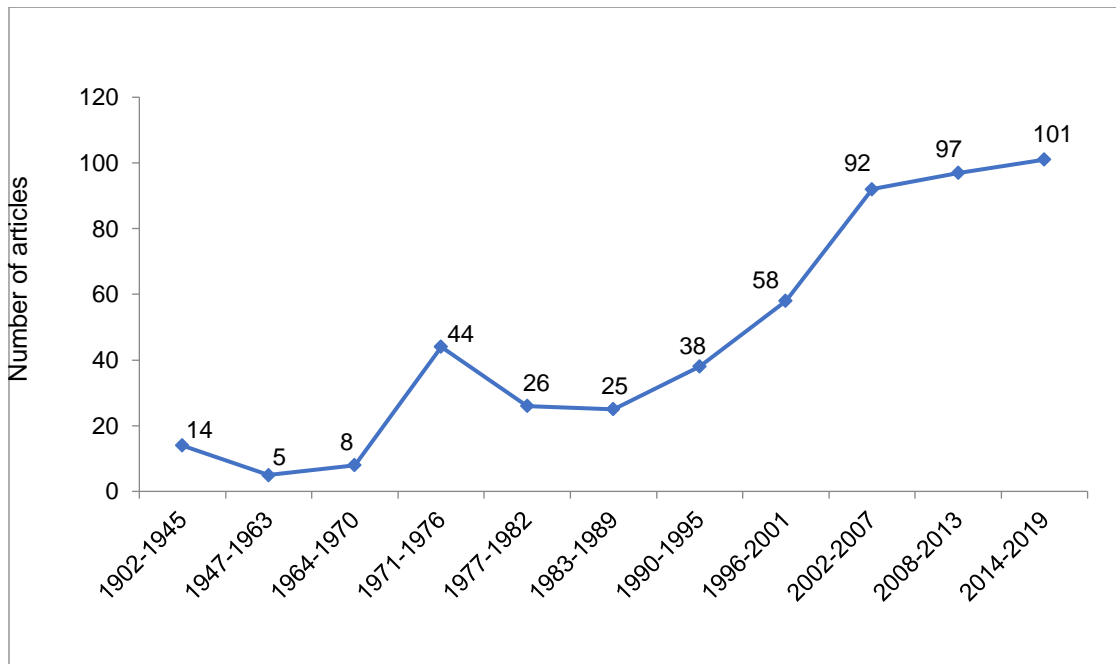


Figure 1. Periods of publication of the papers. Source: Data from Scopus 2018.

The first publication registered on the Scopus platform happened in 1902. The time periods with the highest number of papers published were 2002-2007, with 92 papers, 2008-2013, with 97, and 2014-2019, with 101. The year 2019 only comprises the January-May period, so this number is expected to increase.

Overall, in the 1902-2019 period, the Scopus database registered a total of 508 papers. Most of them belong to the fields of Medicine (423), Social Sciences (60), Nursing (55), Human Sciences (16), and Engineering (13).

Over 100 scientific journals have published studies about the theme at hand. The leading journals with publications on the teaching of first aid were *Resuscitation*, with 27 papers, the *British Medical Journal*, with 14, the *Journal of School Health*, with 11, *Lancet*, with nine, *Burns* and the *Emergency Medicine Journal*, each with eight papers, the *Annals of Emergency Medicine*, with six, and *Academic Emergency Medicine*, with five papers published.

The keywords that best define these papers are First Aid, common to 343 papers, followed by Human (337), Teaching (210), Education (133), and Emergency (25).

Concerning the authors, in a list of over 100 names, the leading authors according to the number of publications are Jorm, A.F., with eight papers published, Kitchener, B.A., with seven, and the authors Jelinek, G.A., Martella, R.C., and Pearn, J., each with four.

Observing the institutional links of the authors who published studies on the theme, the countries that stood out are the United States, connected to 101 papers, followed by the United Kingdom, with 63, and Australia, with 32. Brazil and Italy share the fifth place, with 14 papers published each.

Teaching of prehospital care

Similarly to the previous one, this subsection explores the data from the papers about the teaching of prehospital human care.

The years of publication of the papers were sorted into six-year intervals, as shown in Figure 2.

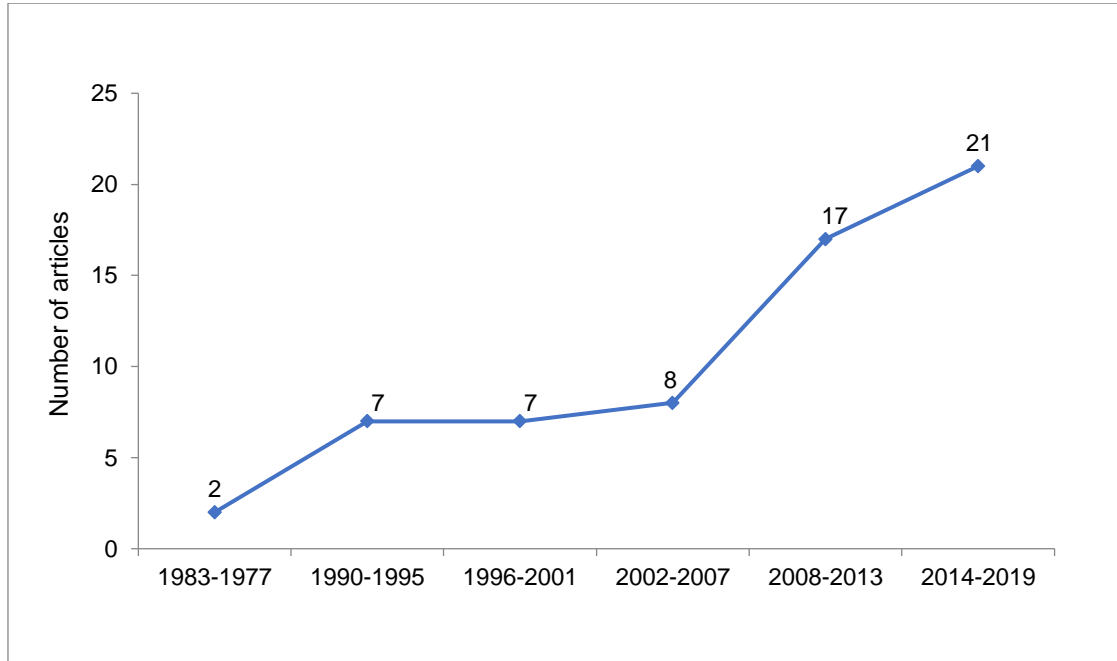


Figure 2. Periods of publication of the papers. Source: Data from Scopus 2018.

Whereas the previous theme resulted in 508 papers found on the Scopus database, the theme of prehospital care teaching returned only 62 papers, with 21 published between 2014 and 2019 and 17 published between 2008 and 2013. The earliest publication was in 1983. The studies belong to only two fields of knowledge, Medicine (61 papers) and Nursing (15 papers).

The foremost journals about the theme of prehospital care teaching were the *Emergency Medicine Journal*, which has published eight papers, *Prehospital and Disaster Medicine* and *Prehospital and Emergency Care*, each with four, and the *Journal of Trauma Injury and Critical Care*, with three.

The leading authors on the theme, as measured by the number of publications, differ from the previous subsection, despite the similarity between the topics of teaching first aid and prehospital care. In the latter case, the authors were Abelson, A., Lindwall, L., and Oteng, R., each having published two papers.

Considering the institutional links of the authors who published the papers found, the countries that stand out are the United States, linked to 29 papers, followed by the United Kingdom, with eight, and Australia, with four. The previous subsection identified the same countries, which illustrates their leading role in human health research, especially about first aid and prehospital care.

The teaching of first aid and prehospital care in engineering courses

The literature review employed six different databases. Table 1 presents the total of papers found via each keyword combination.

Table 1. Number of papers found in each database

Keyword combination	Science Direct	Scopus	Web of Science	Emerald	PubMed	Scielo
<i>“Teaching” AND “engineering” AND “first aid”</i>	0 papers	6 papers	0 papers	0 papers	1 paper	0 papers
<i>“Teaching” AND “prehospital care” AND “engineering academics”</i>	0 papers	0 papers	0 papers	0 papers	0 papers	0 papers
<i>“Prehospital care” AND “engineering course” AND “discipline”</i>	0 papers	0 papers	0 papers	0 papers	0 papers	0 papers
<i>“Teaching” AND “prehospital care” AND “university students”</i>	0 papers	0 papers	0 papers	0 papers	0 papers	0 papers
<i>“First aid” AND “engineering academics”</i>	0 papers	0 papers	0 papers	0 papers	0 papers	0 papers
<i>“Discipline” AND “first aid” AND “university academics”</i>	0 papers	0 papers	0 papers	0 papers	0 papers	0 papers
<i>“Primeiros socorros” AND “acadêmicos” AND “engenharia”</i>	0 papers	0 papers	0 papers	0 papers	0 papers	0 papers

Studies on the teaching of first aid and prehospital care in Engineering courses, or in higher education in general, are lacking except in the fields of human health such as Medicine and Nursing. Table 2 presents the focus of the few papers found on the subject.

Table 2. Studies about the teaching of first aid to engineering majors

Author	Title of the paper	Focus
Tian et al. (2018)	<i>The Development of Electronic Assembly Technology Course Aided by Video and Flash Courseware and Teaching Effectiveness Verified by Radio Assembly and Shakedown Test</i>	Method directed at electrical engineering majors comprising the precautions required in working with electric/electronic machinery, magnetic fields, and professionals of the area.
Hamid (2018)	<i>Effectiveness of Structured Teaching Program on Academics' Knowledge about First Aid at University of Baghdad</i>	Study through an experiment involving two distinct groups of students, each adopting different procedures for first aid programs.

Kureckova et al. (2017)	<i>First aid as an important traffic safety factor - evaluation of the experience-based training</i>	First aid training offered to driver's education students and traffic dispatchers in Czech Republic.
Pate and Lawver (2014)	<i>Promoting Safety in High School Supervised Agricultural Experiences: Teachers' Training and Student Injury Experiences</i>	Basic training offered to the teachers of an agricultural high school. Its purpose is to enable teachers to provide care for students in diverse situations, like snake bites, wounds, injuries, among others.
Hubert et al. (2001)	<i>Texas Entry-Year Agriculture Teachers' Perceptions, Practices, and Preparation Regarding Safety and Health in Agricultural Education</i>	Report on the first aid training of agricultural education teachers. The training sessions were theoretical, involving tutorial videos.

The studies above are lacking in certain aspects. The target public of the instruction was the faculty rather than the students and the techniques employed were shallow and simple. Moreover, they lacked practical lessons, limiting themselves to tutorial videos and lectures. According to Tian et al. (2018), it is absolutely crucial to teach students about first aid procedures, especially to enable them to act in the industry, where they may face adverse situations.

Project SOS - UTFPR

The Project SOS - UTFPR is an extension mode that comprises 124 hours of theoretical and practical classes about first aid, saving and rescue in all types of accidents, in and out of the organization, on the road, at their houses, or any other location in which the student may be. It encompasses the following topics:

- Basic Concepts of Human Anatomy;
- Environment Safety;
- Primary Approach of Clinical Emergency;
- Cardiopulmonary Resuscitation (CPR), use of Automated External Defibrillator (AED);
- Secondary approach, immobilizations, and transportation;
- Convulsion crisis, intoxication, and sudden onset;
- Fractures, hemorrhage control;
- Burns, bandages, and transportation of the injured;
- Firefighting and basic notions of Fire Brigade;
- Evacuation plan and escape routes;
- Emergency drills.

These topics expose the student to an array of knowledge, with emphasis on the human body, environment hazards, emergency procedures, use of basic first aid equipment, among other situations.

A total of 61 students enrolled in the Project SOS - UTFPR. Most of the students (70%) were between 19 and 25 years old, followed by freshmen aged 18 or younger (21.70%). Only 8.30% of the students were over 25 years old.

In addition to Engineering courses, the project included two other UTFPR courses, biology and natural sciences, and the technological courses. Therefore, all of the courses available at the Ponta Grossa campus of UTFPR participated in the Project SOS. They are Chemical Engineering (15 students), Mechanical Engineering (11 students), Production Engineering (eight students), Electronic Engineering (eight students), Biotechnology Engineering (five students), Computer Engineering (three students), Natural Sciences (three students), Biological Sciences (three students), Food Technology (two students), and three other technological courses with one student each, resulting in the 61 enrolled distributed into 12 majors. The Engineering courses (Chemical, Mechanical, Production, and Electronic) presented more participants. They are significant Engineering courses whose students will act mainly in industries that contain hazards of several natures.

Among the 61 enrolled students, 45 answered the questionnaire. It contained ten basic questions regarding the central modules of first aid, with the purpose of assessing the knowledge level of the participants (Figure 3). Those modules are Basic concepts of first aid; Clinical emergency; Convulsive crisis, intoxication, and sudden onset; Fractures, hemorrhage control, and immobilization of the injured; and Burns, bandages, and transportation of the injured.

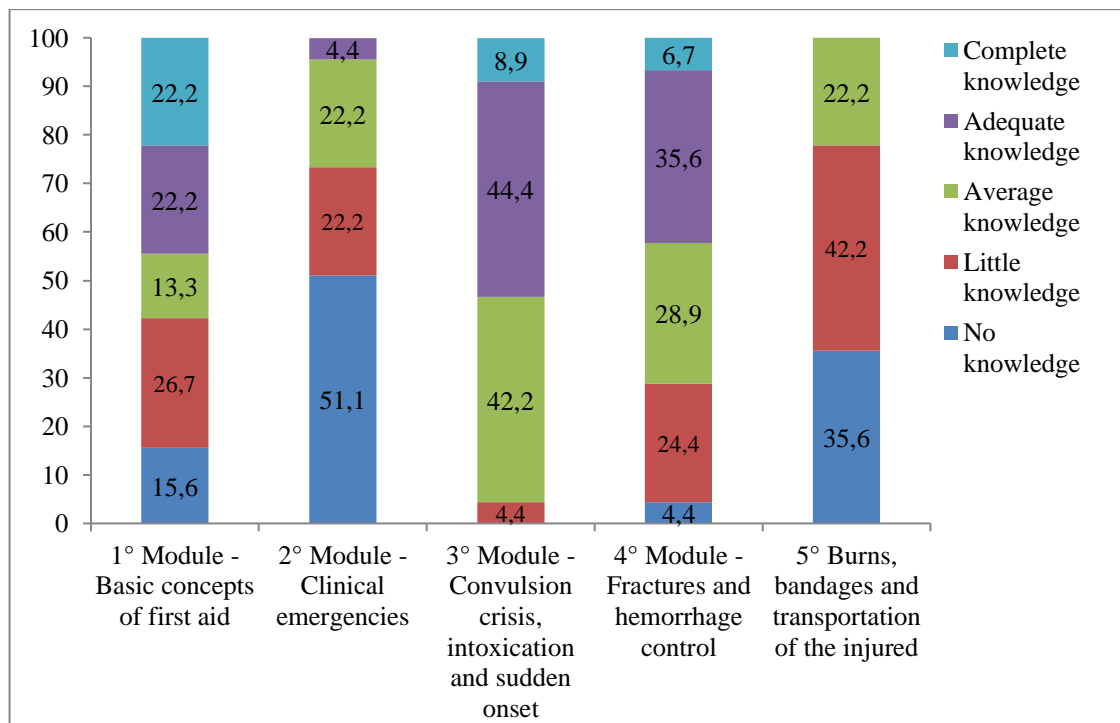


Figure 3. Knowledge level of the students.

Figure 3 shows that the initial assessment sought to ascertain the students' intrinsic knowledge about the theme, judging whether their answers adequately met the guidelines of the World Protocol of Prehospital Care (PHTLS). The questionnaire also found that the students had the least knowledge about the modules Clinical Emergency and Burns, Bandages and Transportation.

On the other hand, a considerable number of respondents declared that they had adequate knowledge or total mastery of the module Convulsive Crisis, Intoxication, and Sudden Onset, followed by the module Basic Concepts of First Aid. This scenario is possibly explained by their direct involvement with the Project SOS - UTFPR, which presents and explores those concepts.

The knowledge of the student group evolved gradually, developing over the months of theoretical and practical classes, tests, emergency drills, and joint participation with the companies belonging to the PAM, which have appreciated the initiative and have been providing the students from the project with opportunities, first hiring them as interns and after as collaborators.

The first positive report about the Project SOS - UTFPR came from a few of the participant companies, which stated that the students would be able to work in the industry at the end of one year of training because they acquired not only knowledge about the trade but also complementary skills concerning health and safety. The students thus become much more competitive in the job market, as shown by the hiring of several of them by the leading multinationals of the city. Moreover, the project also includes approaches to natural disasters, often observed in developed and developing countries.

One of the instructors also described the significance of providing this knowledge to the students. He acted as a volunteer after the catastrophe in the State of Minas Gerais, the rupture of a dam belonging to Vale, a mining company, in Brumadinho, which resulted in 228 confirmed deaths and numerous missing people. In his words, "I knew I could help much more effectively if I were present in the operation."

It is worth mentioning that Project SOS - UTFPR enables and prepares students to act as volunteers in extraordinary cases of adversity, such as disasters that may require them. Brazil is currently lacking in that regard, considering the dam ruptures, collapses, landslides, and floods, among others, as the media has broadcast worldwide.

The environmental disasters of Mariana and Brumadinho, both in Minas Gerais, in 2015 and 2019 corroborate with what the scholar Beck stated back in 1980, predicting the constant conflict about the disregard toward hazards and the premeditated carelessness with problems resulting from modern society. The 21st century carries a higher social appreciation of the term responsibility facing this society of risk, which environmentally-speaking gains magnitude due to the property juridically protected (ALVES, 2019). In the case of an accident, the immediate aid from a spectator may save lives and reduce health damage. First responders may also significantly reduce the arrival time of professional medical assistance by calling them immediately. Therefore, appropriate first aid procedures are an essential aspect of traffic safety (PATE; LAWVER, 2014).

Taking all that into account, it is worth emphasizing that the students are not always at the university. They occupy various contexts, such as roads, industries, households, places of leisure and others, all of which are susceptible to dangers, hazards and their consequences. The Engineering majors receive the technical training necessary to fulfill their professional functions but they lack certain basic concepts of first aid. The Project SOS - UTFPR revealed that it is possible to prepare and train them in that regard, even if in a more succinct manner than a Nursing major, for instance, without discarding the fundamental basic approaches.

CONCLUSIONS

It was possible to observe that this paper achieved its goal by ascertaining the relevance and uniqueness of the theme, as shown by the systematic literature review, which proved that both Brazil and developed countries lack similar classes or projects within the Engineering and

exact sciences field. Even further, it showed that higher education in general lack studies on the subject, with the exception of the fields of Medicine and Nursing.

This study approached the teaching of first aid and prehospital care through a case report on the Project SOS at the Federal University of Technology - Paraná, at the Ponta Grossa campus.

The basic knowledge of hazards, their consequences, and their management is essential in the care of people who are injured, wounded, or needing assistance or guidance. This paper is relevant in that regard, pointing out the need for expanding the teaching of first aid in higher education overall.

The Engineering majors lacked general knowledge in the fields of health and human sciences. Even though the Production Engineering course presents a class on work safety, it is limited to the work environment.

Regarding the positive aspects for the students, the knowledge acquired by them may be useful in their day-to-day, if needed, in addition to their future workplaces (industries). Moreover, they will be prepared to act at the university, providing care for other students, professors or employees, in their homes, for themselves, or even as volunteers in the case of adversity in the community.

At the time of writing, in 2019, the project now has its second class, having gained new monitors. It has established a partnership with companies, due to their appreciation of the initiative. It is also supported by the Fire Brigade of Ponta Grossa in practical training sessions and drills, and by the University in scientific matters. This study has strengthened the link between the government (represented by public organizations like the Fire Brigade), companies, and the university.

CONFLICT OF INTEREST

The authors have no conflict of interest.

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