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GERMANA ARRUDA DE QUEIROZ

What should we be learning about ethics in software engineering and what are we formally studying in the Brazilian academy?

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GERMANA ARRUDA DE QUEIROZ

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Germana Arruda de Queiroz

“What should we be learning about ethics in software engineering and what are we formally studying in the Brazilian academy?”

Dissertação de Mestrado apresentada ao Programa de Pós-Graduação em Ciência da Computação da Universidade Federal de Pernambuco, como requisito parcial para a obtenção do título de Mestre em Ciência da Computação. Área de Concentração: Engenharia de Software e Linguagens de Programação.

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BANCA EXAMINADORA

Profa. Dra. Patricia Cabral de Azevedo Restelli Tedesco
Centro de Informática / UFPE

Profa. Dra. Clarisse Sieckenius de Souza
Departamento de Informática / PUC/RJ

Prof. Dr. Geber Lisboa Ramalho
Centro de Informática / UFPE
(**Orientador**)

I dedicate this work to God, to my parents José Severino de Queiroz and Solange Arruda de Queiroz, to my sisters Rafaela Arruda de Queiroz and Camila Arruda de Queiroz and to my dog Layka for all the unconditional support and encouragement at all times.

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“A imaginação é mais importante que o conhecimento” (EINSTEIN, 1931).

ABSTRACT

Software has a constant, increasingly present influence in our lives. For example, recently developed technologies, such as autonomous cars and social networks, can introduce prejudices, cause breaches of privacy, lead to digital addiction, and introduce other issues. This study aims to identify ethical issues that occur in software engineering and check how this subject is taught in the IT field. A systematic mapping study was conducted. Herein, 744 articles from four databases were returned, 50 of which were accepted for data extraction. Thereafter, we conducted an educational survey with 93 participants and composed a document analysis on the discipline of ethics in 20 Brazilian universities. Based on the data extracted in the review, it was possible to answer the research questions and understand the ethical issues that have been present throughout the last five years. The main ethical issues that can be mitigated through the teaching of ethics in higher education are those pertaining to privacy, awareness, and security. In our survey, we collected opinions from university students and professors. Among the students, 63% reported that the discipline of ethics is important in the curricula of undergraduate- and graduate-level informatics, 61.3% had knowledge about ethics applied to their professional field, 75.3% considered ethics important for IT professionals, 35.5% were interested in pursuing an ethics-related course, 72% did not read the code of professional ethics in any area of information technology, and 47.3% never studied ethics. Among the teachers, 82.3% never taught a specific code of ethics in information technology, 93.1% agreed that a code of ethics is necessary for good professional conduct, and 72% did not have sufficient knowledge regarding ethical issues. The recommendations of the MEC and SBS were reviewed, and it was noted that the recommendations do not provide information on the program, workload and content of the disciplines. The MEC and SBC recommendations were reviewed, and it was noted that the recommendations focus on the student profile at the end of the course. In Brazilians universities the most of disciplines are taught in ethics and society, only 30% of the courses have a workload of 30 hours and there is no standardization at both undergraduate and graduate levels. By combining the information collected, we found that, through systematic mapping, the main ethical issues were privacy and transparency. In the document's analysis, the words that appear most where privacy and intellectual property at the undergraduate level and privacy and responsibility at the graduate level. In the survey and analysis of documents we realized that the students consider the topic of ethics important for undergraduate and graduate courses because most courses have a workload of only 30 hours. The mapping study contributed to evidence the main ethical issues that were discussed in the scientific literature in the last five years, the survey on the opinion of students and teachers contributed to better understanding and suggestions for future changes to obtain greater student interest and greater motivation teachers' professional. Document analysis show that privacy is an issue discussed both in academia and scientific publications, transparency was seen more in publications and not in the syllabus of university courses, other ethical issues were seen as intellectual property and responsibility.

Keywords: ethics; mapping; survey; education; software.

RESUMO

O software está cada vez mais presente em nossas vidas e nos influencia constantemente. Por exemplo, os carros autônomos desenvolvidos e as redes sociais podem introduzir preconceitos, quebrar preferências de privacidade, levar ao vício digital e outras questões semelhantes. Este estudo tem como objetivo identificar os dilemas éticos que ocorrem na engenharia de software e verificar como este assunto está sendo ensinado na área de TI. Foi realizado um estudo de mapeamento sistemático; a pesquisa retornou 744 artigos de quatro bases de dados, dos quais 50 foram aceitos para extração de dados. Além disso, foi realizado um survey na área de educação; obtivemos 93 participantes na pesquisa e ao final foi realizado uma análise documental sobre a disciplina de ética em 20 universidades brasileiras. A partir dos dados extraídos na revisão, foi possível responder às questões de pesquisa e compreender os dilemas éticos que estiveram presentes nos últimos cinco anos. Os principais dilemas que podem auxiliar no direcionamento do ensino da ética no ensino superior foram privacidade, conscientização e segurança. Por meio do survey, foram coletados opiniões de alunos e professores universitários: 63% dos alunos relataram que a disciplina de ética é importante para a grade curricular dos cursos de graduação e pós-graduação da área de informática; 61,3% possuíam conhecimentos sobre ética aplicada ao seu campo profissional; 75,3% consideram a ética importante para os profissionais de TI; 35,5% tinham interesse em fazer curso relacionado à ética; 72% não leram o código de ética profissional em nenhuma área da tecnologia da informação; e 47,3% nunca estudaram ética. A percepção dos professores mostrou que 82,3% nunca ensinaram sobre a existência de um código de ética específico em tecnologia da informação; 93,1% afirmaram que o código de ética e conduta profissional é necessário para uma boa conduta profissional; e 72% não leram muito sobre questões éticas. As recomendações do MEC e SBC foram revisadas, e notou-se que as recomendações focam no perfil do aluno ao finalizar o curso. Nas universidades brasileiras a maioria das disciplinas são ministradas em ética e sociedade, apenas 30% dos cursos têm carga horária de 30 horas e não há padronização tanto na graduação quanto na pós-graduação. Ao combinar as informações obtidas, constatamos que, por meio de mapeamento sistemático, as principais questões éticas foram privacidade e transparência. Na análise do documento, as palavras que mais aparecem são privacidade e propriedade intelectual na graduação e privacidade e responsabilidade na pós-graduação. No survey e na análise de documentos percebemos que os alunos consideram o tema da ética importante para os cursos de graduação e pós-graduação, porém a maioria dos cursos tem carga horária de apenas 30 horas. O estudo de mapeamento contribuiu para evidenciar as principais questões éticas que foram discutidas na literatura científica nos ultimos 5 anos, o survey sobre a opinião de alunos e professores contribuiu para uma melhor compreensão e sugestões de mudanças futuras para obter maior interesse dos alunos e maior motivação profissional dos professores. A análise documental mostra que privacidade é uma questão discutida tanto na academia quanto nas publicações científicas, transparência foi visualizada mais nas publicações e não nas ementas dos cursos universitários, outros dilemas éticos foram visualizados como propriedade intelectual e responsabilidade.

Palavras - chaves: ética; mapeamento; survey; educação; software.

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LIST OF ABBREVIATIONS

ACM	Association for Computing Machinery
IEEE-CS	Institute of Electrical and Electronics Engineers Computer Society
MEC	Ministry of Education
RQs	Research Questions
SBC	Brazilian Computer Society

CONTENTS

1 INTRODUCTION

1.1 Context

Computers are a part of our everyday lives, and their applications in industry, commerce, education, medicine, government, entertainment, home, and offices have been significantly increasing. Many people contribute to the development of the software, either directly as developers or indirectly as teachers (GOTTERBARN, MILLER, AND ROGERSON, 1999).

The development of software is a considerable responsibility because software failure can lead to major losses. In fact, software engineers constantly make ethically loaded decisions in their professional lives, such as collecting user data, designing functionalities with potential adverse environmental effects, and minimising the risks of critical security bugs. These decisions affect people, companies, environments, and our planet at large (McNamara, SMITH, MURPHY-HILL, 2018).

Two examples that illustrate this point are the Uber versus Waymo dispute (O'KANE ET AL. 2018) and the 'Diesel gate' scandal (MANSOURI, 2016). In the first example, Waymo sues Uber because it was found that a former employee involved with Waymo participated in corporate espionage on behalf of Uber. Thus, the two companies settled a lawsuit for $245 million. In the second example, certain diesel-powered Volkswagen vehicles have been programmed to work in two modes, one of which resulted in emission levels above the limit stipulated by American and International regulations. Consequently, the company paid a fine of $30 million.

These examples show that there are many reasons to adhere to ethical practices in software engineering. In fact, it is necessary for software engineers to have expertise in and adhere to a code of ethics to ensure the safe development and use of software (TAHERDOOST et al., 2011).

In 1972, a new code of ethics was designed by the Association for Computing Machinery (ACM) specifically applying to software development. Since the 1980s, computational ethics have been attracting remarkable academic interest (BYNUM, 2016).

In 1997, the ACM and the Institute of Electrical and Electronics Engineers Computer Society established a code of ethics to reduce this gap. This code was developed by the efforts of a multinational company led by IEEE/ACM (GOTTERBARN, MILLER, ROGERSON, 1999; ABERKANE, 2018).

Education and training can help foster a strong level of professionalism, and the research on ethical issues helps establish effective curricula (DODIG-CRNKOVIC AND FELDT, 2009; THOMSON AND SCHMOLDT, 2001; KARIM, 2017). Taherdoost et al. (2011) incorporated an education plan for computer ethics into a software engineering course. Topics including computer crime, privacy, intellectual property, accuracy, morality, accessibility, and awareness were considered for addition to the course (TAHERDOOST et al., 2011). Dodig-Crkovic and Feldt (2009) considered the importance of teaching professional, social, and ethical issues in software engineering. The inclusion of ethics provides professionals with the ability to identify and address ethical problems. Such a course would help develop rational thinking skills and instil a strong sense of professional judgement and decision-making (KARIM, 2017).

1.2 Objectives and method

The technological area has recently evolved, and there have been many problems that need to be solved. Further, there is still a series of discussions about what is possible to do, what should be done, what is moral or immoral, what is ethical and how these concepts materialize both in professional practice and in the educational training of software engineers. These discussions become considerably complicated when there is no global code to solve the problems that arise in this area. These factors motivated an investigation into the knowledge of ethics in the development of software processes and how such ethical issues can be addressed.

Whereas the discussion on ethics in the computing domain is growing worldwide, we are particularly interested in evaluating how it is addressed in Brazil. The ethical issues are probably quite universal, but educational approaches may have an influence of local cultures. So, we decided to restrain our investigation into how ethics have been studied, learned and taught in the computing undergraduate and graduate courses in Brazil. Thus, the ultimate objective of this study is to answer this master research question: how ethics have been studied in the Brazilian undergraduate computing courses? As the scope of this question is too large for a master's thesis, we adopted both scope constraints and a methodological strategy to pursue this objective.

There were different possible methodological paths to developing our research. For instance, we could start by examining ethics teaching and learning in computing courses

abroad, and the compare them with the Brazilian ones. But we are not sure that event the foreign courses are up to date to current ethical issues. We could also interview higher education Brazilian lectures involved in teaching ethics to understand what is being learned with respect to what should be. But, as far as we know, the Brazilian computing lecturers deeply involved in ethics studies are too few, so far. That is why, we took a different methodological path, performing 3 studies, and then, cross their results to draw some conclusions.

First, we decided to understand which are the main ethical issues in computing, looking at the current literature. In our case, we decided to achieve this secondary objective via a mapping study of the literature seeking to enumerate the current ethical issues in software engineering. The idea was to restrain the scope of computing to software engineering, but still remains in a computing domain with a large number of professionals and practitioners. We could have interviewed people in this phase, but this would require any people and there was available literature on the subject.

Second, we thought it might be informative to have a better view of how computing teachers and students currently understand ethics and its importance as a component of professional computing education. To pursue this secondary objective, we decided to run a survey with this public.

As a third secondary objective, it was naturally necessary to census the current course on ethics in Brazilian undergraduate computing departments, which we have done via document analysis of the syllabus of each course mentioning ethics in the main Brazilian departments. Of course, there is no guarantee that the syllabus is up-to-date or that the teachers are really following them, but this is an official source of what is being taught.

Then, finally we could compare what has been formally taught in the courses with the current ethical issues and with what the academic community's perception of the relevance of ethics in computing.

In short, we defined the following specific objectives to better frame and answer our research question:

- Raise the main ethical issues with the literature in the area of software engineering
- Collect information about knowledge and relevance ethics with teachers and students through a survey
- Analyze what formally, via syllabus, is being taught.
- Cross-check all information obtained

1.3 Dissertation structure

This dissertation is organised as follows.

Chapter 1 introduces the context and objectives of this research.
Chapter 2 summarises the basic concepts of ethics, code of ethics, software ethics, education.
Chapter 3 presents the methodological procedures and the results of the systematic mapping.
Chapter 4 presents the methodological procedures and the survey results.
Chapter 5 presents the methodological procedures and results about document analysis
Chapter 6 provides information crossovers
Chapter 7 concludes the thesis with the conclusions, limitations, and future work
References and APPENDIX A - QUESTIONNAIRE

2 BACKGROUNDS

2.1 Ethics in Software engineering

2.1.1 Ethics

The concept of ethics can be defined in several ways, this definition depends on the area and the source. According to the Stanford University Centre for the Study of Language and Information (2015) ethics are related to Philosophy and aims to have an understanding and description of how people should live. Ethics can also be explained as one code of conduct that people must follow and must be guided by a moral guide. For example, making good decisions is considered a very good and desirable thing (HARSANYI, 1977).

In History, several frameworks were created and discussed. The religion influenced in the ethics guide moral behaviour, such behaviour could be defined as something Good or Evil. Each religion (Christianism, Islamism, Ubuntu, Shintoism, Buddhism and among others) has its own framework (LANDAU, 2012). Another definition is given by the Cambridge Dictionary of Philosophy which relates to the term morality and is usually used for meaning the moral principles of a group or tradition.

There are also subdivisions of ethics. There are four traditional branches of ethics (metaethic, descriptive ethics, normative ethics and applied ethics). Metaethics is the attempt to comprehend the metaphysical, epistemological, semantic and psychological presuppositions and commitments of moral thought, discourse and practice (SAYRE-MCCORD, 2014). Descriptive ethics are based on what people think is right or wrong. Human actions may be maintained as acceptable or unacceptable or punishable by custom or statute. Normative ethics are centred on creating theories which provide general moral rules governing our behaviour, such as utilitarianism or Kantian ethics. Applied Ethics is the study of how we should act on specific areas of our life, such as meat-eating, euthanasia or stealing (FISHER, 2011).

The authors Pollice (2006) and Paul and Elder (2006) related ethics as “A branch of philosophy dealing with that is morally right or wrong” and “with ideas about what is a good or bad behaviour”, respectively. As discipline the general perception is that it is “the study of value concepts such as ‘good’, ‘bad’, ‘right’, ‘wrong’, and ‘ought’, applied to actions in relation to the group norms and rules’(VEATCH, 1977). Undeniably, ethic is designed to deal with issues that are fundamental to decision-making. Ethics also refer to the norms that guide societal behaviour.

The relationship between personal identity and ethics is considered as well. The term "ethics" is interpreted in terms of how people ought to live their lives. Self-regarding concerns may take into account those relating to nature and reasons for survival and immortality, advance directives and general caution. Others-regarding concerns can be seen as moral responsibility, interpersonal moral relationships and so on (SHOEMAKER, WITT, DUFNER, 2021).

The studies of ethics also focused on the creation of rules to distinguish between right or wrong. At an individual level and as a professional there are also definitions, at an individual level ethics can be expressed as a person's self-reflection who would like to become a better person and as professional ethics is a formal code of standards of practice as an example: medical ethics in the medical profession or engineering ethics in the engineering profession (QUIGLEY, 2007).

According to Berenbach & Broy (2009) conceptualizing ethics as stakeholder interactions, all decisions and actions must be consistent with the moral and professional principles of people and the organisation.

2.1.2 Ethics Issues

Ethical issues in computer ethics can be defined as issues that persist in the evolution of computer technology and the introduction of new ways generating new questions that arise simultaneously (FLORIDI, 2003).

For example, the use of facial recognition software by the American police has caused a lot of problems and controversy in the country. The training data consists mainly of white people, mistakenly recognizing African Americans as if the software had not been trained on their facial features (LOHR, 2018). Problems with false positives have had adverse consequences as some individuals have been "recognized" as criminals. This example shows the necessity for ethical awareness in the creation of software because was created a discriminative software that facilitates the racial discrimination of black people in the United States.

A famous cosmetics company called Revlon had problems with software in 1988. The relationship with Logisticon Inc was in conflict because the software was turned off and both companies were impacted. Revlon accused several failures as interference with contractual relations, breach of contract and warranty. This example demonstrates the need for ethical accountability in the relationship between business and consulting (GILBERT, 1992).

Singer & Vision (2002) elaborated an article introducing ethical issues raised by Empirical Studies of Software Engineering (ESSE) to the research community. In this paper, they reviewed the codes and found four significant high-level ethical principles: informed consent, scientific value, beneficence, and confidentiality. These principles are part of the standards of ethical research practice. The examples of ethical issues in ESSE were:

1- Informed Consent: The Case of the Student Subjects – This criterion protects the people who may not understand the research, such as children, mentally disabled or people without knowledge about the research.
2- Scientific Value: The Survey Says… - This criterion has two components: The first component is about the importance of the research and the second is about the validity of experimental values.
3- Beneficence — Human: The Case of the Re-Engineered Engineers – This criterion is related to the equilibrium of benefits and harms.
4- Beneficence — Organizational: The Case of the Process Modeler – This criterion is about the minimization of harm, but at the organization, rather than at the individual level.
5- Confidentiality: The Case of the Novice Programmer - confidentiality has two components: anonymity and confidentiality of the data.

Another example occurred with the Aegis radar system, this software was developed according to the standards established by the developer and the client. However, the developer did not closely observe the users of the software or how it could be used. The results of the project were encouraging in relation to budget, schedule and satisfaction of requirements. However, the principal factor for the crash of an Iranian commercial airplane in Vincennes, killing 263 people, was the user interface for the software system (GOTTERBAM, D., 2002).

There are two main factors that contribute to system failures: Firstly, failures can be caused by limiting the consideration of the Stakeholders of the system to the software developer and the client only. In the example shown above (Aegis), the messages were not clear to users of the system operating in a hostile environment. Secondly, the failures can occur because the developers limit the scope of software risk analysis of technical and cost issues only. For the complete development of the software, it is necessary: identification of all interested parties and risk analysis including social, political and ethical issues (GOTTERBAM, D., 2002).

2.1.3 Code of ethics

In 1994, relevant research was carried out on the development of the Code of Ethics. This characterization software Engineering Ethics and Professional Practice (SEEPP) teamwork was organized (KARIM; AMMAR; AZIZ, 2017). Several versions were created about the code of ethics, the first version was presented as a proposal for the professional society including ACM's SIGSOFT (GOTTERBARN; MILLER; ROGERSON, 1999). After several revisions to the code of ethics, a version was accepted and adopted by the prominent computer societies of Association for Computing Machinery (ACM) and Institute of Electrical and Electronic Engineers Computer Society (IEEE-CS) in 1999 (BYNUM, 2016; GOTTERBARN. MILLER. ROGERSON, 1999) software engineers must be classified under eight principles and have an educational function that serves to educate both the public and professionals about the ethical obligations of all software engineers. Two versions of the Code of Ethics were released: a full version with more details about each principle and a short version with a description about each principle as shown in Table 1.

Table 1 - ACM and IEEE-CS software engineering code of ethics principles.

Principle	Description
Public	Software engineers shall act consistently with the public interest.
Client and Employer	Software engineers shall act in a manner that is in the best interests of their client and employer consistent with the public interest.
Product	Software engineers shall ensure that their products and related modifications meet the highest professional standards possible.
Judgment	Software engineers shall maintain integrity and independence in their professional judgment.
Management	Software engineer managers and leaders shall describe to and promote an ethical approach to the management of software development and maintenance.

Profession	Software engineers shall advance the integrity and reputation of the profession consistent with the public interest.
Colleagues	Software engineers shall be fair to and supportive of their colleagues.
Self	Software engineers shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession.

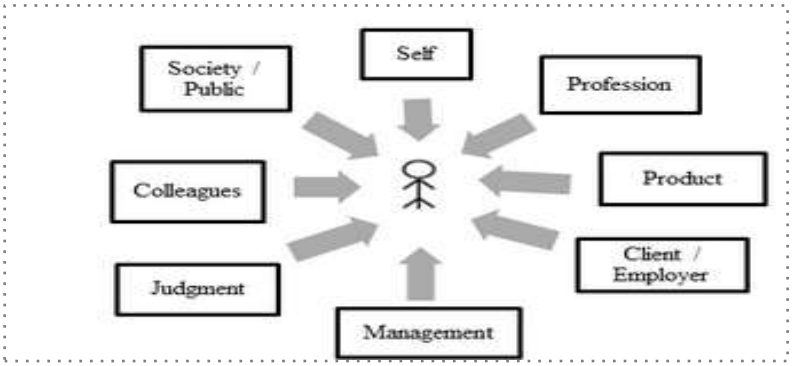
Source: *GOTTERBARN; MILLER; ROGERSON (1999).*

In the short version there are aspirations with a high level of abstraction. In the full version the information about the clauses is more detailed, there are examples and details of how the software engineer must act when the aspirations change. The two versions are very important because one complement the other making the Code of Ethics more cohesive (GOTTERBARN, 1999)

The Code of Ethics contains eight relevant principles related to the environment and decisions that are carried out by professionals of software engineering include educators, administrators, supervisors as well as trainees and students in the profession. These principles indicate the relationship ethically responsible in which several groups have participated as individuals, groups, and organization. The clauses of principles show the obligations that exist in these relationships, and these obligations are based on the humanity of software engineering (GOTTERBARN, 1999).

Patterns can be evolved in complicated situations and generate tensions between them. In these cases, the software engineer needs to use ethical judgment to solve problems and situations and must act according to Code of Ethics and Professional Practices, under the circumstances (GOTTERBARN, 1999). Figure 1 depicts that the principles that were created to guide the software engineers and shows that they are affected by their work, for example: to check if people are treated with respect, if the public is well informed, if the people without knowledge will be affected by their decisions, and among others. In all cases it is necessary to consider the public's health, safety, and well-being. The code was written according to “Public Interest” (GOTTERBARN, 1999).

Figure 1- Obligations of the software engineer according to the principles of code of ethics.



Source the author (2022).

Another function very important of the code of ethics is the educational function. A way to show both to the public and to professionals or aspiring professionals about the ethical obligations of all software engineers (ABERKANE; AYDEMIR; DALPIAZ, 2018)

Doing an analysis of the full version we can highlight some points. The first principle is the “public”. This principle shows that the software engineer must understand that his work must benefit the public, according to the universal ethical thinking and not only limit himself to the perfection of the work performed. The principles of the profession (sixth), colleagues (seventh) and self (eighth) must also follow the universal ethical thinking (GOTTERBARN, 1999; GOTTERBARN. MILLER. ROGERSON, 1999).

The second principle is the Client and Employer, this principle is related to the first principles elaborated to the company and employer in the early 20th century. It is important to note that the best interests of both the client and the employer are consistent with the public interest (GOTTERBARN, 1999; GOTTERBARN. MILLER. ROGERSON, 1999).

The third principle is the Product, this topic is very important because the product is always in transformation and the software engineer must guarantee fulfilment of customer requests. The fourth principle is judgement, this issue relates to the professional signing qualified documents, not participating in inappropriate financial practices and among others (GOTTERBARN, 1999; GOTTERBARN. MILLER. ROGERSON, 1999).

The fifth principle is about management, this principle is important because their decisions affect their subordinates and the company's fate. When the administration does not see the professional ethics, the level of commitment decreases, and credibility is affected (GOTTERBARN, 1999; GOTTERBARN. MILLER. ROGERSON, 1999).

Several studies show that knowing the Code of Ethics helps in the development of the

software, the code assists in decision-making and makes clear complex problems. Gotterbarn and Miller (2009) related that the code of ethics helps software engineers assist in making decisions that have a lot of complexity, both technical and ethical.

Evans (2012) in his studies worked with the IEEE Code of conduct and with the ethical issues of privacy, barware and net neutrality. Several factors were found as the topic about obligations to software engineers to act correctly and ethically in the development of software.

2.2 Ethics in computer courses

According to Masiero (2004), the professional who works in the computing area possess several functions include designs and develops computational devices, thus elaborating the results of a software development process such as: user manuals, source code, documentation, studies of feasibility, test plans, analysis models, requirement specification and etc.

Computer Science, computer engineering, systems analysis etc. are the courses that can be taken from higher education in Brazil. The performance of this professional is quite broad because he can work in the industrial sector and in companies. In addition to becoming autonomous, creating your own business. The regulation of the profession in Computer does not yet exist, but there have been several projects and discussions about this topic by the scientific community since before the creation of the Brazilian Computer Society (SBC) in 1978 (BIGONHA, 2016).

The Brazilian Computer Society is a scientific and non-profit association which is formed by researchers, professors, students, and professionals working in research, scientific, education and technological development in the generic area of Computing (SBC, 2016). The SBC does not have a code of ethics, there is a project that tries to regulate the Informatics profession and create self-advice regulation, with the aim of control of the activities of professionals and to check for possible deviations from ethical conduct (BIGONHA, 2016).

One possibility for computer engineers is to join the Regional Council of Engineering, Architecture and Agronomy (CREA) and follow the code of ethics elaborated by the Federal Council of Engineering and Agronomy (CONFEA). However, this code does not have specific computing issues such as rights, privacy, intellectual property, etc. The computer professional will find several ethical challenges in his career.

The goal of teaching ethics in computer courses is to promote debates to encourage the critical-reflective thinking skills of professionals so that they find better ways to solve problems and do not practice any improper action. According to Masiero (2004) the main

challenges faced by professionals are Access Copyright, Intellectual Property and Privacy.

Access to a computer system is authorized when the person who executed it has a valid account in the system, created by the system administrator. Access does not happen when a user accesses a computer system without authorization, either from any person or organization. Since the 15th century, the protection of intellectual property has been developed, studied, and applied. This intellectual protection was created to protect material creations, copyright, and patents. Besides protecting ideas as well as maintaining harmony in society. Privacy is a big challenge because there are several problems with invasion of privacy in computational media. The professionals must follow ethical principles associated with command 3.13 of the IEEE/ACM unified code of ethics in the design of any database that involves information about third parties (MASIERO, 2004).

An ethical approach must be made possible by software engineers to guarantee a better professional practice. One way to enhance professional ethics is to introduce the university program in software engineering. Many educational institutions already recognized the importance of introducing specific and solid knowledge about ethical education in university's courses (MOOR, 1998). Other areas of technology also aim to make important ethical knowledge applied within the area of interest. The Curriculum Guidelines for Undergraduate's Degree Programs in Software Engineering developed by ACM/IEEE (2004a, 2004b), emphasizes ethics and clearly describe in a few sentences:

> "To help ensure ethical and professional behaviour, software engineering educators have an obligation not only to make their students familiar with this code, but also to find ways for students to engage in discussion and activities that illustrate and illuminate the code's eight principles".

Moreover, code of ethics and professional conduct should be incorporated into SE curricula because they are recommended and **very important in SE education knowledge**.

2.2.1 Open science in Education

The definition of Open Science is widely discussed but among several definitions, it can be said that open science is a broad field with many divergent perspectives from different stakeholders (VICENTE-SAEZ & MARTINEZ FUENTES, 2018). Fecher and Friesike (2014) investigated about five schools of thought (democratic, pragmatic, infrastructure,

public and measurement) but concluded that there is no clear differentiation.

According to Van der Zee & Reich (2018), Open Science teaching can be viewed as enabling change. Open Science education can have, for example, 2 meanings: First, the education for introducing Open Science as a subject (i.e., theories and practices as an educational topic) and second, Open Education following Open Science principles (i.e., learning processes as pedagogical methodologies).

Over the past several years, educators and community organizations have supported the openness of education and its research. The UNESCO Recommendation on Open Education and Open Learning Resources (2019a) was the subject of open consultations. And the 40th General Conference has been adopted as recommended (2019b).

3 FIRST STUDY: A MAPPING STUDY SOFTWARE ENGINEERING LITERATURE

In order to discuss whether the courses oriented to ethics in Brazilian computing higher education departments in Brazil are or not in line with the current ethical issues, we need to know which these issues are those. To identify these issues, we an appropriate methodological approach would be to perform a systematic study of the literature. Thus, we decided to conduct a systematic mapping, which is a consolidated method for identifying, analyzing, and interpret the evidence from scientific literature (KITCHENHAM, 2007).

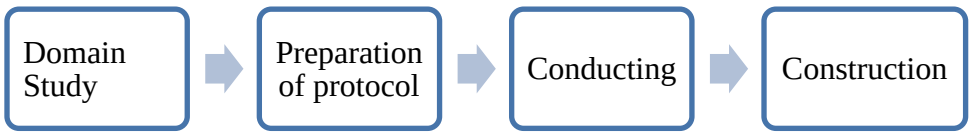
3.1 Systematic mapping study protocol

The description of each step of the systematic mapping process can be visualized in Figure 2.

- Domain Study: The study of software ethics in the software development process was carried out. Therefore, the research used articles published in digital databases such as Science Direct, Springer, IEEE and ACM.

- Preparation of protocol: the protocol was defined using the research questions, databases, search strategies, study selection and data extraction. Guidelines from (KITCHENHAM; CHARTERS, 2007) have used literature in developmental research.
- Conducting: In the first step, the protocol was defined and from there the articles were obtained to be evaluated and analysed and, from them, to extract the data. Parsifal was the support tool used.
- Construction: Several tables were created, and the data were analysed by extracting the data obtained through the mappings.

Figure 2 - Steps in the mapping study process used in this research.



Source the author (2022)

The guidelines of (KITCHENHAM; CHARTERS, 2007) were used in this research work. The protocol developed using the Parsifal tool is fully detailed in the next sections. This tool

makes it possible to perform work online and to share it among researchers. There are several tools that help in the systematic review process, among them we can highlight StArt (State of the Art through systematic review), ARS – Automatação de Revisão Simática, SLuRp (Systematic Literature unified Review Program), SLRTOOL, SLR-Tool, Metta, EPPI - Reviewer and DistillerSR. The key feature of Parsifal is that this tool is designed to assist in planning, conducting and extracting data in accordance with the Kitchenham reference (2007). There are many qualities for the use of this tool because it is more practical, and we have a better organization of the information but there are some limitations in obtaining the data.

3.1.1 Identification of the research topic

At the beginning of the research process, it is necessary to check whether this research is really necessary. Thus, it is essential to read articles in the area of interest. In this research, some gaps were observed in the area of software development focused on ethics. And it was noticed that there are not many mappings study and systematic reviews addressing ethics and its ethical issues. From that, papers were selected and compared and noted that the theme of this work would be appropriate for a systematic mapping study.

3.1.2 Review commissioning

This phase will not be delegated to third parties, so it is not necessary to carry out this research. The student will be responsible for conducting the research.

3.1.3 Research Questions

The most important step in the process of systematic review is the definition of research questions. According (KITCHENHAM; CHARTERS, 2007) the research questions are responsible for directing the methodology to be adopted. Starting from the objective, we seek to answer the question central to the study, described as: What students of "software engineering" should learn from the point of ethics? Two questions were elaborated in order to assist with the following questions:

✔ RQ1.What are the ethical issues related to software engineering?

This question presents ethical issues that are present in the scientific literature. What are the most discussed ethical issues in software engineering? As an answer to this question, we want to provide information on the ethical issues that are most discussed in selected articles in the last five years.

3.1.4 Keywords used

The Table 2 shows the keywords, synonyms and related to use in the development of this research.

Table 2 - Keywords and Synonyms.

Keyword	Synonyms	Related to
ethics	code of conduct code of ethics ethical	Population
Software engineering	software development software process software specification	Outcome

Source the author (2022)

3.1.5 Search string

Using the keywords, a search string was elaborated. Several searches were carried out and tested. The tests were carried out because it is necessary to make a refinement. Some exclusions were necessary, the keywords were excluded because they did not have enough articles, or the number was over 10,000 publications that did not have much to do with research. After several attempts, the following search string was defined to search the keywords, title, abstract and the text of the articles:

("ethics" OR "code of conduct" OR "code of ethics" OR "ethical") AND ("software engineering" OR "software development" OR "software process" OR "software specification"

3.1.6 Database

Table 3 shows the database that was used in the research.

Table 3 - Bases used in the research.

Sources	
Name	URL
ACM Digital Library	http://portal.acm.org
IEEE Digital Library	http://ieeexplore.ieee.org
Science@Direct	http://www.sciencedirect.com
Springer Link	http://link.springer.com

. Source the author (2022)

3.1.7 Inclusion and exclusion criteria

Exclusion and inclusion criteria are very important because they give greater certainty to the topic studied. The criteria adopted in this work are presented below and were supported by Parsifal's online tool.

Inclusion criteria:

- Primary articles;
- Articles published until September 2020;
- Articles that related to this ethic;
- Articles that answer a research question.

Exclusion Criteria:

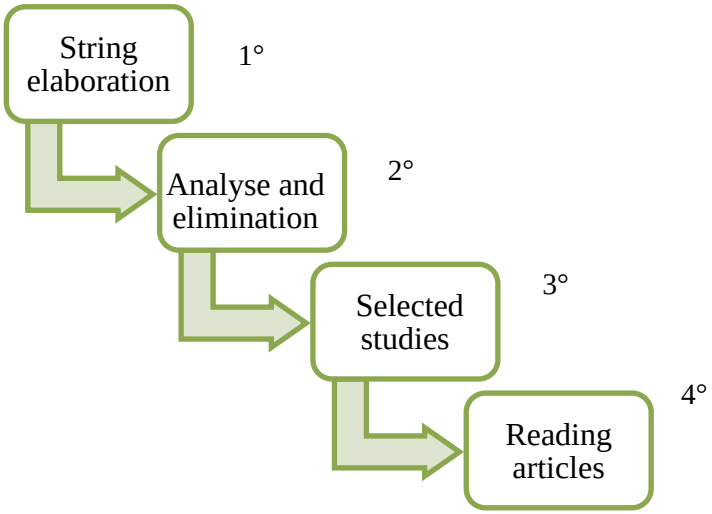
- Duplicate articles;
- Articles that are not written in English;
- Secondary articles;
- Gray literature (theses, dissertations, monographs, etc.);
- Articles whose text was not available.
- Studies that are not relevant to research

3.1.8 Procedure for selecting studies

The selection of studies consisted of four main steps. In the first stage, the string that was elaborated was used and this is presented in section 3.1.5. The string was placed on each search platform as shown in table 3. In this step the studies were consulted and obtained by automatic search. The research was stored in the Parsifal tool. The second step, the articles were analysed and eliminated. And in the third step, the primary studies selected in the previous step were selected by reading the title and summary and the inclusion and exclusion criteria in Section 3.1.7

The fourth step consisted of a complete reading of articles to answer the research questions described in Section 3.1.3. Figure 3 shows a flowchart with all the steps followed.

Figure 3 - Steps used for the selection and classification of studies.



Source the author (2022)

3.2 Threats to validity

The categories of threat to validity are presented in this section. These categories include 4 validity types: construction, external, internal and completion (WOHLIN et al. 2000)

- Construct validity: Generalization of the result is the threat that can occur in obtaining study data for the concept or theory involved (WOHLIN et al., 2000). It was minimized using the Synonyms words in the search string as shown in Table 1.
- Internal validity: The threats are the possible conclusion errors between treatments and

results (WOHLIN et al., 2000). Some decisions regarding the selection and extraction of articles may occur due to the lack of a clear description in the data and information, making it difficult to apply the exclusion and inclusion process. In this work, the selection occurred in an iterative way, where the study was not eliminated and went on to the next phase to really be evaluated. The conflicts were discussed and solved in a collaborative manner between the student and the supervisor. Thus, the threats were minimized due personal bias in understanding the study.

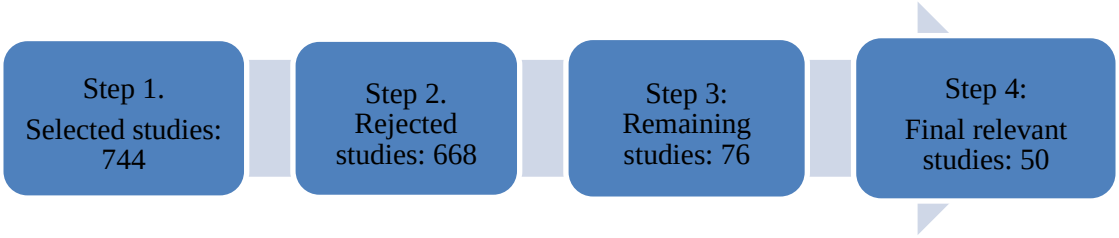
- External validity: These threats depend on the identified literature; when it is not valid externally, there is no interest in the synthesis of the content (GASPARIC; JANES, 2016). In this work, this threat was minimized due to the use of the exclusion criterion to eliminate studies from Gray literature from the research.
- Completion validity: Not all primary studies that exist related to the research can be identified (KITCHENHAM; CHARTERS, 2007). Thus, in this work, to minimize this threat, the review process was carefully designed and discussed by the authors to minimize the risk of excluding relevant studies. The use of synonyms and synonymous words for the constructs of this work was another method used to verify relevant works.

3.3 Results and discussion of the mapping study

3.3.1 Article selection process

The selection of studies comprised four steps as shown in Figure 4. A total of 744 articles were selected (Step 1) from the four search sites used in this study. After reading the title and abstract (Step 2), 668 articles were rejected based on the exclusion criteria. After Step 3, 76 articles remained in the selection process. Finally, after reading the complete text of these 76 articles, we obtained only 50 relevant articles according to table 4.

Figure 4 - Selection of studies in the review



Source the author (2022)

The distribution of articles and their corresponding bases is summarised in Table 4. Further, we can visualise the articles selected for the automatic selection and the articles selected in the final phase.

Table 4 - Distribution of works in the review.

Database	Automatic selection	Final studies
ACM Digital Library	24	8
IEEE Digital Library	83	31
Science Direct	5	1
Springer Link	632	10
Total	744	50

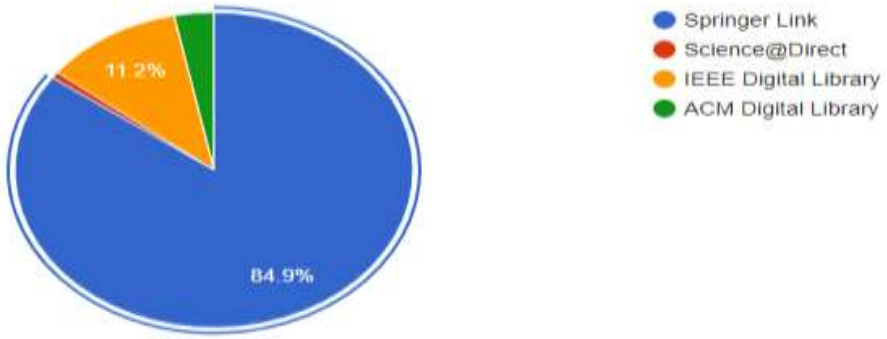
Source the author (2022)

The extracted data satisfied the inclusion criteria described previously. An overview of the general characteristics of the studies is provided before presenting the results and analyses of the research questions.

3.3.2 Overview

The databases returned a total of 744 works distributed in the ACM: 24; IEEE: 83; Science direct: 5; and Springer: 632; a pie-chart is illustrated in Figure 5.

Figure 5 - Articles by base.

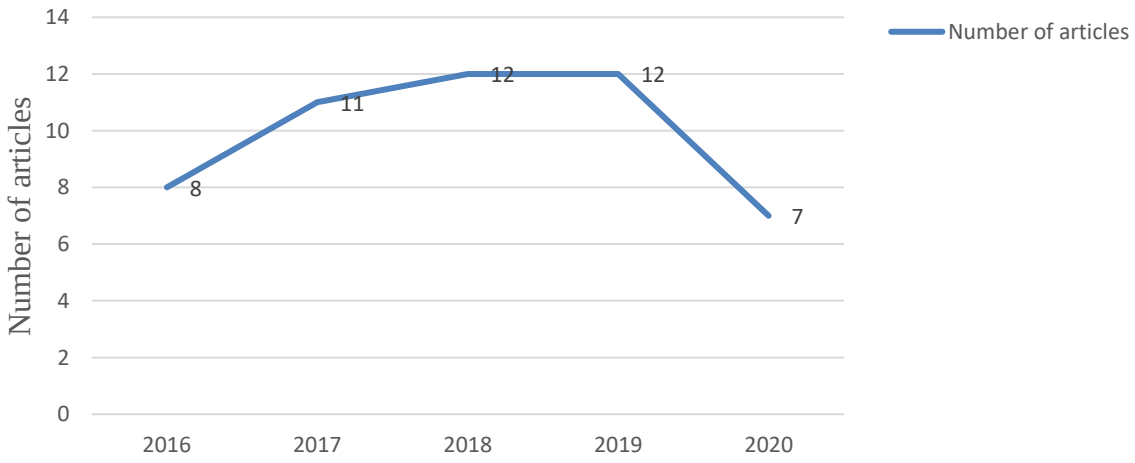


Source the author (2022)

A total of 50 works were accepted by each database, and they were distributed as follows: ACM: 10; IEEE: 31; Science direct: 1; and Springer: 10.

Research on software development has grown over the years; Figure 6 illustrates the years of publication of the articles evaluated in this study. Eight articles addressing ethics in software engineering were published in 2016; this number grew in 2017 and 2018 and stabilised in 2019. Published articles were verified until September 2020, and a decrease in the number of articles in this area was observed. After analysing the last five years (2015-2020), we conclude that the number of studies on engineering software ethics has been limited throughout the years.

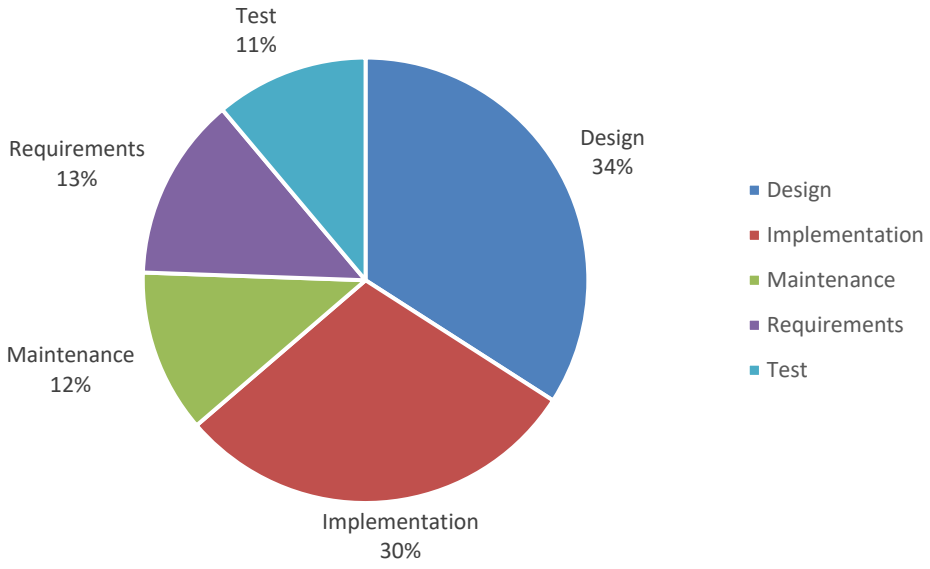
Figure 6 - Year of publication of the works.



Source the author (2022)

Figure 7 categorises the phases of software development as design, implementation, maintenance, requirements, and tests. In this study, the design and implementation were 34% and 30% respectively. Software engineers must be responsible for projects and must perform a set of analyses at all stages of the project's development. The design phase represents product design and specification. This concept takes shape in the form of specifications (SOMMERVILLE, 2011); the research shows that many authors are concerned with ethical issues in the design phase. In the implementation phase, the system produces what is described in the design phase, and in this phase, a code for software development is possible (SOMMERVILLE, 2011). Maintenance, requirements, and testing phases had similar values of 12%, 13%, and 11%, respectively. These values indicate that in the product development process, ethical issues are considered in the design and implementation phases. However, there is little work on the maintenance, requirements, and testing phases. This is because there was more concern during the initial phase of the product.

Figure 7 - Ethical articles at different stages of software development.



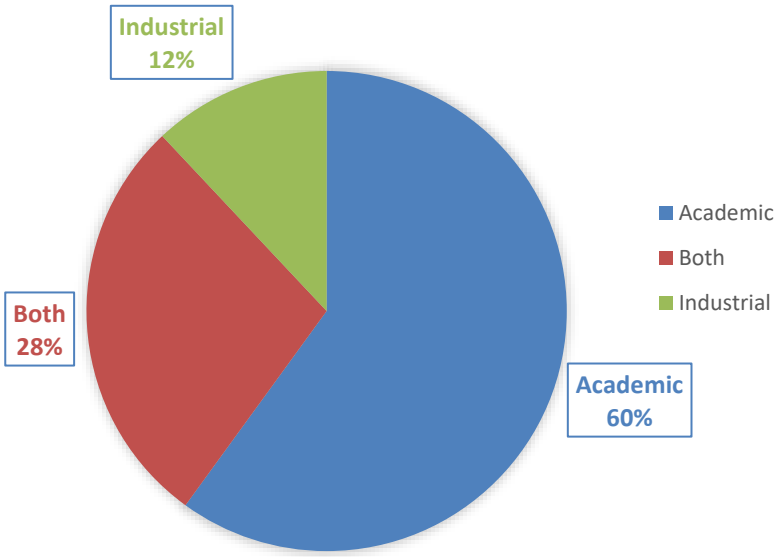
Source the author (2022)

We categorised the applications of the studies as *industrial, both, or academic*, as indicated in Figure 8. The term *industrial* was applied when the study was performed in a real company or when the authors worked in the company. The term *both* was applied when the studies were performed by industries or by authors affiliated with the university. Finally, the term *academic* was applied when the studies were performed only in universities. The results show that 60%

of studies belong to the *academic* context, 12% of the studies were conducted in an *industrial* context, and 28% belonged to *both*. These values show that more than half of the studies are in an *academic* context, which indicates that there is considerable research in universities working on this theme. Further, the results show that there is a relationship between universities and the industry, and there is interest from both sides in the theme of this research. Further, it suggests a relationship between the industries and the universities.

Aberkane et al. (2018) researched ethics in requirements engineering and in the selection of studies identified that 93% were authored by academics, 4% by both academics and industries, and 2.67% were authored in an industrial context.

Figure 8 - Application of the studies as industrial, both or academic.

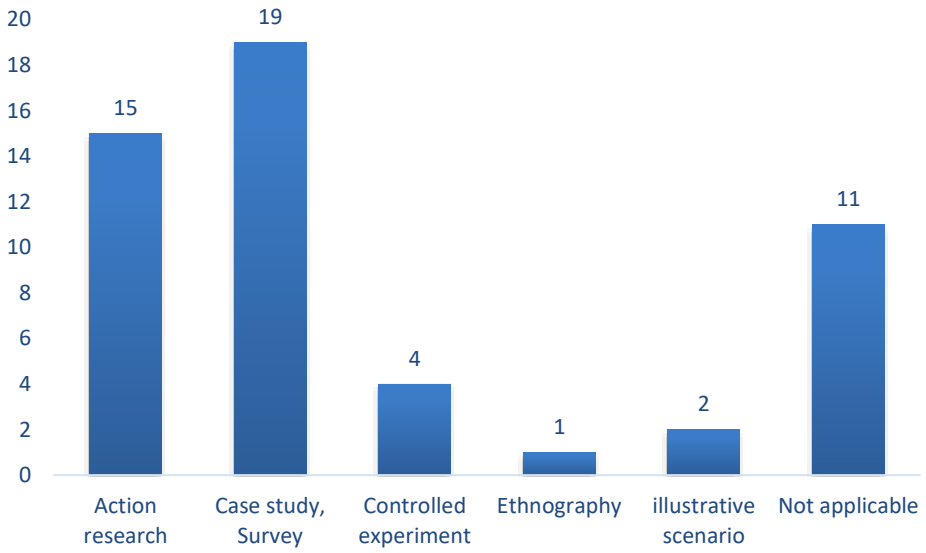


Source the author (2022)

According to Easterbrook et al. (2008), the classification of the evaluation method was based on the categories-controlled *experiment, case study, survey, ethnography,* and *action research*. Two categories were used in previous works (DERMEVAL et al., 2015; TIWARI AND GUPTA, 2015) *illustrative scenarios* and *not applicable*. The *illustrative scenario* evaluates contributions using small examples and *is not applicable*, indicates articles that do not have an evaluation of the study method. Figure 9 shows the research methods evaluated in this study. Most studies adopted case studies and survey strategies as research methods, with a total of 19 studies (38%), action research had 15 studies (30%), 4 studies (8%) presented controlled experiments, only 1 study (2%) adopted ethnography, 2 studies (4%) illustrated scenario, and 11 studies did not present any kind of evaluated method, or it does not apply

because it is an opinion paper. We noticed that there is little research on methods of controlled experiments, ethnography, and illustrative scenarios in the ethical context applied in software engineering. This is due to the fact that there is often no proper way to test a hypothesis using, for instance, a controlled experiment. In addition, it was observed that a majority of the research methods were case studies or survey strategies; however, there are several works in action research. This type of research is very interesting because it seeks to make a connection between theory and practice, which achieves practical and scientific results (SUSMAN and EVERED, 1978) and according to Thiollent (2009), this type of research emphasises the analysis generated by the researcher in day-to-day scenarios.

Figure 9 - Evaluation of the methods of research.

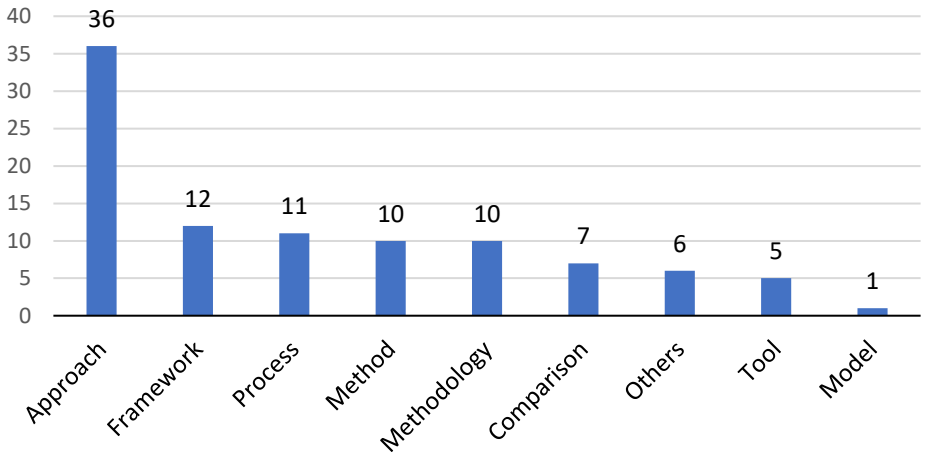


Source the author (2022)

The types of contributions were categorised according to Petersen et al. (2008): approach, framework, method, tool, process, model, methodology, template, comparison, metrics, protocol, checklist, language, and discussion. In this research, approaches, frameworks, methods, tools, processes, models, methodologies, and comparison were considered. It is important to highlight that a study can be classified into more than one category. In this study, the type of contribution with the greatest amount of work was approach, 36 studies (72%); Framework, process, method, and methodology had similar results with 12 (24%), 11 (22%), 10 (20%), and 10 (20%), respectively, followed by comparison (14%), tool (10%), model (2%), and others (12%). The approach can be used in different phases of software development before implementation, for example, in the design phase (SOMMERVILLE, 2011). This

contribution was adopted by Vakkuri, Kemell, and Abrahamsson, 2019; Holstein and Dodig-Crnkovic, 2018; McNamara, Smith, and Murphy-Hill, 2018 to introduce ethics in software engineering. Figure 10 shows the types of contributions found in this study.

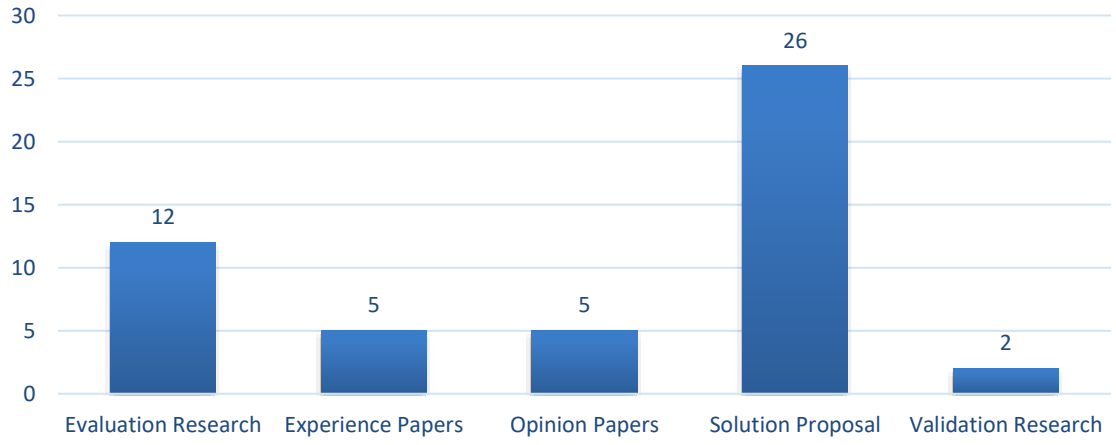
Figure 10 - Types of contributions made in this study.



Source the author (2022)

The applied research types were defined by Wieringa et al. (2014), as shown in Figure 11. In this study, the most adopted research type was *solution proposal* with 26 studies (52%), followed by *evaluation research* with 12 studies (24%), *experience paper* and *opinion paper* with 5 studies each (10% each), and *validation research* with only 2 studies (4%). It is necessary to highlight that none of the selected studies belong to the philosophical paper's category of research types.

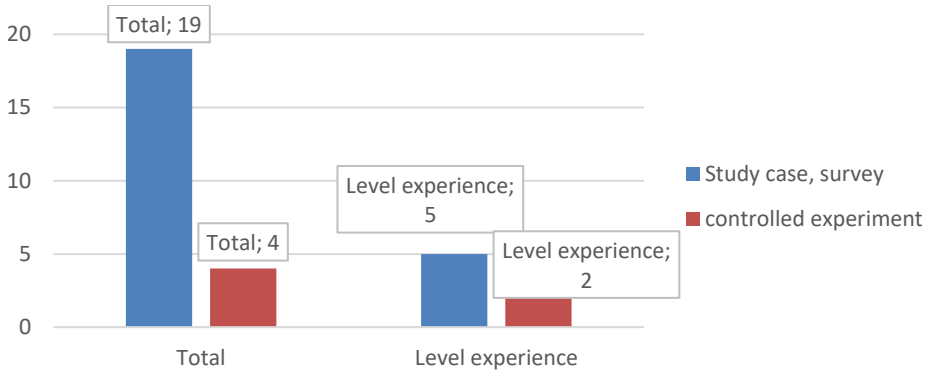
Figure 11 - Research types.



Source the author (2022)

Figure 12 shows the number of papers that highlighted the level of experience of developers or software engineers in the development of software. Little attention has been paid to the level of experience of the developers or software engineering, although the level of experience (junior and senior) greatly influences the decision-making process in the development process. In 19 survey articles, only 5 articles focused on the developer's level of experience and the remaining 4 studies focused on controlled experiment, only two studies presenting information about the developer's level of experience.

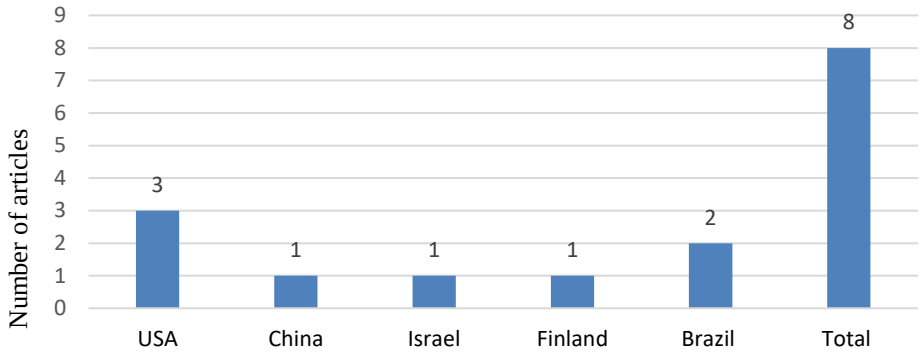
Figure 12 - Level of experience of developers or software engineers in the development of software.



Source the author (2022)

Figure 13 shows the number of papers that addressed ethics in subjects of higher-level courses in the area of informatics. Of the 50 studies selected in this research, 8 articles are from the computer education. Further, it is interesting to see how some countries are interested in this topic; the country with the largest publication was the United States (USA) with 3 papers, followed by Brazil with 2 papers and then by China, Israel, and Finland with 1 paper each.

Figure 13 - Articles about ethics in the education area.



Source the author (2022)

3.3.3 What are the ethical issues related to software engineering?

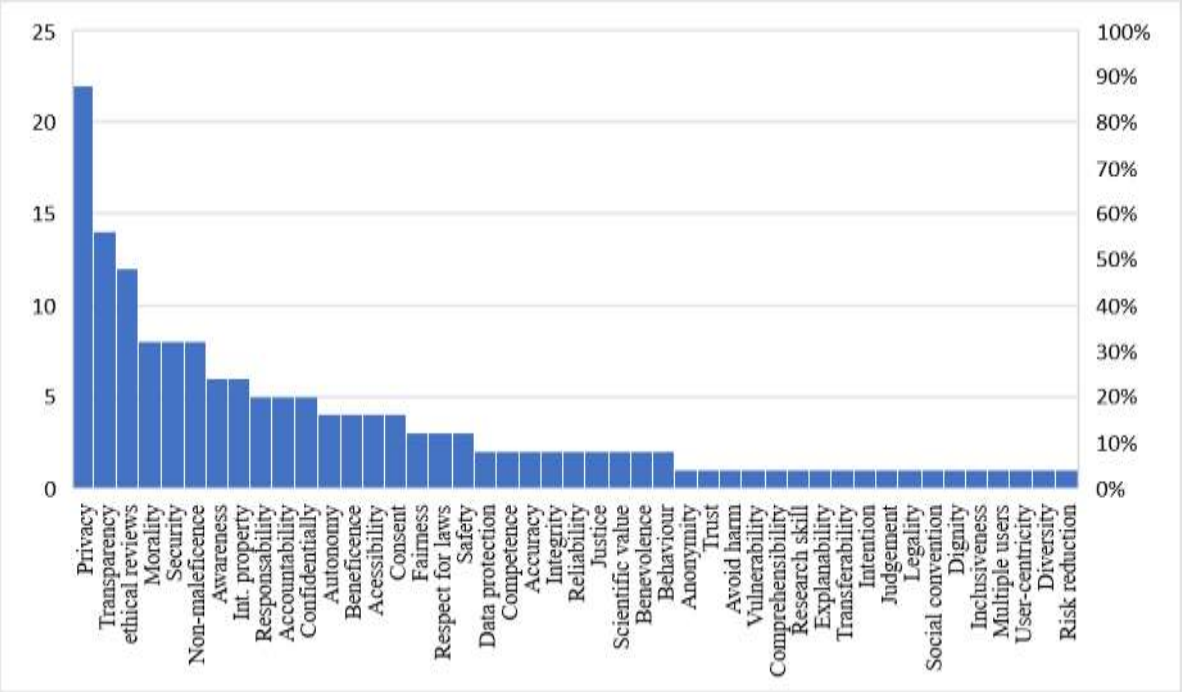
The first research question aims to explore the ethical issues related to software engineering. We can classify this information as descriptive knowledge. To answer this question, a descriptive analysis was performed with all selected articles.

Figure 14 shows the 45 most common ethical issues found in the selected studies. The most common issue, **privacy**, was alluded to in 22 studies, followed by **transparency**, which was reported in 14 studies. The issues of **morality, security, and non-maleficence** were captured in eight studies each; **awareness and intellectual property**, six studies each; **responsibility, accountability and confidentiality**, five studies each; **autonomy, beneficence, accessibility, and consent**, four studies each; **fairness, respect for laws, and safety**, three studies each; **data protection, competence, accuracy, integrity, reliability, justice, scientific value, benevolence, and behaviour**, two studies each; and expandability, transferability, intention, judgement, legality, social convention, dignity, inclusiveness, multiple users, user-centricity, diversity, risk reduction, harm avoidance, anonymity, comprehensibility, trust, vulnerability, and research skill, one study each.

Some important facts may be related to the ethical issues most frequently mentioned in the publications. For example, in 2013, there was an extensively discussed and documented the whistle-blowing incident with Edward Snowden, when mass surveillance by government spy agencies was discovered. This event has attracted considerable attention to the issue of privacy, which has led to an increased interest in improving the privacy of companies. Another example is the Volkswagen emissions scandal in 2015, wherein Volkswagen admitted to the use of falsification software (ROGERSON, 2017). The responsibility associated with ethical

issues directly relates to this scandal. In 2017, the two ethical issues that appeared most in publications were responsibility and privacy.

Figure 14 - Ethical issues.



Source the author (2022)

4 SECOND STUDY: A SURVEY WITH COMPUTING TEACHERS AND STUDENTS

We thought it might be informative to have a better view of how computing teachers and students currently understand ethics and its importance as a component of professional computing education. To pursue this secondary objective, we decided to run a survey with this public in Brazilian universities. The survey seemed to us to be an appropriate tool since we were looking for a general view of how ethics and its importance is perceived, instead of more in-depth analysis of the issues of teaching and learning ethics in computing courses.

4.1 Search method: SURVEY

According to Creswell & Creswell (2017), research methods can be classified as qualitative, quantitative and mixed. The method chosen for the second stage of the research has a quantitative approach. Survey seeks information directly with an interest group about the data that you are interested in obtaining, especially in exploratory and descriptive research (SANTOS, 2009). The information obtained is used to describe, compare, or explain knowledge, attitude or behaviour (GRAY 2009; KITCHENHAM AND PFLEEGER, 2002).

The survey purposes are classified as exploration, description and explanation (BABBIE, 1999).

a- Exploration: It aims to better clarify the problem by making it more explicit or improving ideas.
b- Description: Description of the characteristics of a particular phenomenon or establishment of variable relationships.
c- Explanation: identify factors that determine or contribute to the occurrence of certain phenomena

4.2 Survey population and sample

The population of this research is composed of students who studied at undergraduate or postgraduate courses in any IT area course at any university and professors who taught in any IT area course at any university. In order to carry out the survey, the corporate email from the Informatics Centre was used and disseminated to undergraduate, graduate students and professors. There was also disclosure on LinkedIn, Instagram and Facebook social networks.

4.3 Collection instrument

The collection instrument used in this work was through a questionnaire (APPENDIX A). The questionnaire was built based on all information obtained in the review prepared previously and in works by authors found in the literature that show the importance of the questionnaire in survey surveys.

The questionnaire was divided into 3 sessions and consisted of 6 quick questions about the profile and experience of the participants plus 12 questions about your opinion regarding ethics directed to the student's perception and 8 questions directed for university professors. Through online searches, we opted for the Google Doc's platform through Forms for the elaboration and dissemination of the electronic questionnaire. Because it is an online and easy tool for shipping and reach, Google Docs, Forms were the most appropriate choice as an online platform and free. In addition to demonstrating the results in general and also through individual filters of each participant who answered the survey.

The questionnaire before being applied went through a pilot experiment, as it needs to be tested to investigate possible failures and errors. The questionnaire was tested by 4 students and 2 teachers and presented to the supervisor of this work, in order to find possible flaws.

The first test was conducted with some colleagues in the research group. Few errors were observed in the participant profile and experience questions, and some questions were raised in the perception part of the students.

The second test was conducted with professors, wherein they answered the questionnaire and pointed out flaws. The flaws pointed out were some errors in some questions and the poor structure of the questionnaire.

Thus, based on test responses, the questionnaire was properly adjusted for official release.

4.4 Data collection

Data collection was conducted from January 5, 2021, to February 28, 2021. The questionnaire was distributed via email, and the participants sent their answers to the questionnaire using the form.

4.5 Survey results

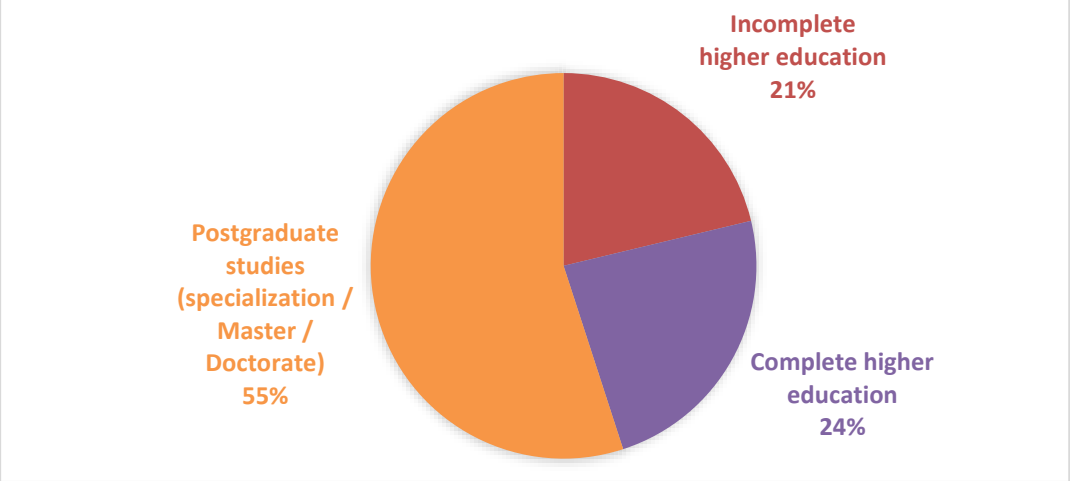
The second stage of the research was administering a survey to collect opinions from students and teachers about ethics. This survey was designed to find out the level of current knowledge about ethics, its dilemmas between computer professors and students and we can also highlight what they think about the relevance of the topic.

We received a total of 93 responses. Section 4.5.1 presents the profile of the participants, section 4.5.2 presents the perception of students, and section 4.5.3 highlights the perception of professors at the universities. We can visualize all survey questions in APPENDIX A

4.5.1 Profile of the participants

The survey conducted showed that the number of graduates that were part of or had completed specialisation and postgraduate courses was equivalent to 55% of the studied sample. While 24% completed an undergraduate course and 21% were still studying, these two groups corresponded to 44% of the studied sample with a total of three participants, as shown in Figure 15.

Figure 15 - Number of graduates who completed or are part of specialization course.

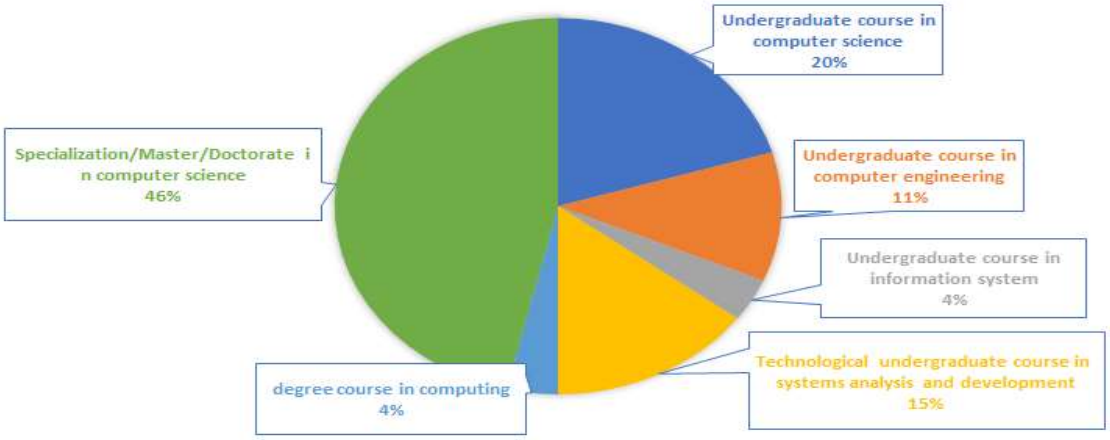


Source the author (2022)

4.5.2 Undergraduate and graduate courses

The main undergraduate and graduate courses taken by the participants of this study or those that they have already completed are shown in Figure 16. Most participants are still completing their courses or have completed a specialization/master/doctorate in computer science. Undergraduate courses in computing, computer engineering, and information systems were cited; computer science had the highest percentage (20%). Participants that took the technological graduation course in the analysis and development of systems and degrees in computing were 15% and 4%, respectively.

Figure 16 - Undergraduate and graduate courses taken/completed by the participants in this study.



Source the author (2022)

4.5.3 Academic background in Brazil and abroad

The survey showed that most students had a background in Brazil, and the others had an interest in seeking training abroad, as listed in Table 5; the most cited countries were Brazil, Germany and the United States and France. Switzerland, Austria, and Japan were the other destinations that were cited.

Table 5 - Academic background in Brazil and abroad.

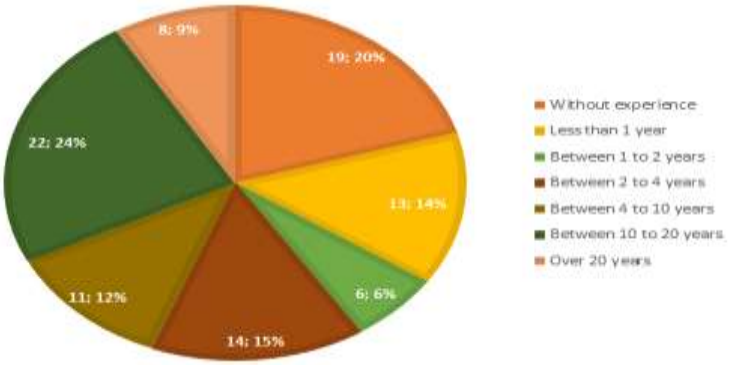
Countries	Participants
Germany	3
Austria	1
Brazil	89
United States	3
France	2
Switzerland	1
Japan	1

Source the author (2022)

4.5.4 Professional experience

The number of participants and the time of professional experience is shown in Figure 17. Most participants had 10–20 years of experience in the area of informatics (24% of the sample). While 20% of participants had no professional experience, 6% and 15% were starting their careers with 1–2 years and 2–4 years of experience in the IT area, respectively. Participants with less than 1 year of experience represented 14% of the study sample. In this study, 9% of the participants had more than 20 years of professional experience.

Figure 17 - Professional experience of participants.

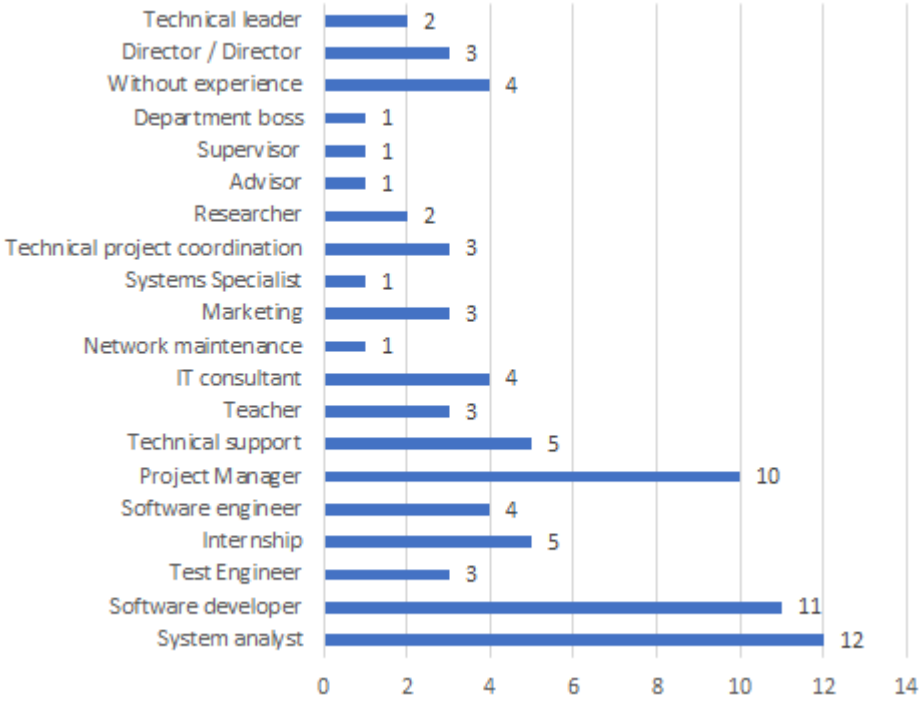


Source the author (2022)

4.5.5 Positions in professional experience

Figure 18 shows that the main positions held by the participants were system analysts, software developers, and project managers. There were also several other positions held by participants including test engineer, intern, software engineer, technical support, professor, IT consultant, network maintenance, marketing, systems specialist, technical project coordinator, researcher, advisor, supervisor, department boss, director / director, and technical leader.

Figure 18 - Positions in professional experience of participants.

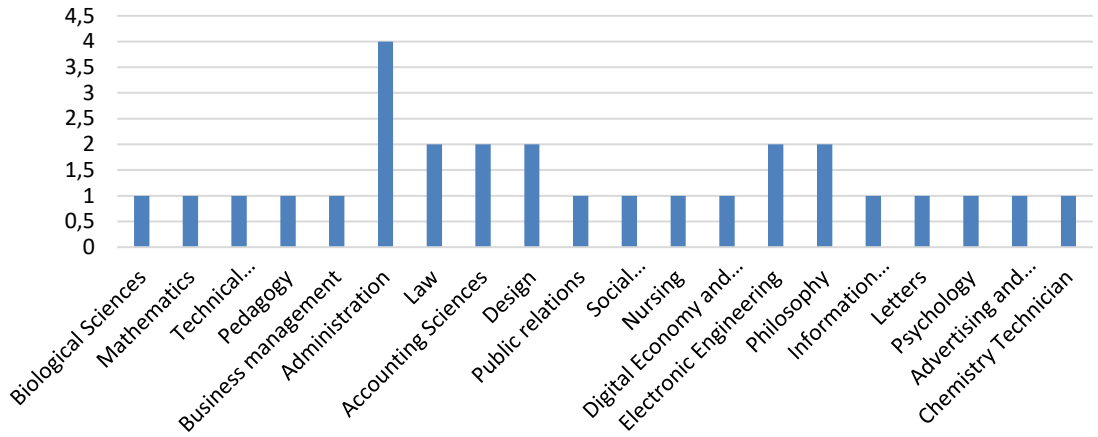


Source the author (2022)

4.5.6 Academic knowledge from another area

A total of 66% of the participants did not have academic knowledge in any area other than computer science; 34% had knowledge in different areas, as shown in Figure 19. The main area was administration with four participants; Law, accounting sciences, design, electronic engineering, and philosophy, each had two participants. The other areas had one participant each.

Figure 19 - Positions in professional experience of participants.



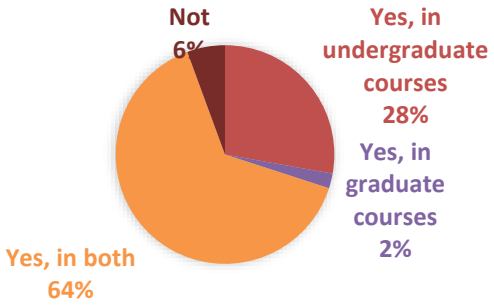
Source the author (2022)

4.5.7 Perception of knowledge of ethics in universities

Eleven questions were presented to students to determine their opinion regarding the teaching of ethics in undergraduate or postgraduate courses in the area of informatics. The survey was sent initially through the contact list of the informatics centre and then published on social networks such as LinkedIn, Facebook, and Instagram.

The first question in the survey was used to identify the importance of the discipline of ethics in undergraduate and graduate courses in the area of informatics. Figure 20 shows that most students agree that the ethics discipline is important for both undergraduate and graduate courses. 28% agreed that it is important in undergraduate courses and 2% agreed that it is important in graduate courses; only 6% did not agree that the ethics discipline was important. This response to this question is important to realise that most students have the knowledge and recognise that the discipline of ethics is important in the curriculum of institutions in the field of informatics. Sedlet (1999) argues that students in the area of informatics need “to understand the potential importance to society before starting professional life.”

Figure 20 - Importance of the discipline of ethics in undergraduate and graduate courses in the area of informatics.



Source the author (2022)

The second and third questions were related to ethics in relation to the professional field. The response to the second question indicated that most students had the knowledge of ethics (61.1%), while 38.9% of participants did not have this knowledge. The third question is related to whether ethics is important for IT professionals. In total, 74.4% strongly agreed that ethics is important for IT professionals, 20% agreed, and 5.3% had a neutral opinion. These results show that most people believe that ethics is very important in the life of professionals in the field of informatics. According to Ponchirolli (2011), ethics is an essential condition for the exercise of any profession. Each set of professions must follow an order of conduct that allows the harmonious evolution of everyone's work, based on the conduct of each one, of a tutelage at work that leads to the regulation of individualism before the collective.

Another question examined whether students would be interested in taking courses on ethics. Table 6 lists the results obtained.

Table 6 - Would you be interested in taking an ethics-related course?

Yes	36.6%
Not	8.8%
Depends on the type of course	54.9%

Source the author (2022)

Several comments were received on this issue; the results are listed in Table 7.

Table 7 - Main comments about this topic.

Comments	Frequency
I think the reflection of ethics applied to technology is very important. Ethics and AI courses have already been offered at CIn, and they were excellent.	2
It would be very interesting to conduct a course where concepts of ethics and their applications in the daily life of an IT professional are presented formally.	1
I would take short courses.	3
Something practical and focused on everyday life.	3
Course on ethics in relation to privacy, marketing, and labour replacement.	1
It would depend a lot on the direction and subjects covered in the course in a more comprehensive manner.	
I took a course at the Coursera of Data Science Ethics, and I found the model of the course to be very good; however, the professor taught it from a utilitarian perspective (he says there are other visions). However, I never took a computer ethics course (which goes beyond the ethical use of data, but the issue of development). I believe that CIn focuses considerably on technical excellence (which is great); however, it fails in humanistic training, which would allow the student to better perceive the positive and negative social effects of the technologies with which they work.	1
Would be interested in courses on ethics applied to decisions and choices made in the design of algorithms and software	2
Especially in the current market where data protection and compliance is a hot topic, there is a great need to work ethically from the classroom itself.	1
Ethics and data security/privacy and good practices related to the topic	1
I consider it important to study the subject of computer ethics to understand the limits related to privacy and the use of data because technology is currently very closely linked to our daily lives.	1
If it were a course that promoted debates in the area	2

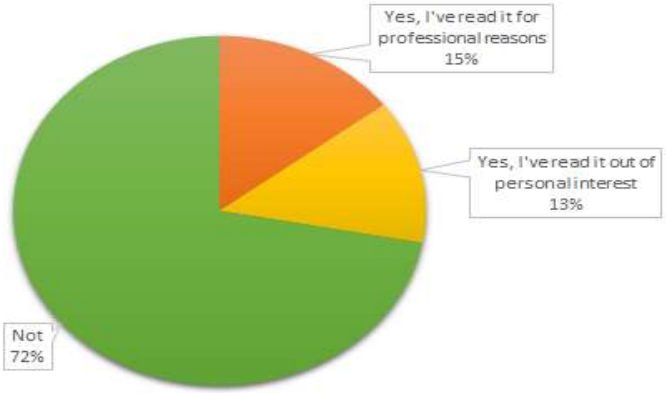
Ethics is the discipline that is most lacking in the IT area because graduation there is an incentive to pirate PDFs of books, as well as in professional life, in which the result is the focus of the work, irrespective of how you get there. Whoever propagates the culture of IT ethics is unfortunately not present anywhere in Brazil.	1
Maybe an update workshop; however, it would not be a priority	1
As I develop my activities in a public institution, and I deal with data from citizens, I consider it important to approach the topic of ethics in this environment.	1
It is important that the professional is trained to act ethically because ethical dilemmas of the profession may not be clear to everyone	2
No course in itself, but I would make chairs in ethics because as my course is difficult any elective that seems easy is interesting.	1
A course focused on my area of expertise such as ethics in engineering and software development	1
Courses on more human subjects end up being taught in a very non-objective way, and they are viewed by students as “free chairs.” However, ethics is extremely important especially in the world of academic research, more especially still in academia in Brazil, which has many questionable practices that are widely disseminated.	1
It is always important to study the aspects that involve the use and consumption of products that we develop in the academy. For this, it is necessary to have a broader view beyond the product or the research itself, as an example of the ethical aspects involved.	1
Given the construction of a completely clueless state and a college completely outside the development reality of our country, an ethics course would be useless, because the institution’s structure is contradictory. Who does it serve? The best brains leave the country, while the worst need to submit to knowledge that is not in the job market to win a title. This is a complete contradiction. Further, the scientific production seems to be in the background; therefore, an ethics course does not seem appropriate until these contradictions are resolved.	1

I believe that the subject is of extreme importance; not only ethics, but other issues considered as “from the humanities” should be discussed further. Feminism, racism, and machismo are guidelines that must be present in computer courses.	1

Source the author (2022)

Another proposed issue is related to the knowledge of the code of ethics. The question was, “Have you read the code of ethics of a professional in any computer area? For example, a software engineer's code of ethics.” Figure 21 shows a graph of the answers obtained. The results show that 72% of participants did not have knowledge about the code of ethics, 15% of participants read the code of ethics for professional reasons, and 13% of the participants read the ethics code for personal reasons. This result shows that the vast majority had no interest in reading the code of ethics. Flores and Meira (2019) corroborate the results of this research because in his work there was the participation of 103 software developers, and it showed that a great part of them did not have any contact with any code of ethics. Only 36% of the respondents came in contact with a code of ethics. Caiçara (2015) states that information ethics refers specifically to standards of right and wrong that pertain to information processing practices. These directly impact the image of the company and its managers, and therefore, it is always recommended that a code of ethics and conduct be established and disseminated in the treatment and use of business information, both from the customers and from the company itself and its contributors.

Figure 21 - Have you read the code of ethics of a professional in any computer area? For example, a software engineer’s code of ethics?



Source the author (2022)

Another proposed question for students was if you think that the academic content given on ethics is/was sufficient? Table 8 shows the results obtained, and we can see that 47.3% of participants did not study any discipline on ethics, 35.2% did not consider the content to be sufficient, and 17.6% considered the content to be sufficient. This result shows that institutions need to teach ethics discipline and improve content.

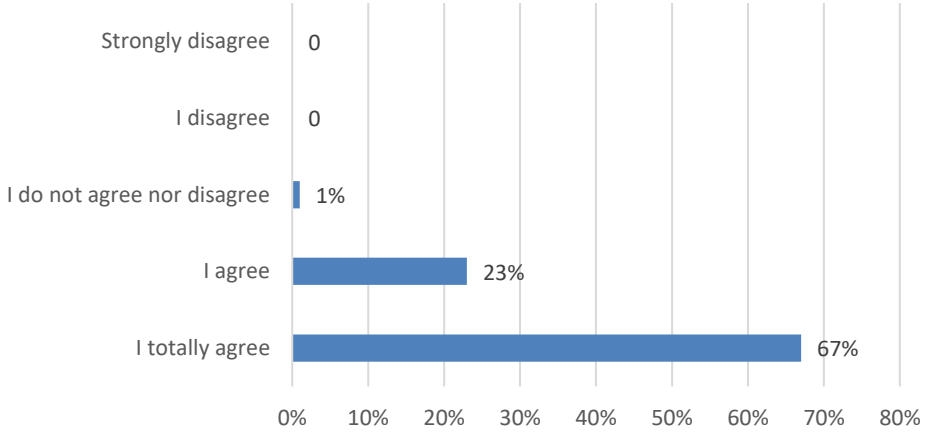
Table 8 - Academic content provided on ethics is/was sufficient?

Yes	17.6%
Not	35.2%
I never studied any discipline on ethics	47.3%

Source the author (2022)

A good ethical conduct was also investigated. The proposed question was, “Do you think that good conduct can influence the image of an IT professional?” Figure 22 shows that 67% of participants strongly agree that good conduct can influence the image of the IT professional, 23% only agree, and 1% remain neutral. There was no disagreement regarding this question. This result shows that poor ethical conduct is considered to damage people’s professional image. Benites and Oliveira (2017) report that studies on ethics show the need for seriousness and commitment in the development of any type of work, in carrying out tasks in the most correct way possible. It indicates how an individual’s inappropriate behaviour influences the result of a whole in an organisation?

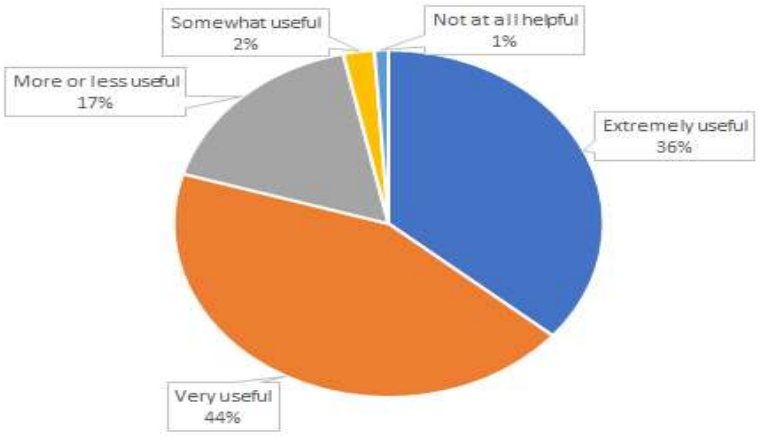
Figure 22 - Can good conduct influence the image of the IT professional?



Source the author (2022)

The value attributed to the ethics discipline within the area of informatics was investigated. Figure 23 shows the results obtained; 44% of participants considered it very useful, 36% considered it extremely useful, and 17% considered it more or less useful. Collins et al. (2009) presented six arguments about why the subject of computer ethics should be studied and analysed. The code of ethics was developed because of the increasing ambiguity of issues related to ethical concerns and it is used to minimise this ambiguity by creating guidelines that can be applied when making decisions.

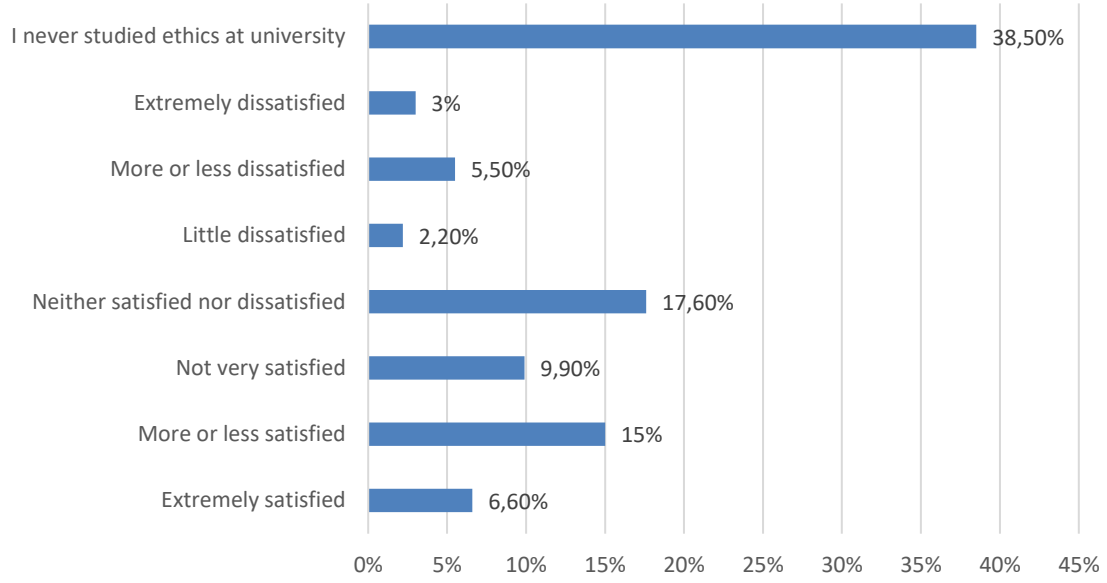
Figure 23 - What is the value you attach to the discipline of ethics in undergraduate / graduate courses in the area of information technology?



Source the author (2022)

In general, were you satisfied, indifferent, and dissatisfied with the knowledge of ethics acquired at the university you study? 38.5% of participants never studied ethics at the university, 17.60% were neither satisfied nor dissatisfied, 15% were more or less satisfied, 9.9% were not very satisfied, 6.6% were extremely satisfied, 5.5% were more or less dissatisfied, 2% were slightly dissatisfied, and 3% were extremely dissatisfied, as shown in Figure 24. A total of 17.6% were indifferent to the knowledge obtained, 31.5% were satisfied, and 10.3% were dissatisfied. This shows that the discipline of ethics is not present in all curricula of undergraduate and graduate courses. Flores and Meira (2019) examined the curricula of 115 undergraduate courses in computer science, computer engineering, and information systems in 64 universities in Brazil and found that disciplines involving ethics are taught in the majority of undergraduate courses with 77% of the courses of computer science, computer engineering, and information systems.

Figure 24 - Were you satisfied, indifferent, and dissatisfied with the knowledge of ethics acquired at the university you study?



Source the author (2022)

The subjects observed in the ethics discipline were investigated. The question asked was, "If you have already studied ethics in undergraduate or graduate courses, what were the main ethical issues discussed?" Table 9 summarises all comments obtained for this question.

Table 9 - Main ethical issues mentioned.

Comments	Frequency
Working methods	1
The use of data and the working relationships that arise with new technologies	1
Ethics was approached from the point of view of organizations. The case of Enron was shown, and it was also said that more ethical companies have better financial results.	1
Types of ethics, ethics and morals, and difference between ethics and laws.	1
Behavioural	1

Moral ethics, privacy, and dilemmas	4
Ethics in the advertising market and professional ethical conduct.	1
Historical context and introduction to the topic without practical content.	1
Business positions and codes of conduct	1
Use of systems and data to cause harm to the population.	1
Veracity, privacy, ethics in professional behaviour, and ethical responsibility	1
Impact of information technology on society.	1
Security posture and hackers	1
Rights, duties, good professional conduct, and penalties	1
Legislation, good conduct, confidentiality, morality, and anonymity of data	1
How to use data provided by users ethically.	2
Ethics in free software	1
Ethics in the survey of software requirements.	1
User / consumer privacy and psychology	1
Difference between ethics and morals, the basics.	1
Professional ethics	1
Ethics in software engineering as situations in which the software engineer must intervene when realizing that certain decisions and implementations entail risk	1
Professional-oriented ethics: How to behave, what you can and cannot do, ethics geared to the public sector: DECREE No. 1,171, ethics and citizenship, and others.	1

Source the author (2022)

Further, ethical issues were investigated. The question asked was, “In your opinion, what ethical issues can be better studied to assist in teaching ethics in undergraduate and graduate courses? For example, morality, privacy, responsibility, etc.” Table 10 shows all the comments obtained for this question.

Table 10 - Main ethical issues mentioned.

Comments	Frequency
Responsibility	14
Morality	14
Diversity, Equality, Equity, and Justice	1
Privacy	24
Veracity, ethics in professional behaviour, ethics in human relations, and ethics in diversity	2
LGPD	1
Compliance, ethical dilemmas applied to the student and / or IT professional's daily life	1
Ethics linked to social technologies, machine ethics, ethics for machines, robotics, professional ethics, data privacy, responsibility in software development, ethics on the internet, and bioethics (at the intersection of Biology and Technology)	1
Copyright	1
Free consent in research	1
Bias in processes and algorithms; legal issues about data and intellectual property of software assets.	1
Respect differences and professional responsibility	1
Piracy, hacker culture, IT teamwork, contracts and tenders, social networks, and the impact of not being ethical in them.	1
Confidentiality and intellectual property	2
Discrimination, legal duties, and moral duties	1
Ethics and data processing, ethics, and AI	1
Use of Free Software / Proprietary / Unauthorised access to computational resources / Intellectual property rights / Ethics in Systems Development - linked to aspects of gender, race, colour / Confidentiality and data privacy	1
I think about morality and legal aspects. I believe that ethics is also linked to laws.	1
Advertising, justice, citizenship, rights, laws on ethics, penalties, warnings,	1

importance of knowing the code of ethics of the company that works, and examples of ethical and unethical people.	
Data security (privacy risks).	1

Source the author (2022)

Methods to improve ethical issues in higher education were also investigated. The question asked was, “In your opinion, how can students’ experience with the topic of ethics be improved in undergraduate and graduate courses?” Table 11 shows all comments obtained to this question.

Table 11 - Main comments about how the student’s experience with the topic of ethics can be improved in undergraduate and graduate courses.

Comments	Frequency
Make it a topic of debate rather than a lesson.	1
A specific discipline. Ask students to write an article.	1
Making students aware of the impacts of the lack of ethics in the market	1
Sharing experiences	9
Methodology to maintain data accuracy	1
Through the transversal of the theme in other disciplines	1
Classes and projects where the concepts could be applied.	1
Study of practical cases with the issuance of a report with the student's opinion on the questions presented.	7
Learn from real cases	22
Inclusion of disciplines related to professional ethics and data protection	1
More business-oriented approach	1
Through classes with philosophy professors specialised in IT.	1
Treating the theme in an integrated manner with the disciplines of the area, without separating ethics and professional practice.	1
Documentaries, technical visits, presentation of codes of ethics, and conduct existing in the areas covered by the course	1
It could have a chair on and points of the subject could be touched on in the other chairs that deal with this humanistic formation (informatics and	1

society and history and future of computing, in the case of CIn-UFPE)	
Through courses offered in the area, optional subjects.	1
Updated debates	2
Experiencing problematic scenarios that force students to make decisions that involve ethical dilemmas	1
Assigning greater importance to discipline and offering it as an essential component	1
Contextualise, set up social scenarios for culture shock, bring in experts from large companies to show how things work in an environment where there is an ethical culture and how to achieve ethical behaviour compliance.	1
Make it a mandatory subject and include it in the final project of the course	1
Working with ethical paradoxes	1
An introductory course in the first term of the course	1
Know the ethical responsibilities in the construction of computer systems, which is acceptable or not considering the moral issue and the responsibility to deal with user data, avoid generating biased data for research and training with IAs, seeking solutions that have concern and respect with people	1
Incorporate ethical issues in the most diverse professional and academic approaches	1
It could be addressed in disciplines that address topics of greater contact with people, such as IT and society and business management	1
Learning to deal with adverse situations, knowing what is right and wrong, improving justice, and the importance of a clear conscience.	1
Elective courses	1

Source the author (2022)

4.5.8 Perception of professors in universities on the teaching of ethics

We present the opinions of 29 professors on the teaching of ethics in higher education. There was no demographic profile, only the finding that the person held or not the position of professor. Of these, 55.17% were university professors, and 44.8% were currently working as university professors. The answers to the objective questions and comments are presented.

The first question asked was, “In your opinion, would a specific discipline on ethics be necessary for courses in the IT area?” The results showed that 89.7% of professors considered it important to include a specific discipline on ethics. Towell (2003) conducted a pilot study to investigate the teaching of ethics in software engineering with the participation of 127 educators. Among the topics considered most critical by the respondents were unauthorised access and computer security. The importance of teaching topics was also highlighted by Towell, Thompson, and McFadden (2004). The teaching of ethics in their curriculum was “largely ignored” by 41% of the participants. Table 12 summarises the main comments on this question.

Table 12 - Main comments about a specific discipline on ethics.

Comments	Frequency
It is necessary to discuss behavioural ethics and in relation to the accuracy of research	1
Yes, but only in graduate school.	1
A mandatory discipline.	1
It is essential that students in IT courses study principles of ethics. This is often relevant to your daily life as a professional. Without a formal minimum ethical base, principles such as morality, justice, etc. can be neglected.	1
The teaching of ethics guides the professional on issues that can be culturally treated incorrectly, such as respect for diversity, data protection, and confidentiality.	1
The specific discipline on ethics allows more density in related content and aims at a deeper exchange of knowledge related to ethics, with the function of making students, professionals not only qualified and qualified at the end of the course, but also in accordance with ethical principles.	1
The discipline must be focused on real cases of ethics in the computing area, it will be very important and attractive.	1
All courses should have the discipline of ethics.	
Guidelines, there is no need for a semester on the subject.	1
Would be very interesting. Today the content is addressed indirectly, and	1

it is up to the teachers to introduce the subject.	
Ethics applied to IT with practices; nothing just conceptual.	1
Ethics content can be approached across the curriculum components of the course.	1
I think it is necessary for those who are going to enter the academic world, to avoid “life lessons.” It is important to clarify to future professionals about their role in society as well as about the regulation of ethical standards applicable to the exercise of their profession	1
In my opinion, debating ethics within another discipline gets in the way because of time constraints and the scope of the discipline. I have the impression that the result is that the student will not absolve the content properly.	1
I had an undergraduate ethics class, and it was very important in my learning. Acting ethically can sometimes become confusing in a given situation. If you do not know that a certain thing is wrong you can be led to do something unethical and break laws, code of conduct, and suffer penalties. Or there may even be a situation where the person must be prepared to report someone they know, if you do not report you are an accomplice and can pay together for the crime.	1

Source the author (2022)

The second question asked was, “Have you taught about the existence of a specific code of ethics in the field of computing at the national or international level?” The results showed that 86% of professors never taught about the existence of a code of ethics. These values indicate that the number of teachers who participated in this research and taught ethics was less than 20%. Table 13 shows the main comments received for this question. The comments show some aspects such as teaching using the IEEE code, and another comment was on business administration; however, the majority said that they were not lucky to teach this discipline.

Table 13 - Main comments about the existence of a specific code of ethics.

Comments	Frequency
I have no knowledge	2
I taught the IEEE / ACM code	1
I taught distance and distance learning	1
The code of ethics I know is from the project manager profession.	1
I taught professional ethics only in business administration, mentioning and applying activities that involved a code of ethics and a code of professional conduct and other related matters	1
I did not get a chance.	6
I have already mentored students and we need to talk about submitting the project to the Research Ethics Committee.	1

Source the author (2022)

The third question asked was, “In your opinion, are the codes of ethics and professional conduct necessary for good professional conduct?” 91.3% said that the code of ethics and professional conduct was necessary for good professional conduct. This issue highlights the importance of knowledge of the code of ethics in professional performance. According to Oriogun et al. (2012), it is necessary to prepare students for the complexities and difficulties of the professional areas in the field of computing. Wilk (2016) also discusses the necessity of teaching a law course with legal and ethical aspects and professional responsibility for better student awareness. Table 14 shows the different comments received on this question.

Table 14 - Main comments about professional conduct.

Comments	Frequency
Despite not having in-depth knowledge, I believe that some professionals should know a little more, especially about responsibilities	1
Without a code of ethics, professional performance ends up being very fragile when faced with important principles such as justice, diversity, morality, etc. A code can better guide professional to better deal with these concepts.	1

Yes, as he said, he guides not to make mistakes related to various issues, which are even treated as social conventions.	1
Offer guidance / reference so that people can make decisions on a daily basis.	1
I see it as an alternative.	1
The code of ethics is a compilation of good practices for a given area.	1
The fact that you do not have the code of ethics does not mean that you will not have good professional conduct; however, it does not mean that it is not desirable to have the code. With the code, conduct is likely to improve.	1
Yes, guidelines. Just like the doctor has his oath.	1
It is important that at least students know about the code of ethics and receive at least a minimum presentation of their topics.	1
A code of ethics is important, but it does nothing by itself. People are responsible for following it.	1
A good professional must appreciate hard work, honesty, and cordiality. These are directly linked to the mentioned topics.	1
It is important to know your role as a computer professional and the values that can guide everyday work. In fact, computers and computer techniques are not the problem of society. The question to be discussed is how they will be created and used in their day-to-day lives. Thus, in addition to the technical knowledge acquired at the university, the professional also needs a sufficient load of disciplines related to ethics, which would help him in certain situations in which decision-making is necessary.	1

Source the author (2022)

The fourth question asked was, “Do you often read newspaper or magazine articles that deal with ethical issues?” The results showed that most teachers did not read newspaper or magazine articles, as shown in Table 15. Only 27.6% were interested in the topic, and the main comments were that there was interest when there was some scandal in this area. Table 16 shows the main comments received for this question.

Table 15 - Do you often read newspaper or magazine articles that deal with ethical issues?

Yes	27,6%
No	72,4%

Source the author (2022)

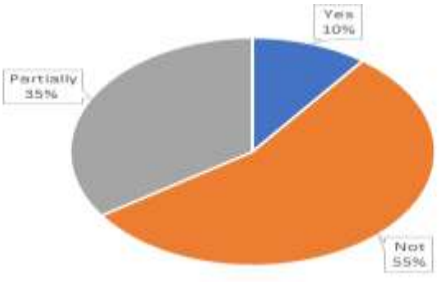
Table 16 - Main comments read newspaper or magazine articles.

Comments	Frequency
Lack of time	2
Eventually, I read in courses and training or when it involves a scandal in this area.	3
Research on Research Ethics involving humans in computing	1
The following always present information with the theme: https://tarciziosilva.com.br/blog/ E http://gitsufba.net/	1

Source the author (2022)

The fifth question asked was, “In your opinion, is the knowledge acquired at the university sufficient for the professional training of students?” 35% participants replied “partially,” 55% answered “no,” and 10% answered “yes,” as shown in Figure 25. There were several comments on that topic, and many professors indicated that the university provides some knowledge on the subject; however, the student needs to seek professional practice and the university alone is not sufficient. Table 17 shows the main comments received on this question.

Figure 25 - Is the knowledge acquired at the university sufficient for the professional training of students?



Source the author (2022)

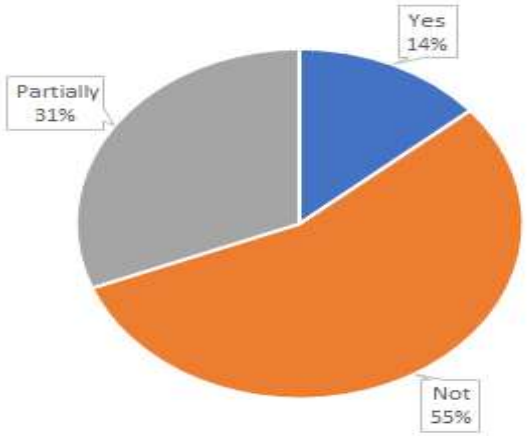
Table 17 - Main comments about knowledge acquired at the university sufficient for the professional training of students.

Comments	Frequency
College provides the foundation	1
We know that no course, no matter how good, trains a professional completely for the challenges he will face when he enters the job market. The experience and practice (in addition to other courses that the professional ends up taking to specialise) end up complementing this training	1
At graduation, this knowledge guides the student to search for information in specific areas within informatics, if necessary.	1
In IT, changes are faster than the university can update itself.	1
It depends on the course, and / or it depends on the student.	1
The curriculum must always be updated with the market, especially in the IT area. That is enough	1
I believe that the university creates the foundation for professional training. However, the university alone is not sufficient.	1
Not every university theory has a role in the market. Many practical problems are not addressed at the university.	1
There is no minimum training for this purpose (at least in Brazil).	1
Students must always be up to date	1
Computing is a very broad area. Students who want to be developers end up learning most things “on the go,” while students who want to be scientists do not really learn about research and academic production until they graduate.	1
There is certainly a need to discuss social issues, gender, race…after all, computing is MEANS and not an END. Only during the doctorate, with greater autonomy in studies. For example, use of digital technologies by native people / how to create and use technology for this audience / not to see the user just as a user of the technology…but rather as a person, who has a life story.	1

Source the author (2022)

The sixth question asked was, “Are students interested in the discipline of ethics in the IT area?” 55% answered “no,” 31% answered “partially,” and 14% answered “yes,” as shown in Figure 26. The professors commented on several things as examples of students’ interest in knowledge related to the labour market, and some students considered it a discipline of “human sciences.” These commenters are very important for analysing the profile and interest of students in the area of informatics in relation to the teaching of ethics. The responses of the students indicate that the discipline of ethics is important for undergraduate and graduate courses; however, the opinions of the teachers is that there is a lack of interest from the students. Table 18 shows the main comments received on this question.

Figure 26 - Are students interested in the discipline of ethics in the IT area?



Source the author (2022)

Table 18 - Main comments about students interested in the discipline of ethics in the IT area.

Comments	Frequency
Most students seek immediate inclusion in the market	1
They think this should be of interest to the humanities.	1
It may happen that students become disinterested in the fact that the discipline of ethics is associated with “human sciences,” and this generates a certain distance from those who only want to focus on technical issues.	1
I believe that they like the discussions that are generated.	1
I am not sure, but I think they are not very interested	1
Usually, students are more interested in the target subjects of the area they	1

want to work in.	
When the student does not see this applicability, he studies only by attending. That is why the discipline of ethics needs to be very close to the reality of computing.	1
The way the discipline is presented will indicate whether the interest will exist. Situational approaches are more interesting and engaging.	1
It is not because they see no need. Until they come across a company that covers it for them.	1
The way the discipline of ethics is taught today, it seems that something just from the ideal world and only serves to fulfil the course load.	1
It has to be a theme modelled to be attractive, otherwise it can be seen as tedious.	1
I believe that people have the curiosity and the need to learn about the subject.	1
It is possible to encourage students to think ethically.	1

Source the author (2022)

The seventh question asked was, “What are the difficulties encountered when teaching the discipline of ethics at the university in the IT area?” There were many comments on this question, but five participants said that the main difficulties were the lack of interest and the professional qualification to conduct this discipline. There were comments about the lack of interest of students in the classes and strategies to improve the given content. These comments show the lack of interest of the students and the difficulty of the teacher in conducting this discipline. This discipline often ends up not becoming attractive because of a lack of knowledge and planning on the part of the teacher. Therefore, it is necessary to adopt better methods for teaching ethics in higher education. Table 19 shows the main comments on this question.

Table 19 - Main comments about the difficulties on teaching ethics.

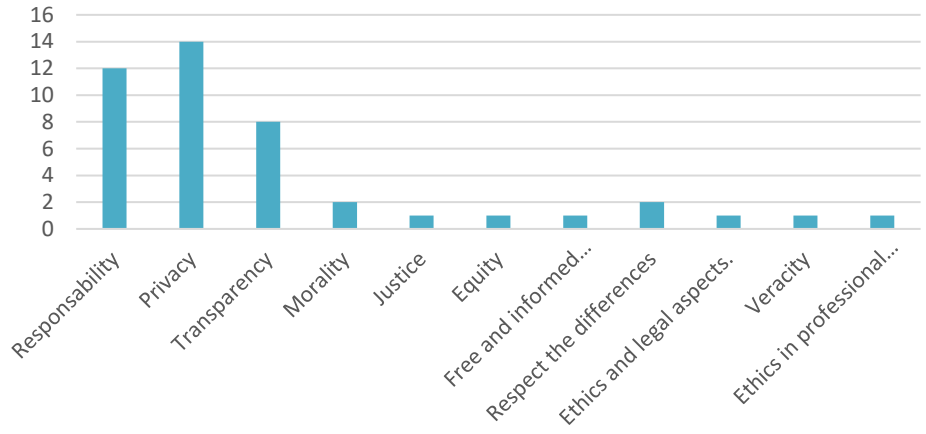
Comments	Frequency
Lack of interest and professional qualification	5
IT students do not want reading material or deep reflections, they want to focus only on the technical aspects.	1

Lack of theoretical framework	1
Interest on the part of students and good strategies to approach the content.	1
Treat the subject in an attractive and relevant way. Associate the content with its application and professional conduct.	1
I see no difficulties, the topic itself produces productive discussions.	1
I do not know how to identify difficulties for this case, because “it is the discipline of ethics.”	1
The plastering of the curriculum, which is very regulated and little updated.	1
Making students responsible for the programs made and what to do with the knowledge acquired is very difficult. It has more to do with character and the character created in childhood than later teaching in adult life. At this time in life, what really works are financial rules / laws / punishments, unfortunately.	1
I did not have the experience of teaching a discipline. But I believe that the challenge would be to deliver content across the other disciplines.	1
It needs to be more objective. Very loose, philosophical, and abstract disciplines do not resonate or are taken seriously by most students.	1
Lack of interest from students; Difficulty bringing content that students can identify with; Structural problems in society that cause unethical behaviour to be considered normal, which makes it difficult for students to understand the importance of following ethical behaviour.	1
I imagine the lack of sufficiently motivating content. Both practical and theoretical.	1
I imagine the lack of sufficiently motivating content. Both practical and theoretical. Applying knowledge on a daily basis.	1
Students are not interested in the lack of prioritization because it is a relatively easy subject and is concomitant with other difficult subjects.	1

Source the author (2022)

The eighth question asked was, “What are the main ethical issues that could be better taught in undergraduate and graduate courses in the IT area? For example, privacy, transparency, responsibility, etc.” Most participants responded that privacy, responsibility, and transparency are the main issues that must be taught in higher education, as indicated in Figure 27. It is interesting to note that the theme of privacy was similar in both systematic mapping and surveys. Other ethical issues were also present in both; however, in different proportions.

Figure 27 - What are the main ethical issues that could be better taught in undergraduate and graduate courses in the IT area?



Source the author (2022)

4.5.9 Discussion

In surveys, the majority of students agree that ethics is important in undergraduate and graduate programs. Student perception of this issue is very important because it shows that students understand that ethics and education are directly connected. Ethical behaviours can be taught, enhanced, absorbed and naturalized by each individual and can be applied by software engineering in the software development process. A knowledgeable professional has the ability to make better decisions.

Another point mentioned by the students is the interest to learn about ethics, they answered that their interest to learn about ethics depends on the type of course offered. This response demonstrates that students understand that ethics should be a topic of discussion between students and professors because there are many conflicts in this area. Many examples in society show that it is common to see reports of corporate misconduct. Thus, students choose something debated and not just theory into the more traditional style.

The code of ethics was not read by university students and most of them did not study it. The code of ethics is an interesting topic to discuss since students must be aware of the reading of this code. Because the code sets a standard of behaviour for computer professionals in the profession. Professional misconduct can occur because of a lack of awareness about reading the professional code affecting the professional image. And the students agreed that professional ethics is very important to IT professionals.

Ethics education can be taught in different ways, teachers can explain the subject in different ways. When asked how ethics teaching could be improved from their perspective, most said it was through learning real cases and sharing experiences. Students choose to discuss issues that have already occurred in order to understand all the factors that led to this decision.

For professors, there needs to be an ethical discipline at the academic level. Professors agree that the university should support students on the issue of ethics. For an ethics professional seeks to offer their best knowledge to be applied in society.

Unfortunately, most professors who participated in this research did not have an opportunity to teach ethics. Most teachers do not read about the subject and only take an interest in it when a scandal is reported.

The professors also point out that the students are not interested in the subject. Explain the lack of interest of student is very complicated as there are many causes of this problem which can be personal and institutional. On the personal side, there may be factors such as family disorganization, social environment, unfavourable financial conditions, lack of personal interests and attention to the labour market. On the institutional side, there are factors such as the availability of the teacher, experience and methodologies applied in the discipline that do not motivate the desire to understand more about the subject.

Professors understand that a code of ethics is required to ensure good professional conduct. However, most professors have never had the opportunity to teach on this theme. Thus, we can understand that there is an idea on the importance of a code of ethics but applying this knowledge within the courses needs to have more attention. This response is very interesting because they can think about the code of ethics and how professors could adopt best practices for teaching it.

5 DOCUMENT ANALYSIS

As a third secondary objective, it was naturally necessary to census the current course on ethics in Brazilian undergraduate computing departments. One methodological choice could be interviewing current teachers responsible for the courses involving ethics. However, we estimated, looking for publication on ethics for computing in Brazil, that so far there are a very number of computing lecturers deeply involved in ethics studies. So, we decided to perform a document analysis of the syllabus of each course mentioning ethics in the main Brazilian departments.

Of course, there is no guarantee that the syllabus is up-to-date or that the teachers are really following them. Moreover, a syllabus is just content. It reveals nothing on the pedagogical approaches, active learning methods for instance, employed by the teachers, which can make lot of difference in students learning (ZALUSKI; OLIVEIRA, 2018). Despite this limitation, we kept our decision of examining the syllabus since they officially represent what the students are supposed to learn. Furthermore, the comparison between the syllabus and the ethical issues raised by our first study would be easier.

Finally, there is a last disclaimer concerning the learning of ethics in computing: should it occur in a specific course or distributed in various courses? Ethics is obviously a transversal subject and could be studied in different courses. On the other hand, as we saw in our second study, many teachers seem not to be prepared to teach ethics in computing. So, operationally speaking, it would be easier to concentrate the ethics study in one single course, to which one could assign the teachers that are really prepared to promote ethics learning. This is a controversial issue so far.

5.1 Document analysis definition

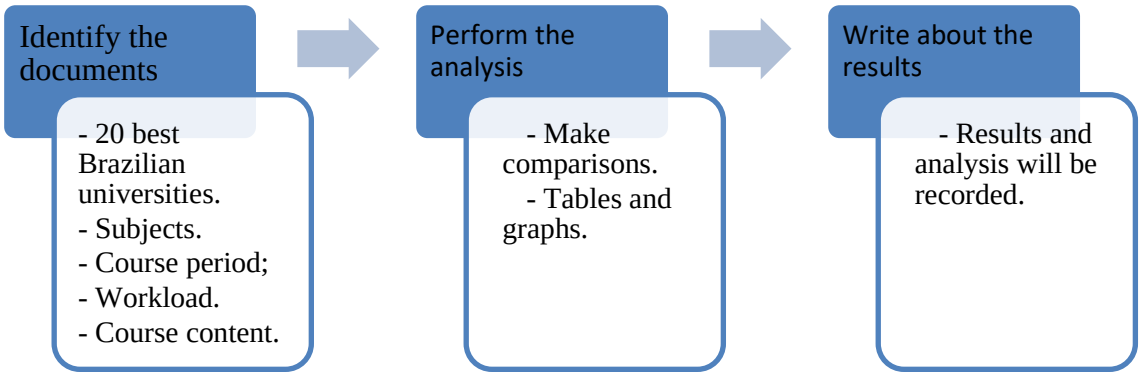
Document analysis is a more specifically oriented form of bibliographic research. Multiple document formats, including tokens, maps, forms, tickets, photographs, and others, are considered with the aim of developing quantitative or qualitative responses about a specific phenomenon (GIL, 2010).

In the documental research phase of this study, all documents were verified and analysed as a matter of priority. Data was obtained using the websites of 20 Brazilian universities.

In this phase of our study, the objective was to identify the 20 best Brazilian universities and extract the information about subjects, course periods, workloads (h), and course syllabi to analyse how computer science students and professors interact with the ethics theme.

Figure 28 shows the phases of document analysis. The details of the research conducted in this phase are documented in Section 7 of this manuscript.

Figure 28 - The activities of the phase of document analysis.



Source the author (2022)

5.2 Document analysis results

5.2.1 Research characterisation

In this section, the results of our document analysis are presented and discussed with the aim of characterising the information obtained from Brazilian universities both at the undergraduate and graduate levels.

Table 20 lists the questions that were asked to guide the search for information about Brazilian universities.

Table 20 - Questions about document analysis.

Item/Sequence	Questions
1	What are the recommendations of authorities and references for the teaching of ethics in the field of computer science?
2	Ethics is taught in which discipline?
3	How many hours are there in the subjects focused on the topic of ethics in the undergraduate and graduate courses in the field of computer

	science?
4	What is the syllabus adopted in the discipline of ethics in the undergraduate and graduate courses in the field of computer science?

Source the author (2022)

5.2.2 Overview of the computer science courses at Brazilian universities

Table 21 lists the computer science courses evaluated in 20 universities across the country. Both undergraduate- and graduate-level courses are included.

Table 21 - Brazilian universities.

Item	Name	State
1	Universidade Estadual de Campinas	SP
2	Universidade Federal de Minas Gerais	MG
3	Universidade Federal do Rio Grande do Sul	RS
4	Universidade Federal do Rio de Janeiro	RJ
5	Universidade Federal de Pernambuco	PE
6	Universidade de São Paulo	SP
7	Pontifícia Universidade Católica do Rio de Janeiro	RJ
8	Universidade Federal de São Carlos	SP
9	Universidade Federal do Paraná	PR
10	Universidade Federal de Santa Catarina	SC
11	Universidade Estadual Paulista Júlio de Mesquita Filho	SP
12	Pontifícia Universidade Católica de Minas Gerais	MG
13	Universidade Federal de Campina Grande	PB
14	Universidade Tecnológica Federal do Paraná	PR
15	Pontifícia Universidade Católica do Rio Grande do Sul	RS
16	Universidade Federal do Ceará	CE
17	Universidade Federal da Bahia	BA

18	Instituto Tecnológico de Aeronáutica	SP
19	Universidade Federal de Uberlândia	MG
20	Universidade Federal do Amazonas	AM

Source the author (2022)

5.2.3 Answers to the questions about documental analysis

The first question was, ’What are the recommendations of authorities and references for the teaching of ethics in the field of computer science?’ While the MEC and the Brazilian Society of Computing (SBC) present guidelines for the teaching of subjects in the area of computer science, nothing specific concerning the subject of ethics is mentioned beyond the requirement that all subjects follow existing ethical standards. An excerpt from Article 4 illustrates how these guidelines are written and directed to university institutions.
‘Art. 4 The bachelor's and degree courses in the field of Computing must ensure the training of gifted professionals (BRASIL, 2016; BRASIL, 2012):

I - knowledge of social, professional, legal, ethical, political and humanistic issues;
II - understanding the impact of computing and its technologies on society in terms of meeting and strategically anticipating society's needs;
III - critical and creative vision in identifying and solving problems contributing to the development of their area;
IV - the ability to act in an entrepreneurial, comprehensive and cooperative manner in meeting the social demands of the region where it operates, in Brazil and in the world;
V - to rationally use available resources in a transdisciplinary way;
VI - understanding the needs for continuous updating and improvement of their skills and abilities;
VII - the ability to recognize the importance of computational thinking in everyday life, as well as its application in other domains and being able to apply it in appropriate circumstances; and
VIII - the ability to act in a globalized world of work’.

The second question asked was, ‘Ethics is taught in which discipline?’ Table 22 lists the ethical disciplines studied in 20 Brazilian universities at the undergraduate and graduate levels. We can observe that there are more ethics courses at the undergraduate level (14

disciplines) than graduate level (7 disciplines). At the graduate level, however, we found that there are no mandatory subjects, and a curricular syllabus is often proposed according to the semester and the professor. We also observe that in private universities, such as Catholic universities, philosophy is an underlying theme. It is also important to highlight that most disciplines address general ethics and society. As an example, Rauber and Zanatta (2004) wrote about ethics and education in a computer science course at the University of Passo Fundo, reporting that the discipline was elaborated in two content cores. The first nucleus refers to the foundation of general ethics, and the second refers to specific ethical issues in computing; hence the name 'General and Professional Ethics'.

Fiesler et al., (2020) published a survey about ethics classes in computer science curricula with the participation of 94 universities in the US and found that the content of computer science ethics courses has significant variability and a lack of standardisation. This is not to say that there are no common patterns. Some topics, such as privacy, algorithms, and inequality, are considered critical. According to Bates et al. (2020), there are various challenges in integrating ethics and society. One challenge relates to the cultural differences between teachers and international students, while another is the issue of miscommunication between different fields of expertise, which is common in interdisciplinary approaches to teach ethics and critical thinking skills.

The third question was, 'How many hours are there in the subjects focused on the topic of ethics in the undergraduate and graduate courses in the field of computer science?' Table 22 shows that 30% of the courses are taught for approximately 30 h per semester, 20% for 60 h per semester, 10% for approximately 70–75 h per semester, and 40% do not have a specific discipline on ethics. These results show that the workload for ethics is relatively small, and few universities address the topic in a 75-h discipline. In a publication about ethics and education in the computer science programme at the University of Passo Fundo, Rauber and Zanatta (2004) report that the discipline on ethics has 60 h/class, divided into weekly meetings of 4 h/class. The subject is a part of a set of mandatory courses and is conducted in the seventh semester of the eight-semester curriculum.

Table 22 - Disciplines at the undergraduate and graduate levels.

Name	Undergraduate level (duration)	Graduate level (duration)
Unicamp	--	--
UFMG	Ethics in computing	--

	(30h)	
UFRGS	--	--
UFRJ	Computers and society (60h)	--
UFPE	Informatics and society (75h)	Advanced Topics in Computational Intelligence 2 (60h)
USP	Ethics and Legislation in Computing: Theory and Practice (60h)	--
PUC-RJ	Social and Environmental Ethics Human Rights (30h)	Top Teo Comp II Philosophy, Computing, Ethics and Technology: An Interdisciplinary Approach (60h)
Univ. Fed. São Carlos	Philosophy of science (60h)	--
UFP	--	--
UFSC	Informatics and Society (72h)	--
Universidade Estadual Paulista Júlio de Mesquita Filho	--	Cyber security (60h)
PUC- MG	Philosophy: Anthropology and Ethics (30h)	Security and Privacy in Web Systems (60h)
UFCG	Informatics and Society (30h)	Higher Education Methodology (60h)
Universidade Tecnológica Federal do Paraná	Ethics, Profession and Citizenship / Fundamentals of ethics (30h)	--
PUC-RS	Ethics and Citizenship (60h)	--
UFC	Informatics and	--

	Society (32h)	
UFBA	Computing, ethics and society (51h)	Various topics
ITA	--	--
UFU	--	Computer Research Methodology (30h)
UFAM	Informatics, Ethics and Society (30h)	--

Source the author (2022)

The fourth question was, 'What is the syllabus adopted in the discipline of ethics in the undergraduate and graduate courses in the field of computer science?' Tables 23 and 24 list the syllabi of disciplines at the undergraduate and graduate levels. At the undergraduate level, we found a diversity of subjects that encompass ancient philosophical issues as well as problems unique to today's society. We can subdivide the content of the syllabus into three disciplines, all of which propose a way of incorporating ethics content. Both modern themes, such as the topic of privacy, and classical philosophical themes were included.

Table 23 - Undergraduate courses in computer science.

Universities	Subject	Courses (syllabus)
UFMG	Ethics in computing	Current Codes of Ethics. Ethics in Research. Citizen's Rights. Responsibilities and Rights of the Computer Professional. Surveillance and Cyber Crimes.
UFRJ	Computers and society	Analysis of the use of information technologies at levels: social, economic, political and cultural. Criticism of the indiscriminate adoption of new technologies. Impacts on work due to the adoption of new technologies. New professional profiles associated with the computer. Uses of information technology in education. History of national computer policy and future trends.

UFPE	Informatics and society	Basic general concepts of sociology; social impact of new technologies in history; sociological changes triggered by information technology; public perceptions and expectations of these changes; basic general concepts of ethics and law; cybercrimes; intellectual property and privacy; intrusion and viruses; privacy and citizenship; legal liability and security; case studies
USP	Ethics and Legislation in Computing: Theory and Practice	Computer Legislation. Software. Technologic innovation. Microelectronics and Digital TV. Digital inclusion. Internet and Information Security. Tax Guidance for the Information Technology and Information Technology Sector. Introduction to project preparation. Elaboration of a project.
PUC-RJ	Social and environmental ethics human rights	Anthropological, historical, philosophical and theological foundations of socio-environmental ethics and Human Rights.
Univ. Fed. São Carlos	Philosophy of science	The Greek model of theory: Plato, Aristotle and Euclid: the idea of proof. Galileo and Descartes: Universal Physics and Mathematics. The Crisis of Classical Reason: Critical Philosophy and Epistemology. Issues in the Philosophy of Science today
UFSC	Informatics and Society	Personal, professional and public ethics in the field of information technology. Ethical dilemmas of computer professionals; privacy, viruses, hacking, internet usage, copyright, etc. Unemployment and computerisation. Social

		responsibility. The professional and the job market. Work and human relationships. Entrepreneurship as an option for IT professionals. Legislation: National policy and current trends regarding the regulation of the profession.
PUC - MG	Philosophy: Anthropology and Ethics	Philosophical-anthropological conceptions. The human being as a being in the world and its symbolic-cultural dimension. The ethical condition of human action. Fundamental and current ethical issues, consumer society, ethnic diversity and ecological challenges.
UFCG	Informatics and Society	Scientific and technological development for society, culture and the individual. The information technology revolution. The emergence of the new economy: informationalism, globalisation and network society. Information technologies as a social construction: work relations, professional career, business ethics and intellectual property. Politics and citizenship in the knowledge society.
Universidade Tecnológica Federal do Paraná	Ethics, Profession and Citizenship	Professional legislation. Professional assignments. Consumer Protection Code. Code of professional ethics. Technical responsibility. Intellectual property.
PUCRS	Ethics and Philosophy of Science	Introduction to ethical concepts. Reflection on the relationship between ethics, knowledge and science. Study of scientific method conceptions and the nature of scientific knowledge. Addressing problems related to the history of science and the epistemology of science.

UFC	Informatics and Society	Ethics and legislation, environment and sustainability. Extension projects. Social, economic, political and cultural implications of Technoscience (Technology and Science); The role of the Third World regarding innovations in Technoscience; Telematics and networks for international communication and their influence on the generation, dissemination and use of Technoscience; Influence of the use of Technoscience on family, education, work and citizenship.
UFBA	Computing, ethics and society	The role of the computer in contemporary society: impacts, consequences and trends. The new paradigms of the information society and its economic, social, political, ethical, cultural and educational aspects. Ethics and the profession. Rights and duties of the professional. Associations, professional bodies and their objectives.
UFAM	Informatics, Ethics and Society	The technical-scientific revolutions and society. Economic, social, cultural and legal aspects of computing. Social development and economic development. Sustainability. Technology-based development models. Social and environmental impacts of Informatics. Professional ethics. Computer labour market. Regulation of the profession. Legislation. Security and privacy. Ergonomics. Informatics in Education and Medicine. New technologies for teaching.

Source the author (2022)

Table 24 - Graduate courses in computer science.

Universities	Subject	Courses (syllabus)
Universidade Estadual Paulista Júlio de Mesquita Filho	Cyber security	Cyber security and society, information in current organisations and the value of control and protection; Cyber security in institutions, attacks and threats; Infrastructure Management as Protection, Continuity and Survival; Risks involving information, dangers and threats existing in the current context, with an emphasis on connectivity and protection of applications and networks; Internet security and defence, cyber security methods applied to information in the current context; Threats and vulnerabilities, the main types of attacks and the methodologies of current attackers, their motivations, purposes and limitations. Secure configuration of network infrastructure environments, perimeter protection, and cyber security enforcement; Legal and ethical issues involving cyber security, the Brazilian General Data Protection Law and the European General Data Protection Regulation.
Pontifícia Universidade Católica de Minas Gerais	Security and Privacy in Web Systems	Technologies to protect security and privacy on the Web. Security and privacy of Internet users. Internet server security. Web service provider security.
UFCG	Higher education methodology	Discipline of a comprehensive and theoretical-practical nature aimed at dealing with training processes for the exercise of teaching. It seeks to approach teaching and learning from a political, historical and cultural perspective of Education

		and Knowledge. It addresses the relationships between the university, the curriculum and culture, examined in the light of ethical, philosophical and epistemological considerations. It sees school education as a mechanism that produces culture, subjectivity and identities. It discusses different perspectives of didactic-pedagogical organisation of school knowledge and its evaluation, examining them in their social, political and cultural effects.
PUC - RJ	Philosophy, Computing, Ethics and Technology: An Interdisciplinary Approach	What is Philosophy and what is Computing? • General definitions to guide the discipline • Computing and Digital Technologies Philosophy and Computing: Points of Tangency and Areas of Intersection • Examples of Interdisciplinary Tangencies & Intersections Philosophy of Computing and Technology: Computing and Digital Technology as a Focus of Philosophical Thinking • Philosophy of Technology: Overview of Main Approaches • Examples of Philosophical Issues in Computing Philosophy in Contemporary Computing: Debates on Ethics and Moral Responsibility • Ethics and Moral Responsibility; • Ethics and Artificial Intelligence; • Ethics in Research in Computing

Source the author (2022)

In figures 29 and 30 we observe which words appear the most repetitive words in the syllabus shown in tables 23 and 24. In figure 29, the words Ethics, Technology, Professional, Information, Social and Computer were the words that had the most occurrences at undergraduate level.

Figure 29 - Word Cloud at undergraduate level.

Source the author (2022)

In figure 30 the words Secure, Computing, Protect, Cyber, Ethics, Current, Culture were the words that had the most occurrences at graduate level.

Figure 30 - Word Cloud at graduate level.

Source the author (2022)

5.2.4 Analysis and discussion

In the analysis of the documents, the recommendations of the MEC and SBC were reviewed, and it was realized that the information is more focused on the student's profile at the end of the course.

By analysing the professional profile of computer science courses, we can see the presence of ethical-social aspects linked to an ethical position in the practice of the profession.

They is a concern about the environment, digital accessibility and the democratization of access to information and human competencies.

In addition to that there are courses within the area of computing that also report that the graduate must be creative, innovative, have oral and written communication skills, leadership spirit, ability to work in a team and a critical view of the area.

In summary, the recommendations do not provide information on pedagogical and didactic training for teachers. There are recommendations on the desired profile of the student leaving computer classes.

The MEC establishes the workload in relation to the course time, for example minimum hours group of 2,400h: Minimum limits to fulfill of 3 (three) or 4 (four) years. Do not establish the distribution of workload by subject. In this way, course coordinators establish this distribution of workload across disciplines.

Most subjects in Brazil are taught in ethics and society, and 30% of classes have a 30-hour workload. This workload is implemented by the departments of each course and the vast majority follows the MEC's recommendations. Another point noted is that there is a wide variety of content and that there is no standardization at the undergraduate and graduate levels.

6 INFORMATION CROSSOVERS

In this session, a cross-examination was done with the information obtained in all three parts of the work. Results from the research questions and the survey were compared to the document analysis.

The research questions revealed that the top ethical issues were privacy and transparency. In figures 35 and 36, the words that were most repeated in the syllabus were identified, it can be seen that the word privacy is seen at undergraduate and graduate levels. However, the term transparency does not appear in the program. This means that privacy is an issue addressed in both ethics' courses and published literature. Transparency has been discussed more in terms of publications than topics in universities. There are other words in both contexts as well, such as intellectual property and responsibility, but not so often that it was privacy.

Another interesting point is to observe how there is a variation of words which shape the discipline of ethics which implies topics such as information, technology and society.

In the survey, by crossing the information on the perception of students and professors on the topic of ethics and the analysis of documents, we realized that the students consider the topic of ethics important but in terms of the courses they assess how the course will be taught. There's no interest when the course is done without discussion and debate. Professors also point out that the discipline of ethics is necessary at the university level, but not everybody reads about ethics and is motivated to teach about it. An issue that can be discussed is: Since the discipline of ethics is so important for undergraduate and graduate courses because most courses have a workload of only 30 hours? It is noticed that there is a variation in terms of workload and syllabus in computer science courses in Brazilian universities.

7 CONCLUSIONS AND FUTURE WORKS

This chapter aims to present some final considerations about the main topics covered in this dissertation, including contributions achieved and the directions for future work. The guiding question of this work was, ‘how well ethics has been studied in the Brazilian undergraduate computing courses? To answer this question, it was necessary to conduct systematic mapping work, survey, and document analysis.

Initially, a systematic mapping process was conducted to identify the major ethical issues discussed in the publications from the last five years and the topics being taught in universities. From this study, a survey was conducted to assess the perceptions of professors and students regarding how ethics are taught in the computer science courses at Brazilian Universities. Finally, document analysis was conducted to analyse how Brazilian universities are working with ethics topics.

Based on this study, a new guide can be created to develop new teaching and learning resources. The development of new curricula for courses in the area of information technology can be implemented, and new techniques for teaching the subject of ethics in universities can be suggested to professors.

7.1 Main contributions

The main contributions can be identified in the three parts of this dissertation work:

In the systematic mapping process, the main contributions were to identify the most prevalent ethical issues discussed in publications and the ethical issues being taught in universities. We also highlight the types of research contributions that have been published the most on this topic, and an interesting fact we found is that there are not many works on both systematic review and mapping with the subject of ethical issues.

Our survey contributes to our understanding of the student satisfaction with the teaching of ethics at the university level. The survey also shows how students would like the subject to be taught. The professors who responded to our survey also provided information regarding the difficulties of working in this discipline.

Our document analyses provide information about the reality of the discipline of ethics in Brazilian universities, types of content covered in curricula, workload, and recommendations. This study synthesises and analyses the information obtained.

The comparisons of information show that some ethical issues are discussed in publications and in teaching at some universities, such as the issue of privacy, but other issues should be better discussed within academia and others should be better published. In the survey, it is possible to see that the discipline of ethics can be improved in terms of teaching methodology and have a greater motivation of teachers and students.

7.2 Limitations

This study has some limitations, such as the demographic scope. A similar study could also be applied to different institutions, or specific types of institutions.

- The sample in the systematic mapping process could be bigger.
- The string search could specify or cover other areas, such as data science, artificial intelligence, and machine learning.
- The questions on the survey could address specific audiences.
- The discussion on some topics could be further explored.
- Further studies on the subject could be included.

7.3 Future work

In future work, the subject of this dissertation can be explored in the development of new computer science curricula and learning resources. New curriculum designs can be composed with the collaboration of scholars in different fields (Computer Science and Ethics, for example) and industry. The curricula will consist of different methodologies including case studies, in-class activities, assignments, and recommended readings.

Another point would be to make comparisons with universities abroad and propose a standard syllabus.

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APPENDIX A - QUESTIONNAIRE

Questionnaire with all survey questions

Informed Consent Form

Dear volunteer,

Through this questionnaire, we invite you to participate in a survey to obtain data related to the teaching of ethics in higher education in technology courses.

This research belongs to a master's thesis at the Centre for Informatics (CIn) of the Federal University of Pernambuco (UFPE).

The objective of this study is your participation so that you can answer the questions presented, in order to diagnose the state of practice regarding the teaching of ethics in higher education institutions; in addition to the collection of other information considered pertinent.

We would like to emphasize that:

1. Your participation is completely voluntary and anonymous.
2. All information you provide will be kept confidential.
3. There is no intention to judge you as a person or a company. There is only interest in investigating your opinion in the area covered in this research.
4. At any time, you can withdraw from participation and withdraw your consent.
6. Your refusal will not harm your relationship with the researcher or the institution.
7. The data collected in this form will not be disclosed in a way that makes it possible to identify it.

If necessary, feel free to contact this responsible committee.

This questionnaire consists of 6 quick questions about your profile and experience plus 12 questions about your opinion regarding ethics and 8 questions directed for university professors. If you decide to participate, it takes approximately 10 minutes to respond.

1º part: Training and professional experience

1- In which country do you study or studied an undergraduate or graduate degree in the field of computer science?

2- What is the highest level of education you have completed?

a- Elementary school
b- Incomplete high school
c- Complete high school
d- Incomplete higher education
e- Technical education
f- Complete higher education
g- Postgraduate studies (specialization / Master / Doctorate)

3.Which undergraduate or graduate course do you take or have completed in the field of computer science?

4. How much professional experience in the IT area?

a- Without experience
b- Less than 1 year
c- Between 1 to 2 years
d- Between 2 to 4 years
e- Between 4 to 10 years
f- Between 10 to 20 years
g- Over 20 years

5. Which positions did you play in your professional experience?

6. Do you have an academic background in another area? (Other than computer science)

a- Not
b- Yes (which?)

2º part: Perception of knowledge and the relevance of ethics in universities for students

7. Do you think that the discipline of ethics is important for the curriculum of undergraduate and graduate courses in the area of information technology?

a- Yes, in undergraduate courses
b- Yes, in graduate courses
c- Yes, in both
d- Not

8. Do you have knowledge about ethics applied to your professional field?

a- Yes
b- Not

9. In your opinion, is ethics important for IT professionals?

a- I totally agree
b- I agree
c- I do not agree nor disagree
d- I disagree
e- Strongly disagree

10. Would you be interested in taking an ethics-related course?

a- Yes
b- Not
c- Depends on the type of course

11. Have you read the code of ethics of a professional in any computer area? For example, the software engineer's code of ethics.

a- Yes, I've read it for professional reasons
b- Yes, I've read it out of personal interest
c- Not

12. If you study / studied ethics in undergraduate or graduate courses do you think that the academic content given on ethics is / was sufficient?

13. Do you think that good conduct can influence the image of the IT professional?

a- I totally agree
b- I agree
c- I do not agree nor disagree
d- I disagree
e- Strongly disagree

14. What is the value that you attach to the discipline of Ethics in undergraduate / graduate courses in the area of information technology?

a- Extremely useful
b- Very useful
c- More or less useful
d- Somewhat useful
e- Not at all helpful

15. In general, were you satisfied, indifferent and dissatisfied with the knowledge of ethics acquired at the university you study?

a- Extremely satisfied
b- More or less satisfied
c- Not very satisfied
d- Neither satisfied nor dissatisfied
e- Little dissatisfied
f- More or less dissatisfied
g- Extremely dissatisfied
h- I never studied ethics at university

16. If you have already studied ethics in undergraduate or graduate courses, what were the main ethical issues discussed?

17. In your opinion, what ethical issues can be better studied to assist in the teaching of ethics in undergraduate and graduate courses? For example: Morality, privacy, responsibility, etc.

18. In your opinion, how can the student's experience with the topic of ethics be improved in undergraduate and graduate courses?

3º part: Participant profile

19. Have you ever been a professor, or do you currently hold this position?

a- Yes, I used to be a professor!
b- Yes, I am a professor today.
c- Not

4º part: Perception of professors in universities on the teaching of ethics

19. In your opinion, would a specific discipline on ethics be necessary for courses in the IT area?

a- Not
b- Yes
c- Maybe (justify)

20. Have you taught about the existence of a specific Code of Ethics in the field of computing at national or international level?

a- Not
b- Yes

21. In your opinion, are the code of ethics and professional conduct necessary for good professional conduct?

a- Not
b- Yes

22. Do you often read newspaper or magazine articles that deal with ethical issues?

a- Not
b- Yes

23. In your opinion, is the knowledge acquired at the university sufficient for the professional training of students?

a- Not
b- Yes
c- Partially (justify)

24. In your opinion, are students interested in the discipline of ethics in the IT area?

a- Not
b- Yes
c- Partially (justify)

25. What are the difficulties encountered when teaching the discipline of ethics at the university in the IT area?

26. What are the main ethical issues that could be better taught in undergraduate and graduate courses in the IT area? Example: Privacy, Transparency, Responsibility etc