Mapping Ethics in EPS@ISEP Robotics Projects

Benedita Malheiro[1,2], Pedro Guedes[1,2], Manuel F. Silva[1,2], and Paulo Ferreira[1]

[1] ISEP, Polytechnic of Porto, Rua Dr. António Bernardino de Almeida, 431, 4249-015 Porto, Portugal

[2] INESC TEC, Campus da Faculdade de Engenharia da Universidade do Porto, 4200-465 Porto, Portugal

{mbm,pbg,pdf,mss}@isep.ipp.pt

Abstract. The European Project Semester (EPS), offered by the Instituto Superior de Engenharia do Porto (ISEP), is a capstone programme designed for undergraduate students in engineering, product design, and business. EPS@ISEP fosters project-based learning, promotes multicultural and interdisciplinary teamwork, and ethics- and sustainability-driven design. This study applies Natural Language Processing techniques, specifically text mining, to analyse project papers produced by EPS@ISEP teams. The proposed method aims to identify evidence of ethical concerns within EPS@ISEP projects. An innovative keyword mapping approach is introduced that first defines and refines a list of ethics-related keywords through prompt engineering. This enriched list of keywords is then used to systematically map the content of project papers. The findings indicate that the EPS@ISEP robotics project papers analysed demonstrate awareness of ethical considerations and actively incorporate them into design processes. The method presented is adaptable to various application areas, such as monitoring compliance with responsible innovation or sustainability policies.

Keywords: Engineering Education, Ethics, Ethics-driven decision-making, Ethics-driven design, Ethics Categories, Ethics Keywords, European Project Semester

1 Introduction

The European Project Semester (EPS) is offered by a network of European universities, including the Polytechnic of Porto at the Instituto Superior de Engenharia do Porto (ISEP) [2]. EPS is a capstone semester designed mainly for engineering undergraduates, combining project-based learning and multicultural teamwork. In addition, EPS@ISEP is strongly oriented toward ethics and sustainability-driven design [11]. The aim of this research is to determine whether students effectively demonstrate these competencies in the technical-scientific papers in which they report on their project work.

Natural Language Processing (NLP) models have gained significant importance in recent years, primarily due to advances in their ability to analyse and understand human language in an automated manner [8]. This research uses NLP techniques to assess whether EPS@ISEP raises awareness of ethical issues among participants. Silva et al. [13] took a first step in 2019, identifying and manually collecting evidence of ethical design and development practices from reports and presentations of three EPS@ISEP projects in the field of robotics. It highlighted the effectiveness of the programme in instilling ethical behaviour and decision-making in participants.

The current method goes further by defining a list of categories and keywords related to ethical concepts and terminology and applying a semi-automated keyword mapping analysis to robotics project papers.

This paper is structured as follows. Section 2 delves into keyword mapping, Section 3 details the method used to analyse team papers, Section 4 briefly describes the set of robotics projects processed, and Section 5 describes the experiments and the results. Finally, Section 6 presents the conclusions and outlines future directions.

2 Keyword mapping

NLP has grown significantly in recent years, primarily due to its flexibility to adapt to a wide range of applications. This research explores text mining, specifically keyword mapping, to process student-written deliverables and detect the presence of ethical concerns.

Keyword mapping has been applied to process and identify relevant patterns in documents. This is the case of scientific literature review [9] or the identification of sustainability concerns, including Sustainable Development Goals (SDGs) [9,15,7,10]. In 2021, Lopez-Belmonte et al. [9] presented a comprehensive analysis of the existing literature on the integration of robotics in educational settings. The study employed bibliometric, co-occurrence, and co-citation analyses to map the scientific landscape of this research area, identifying key trends, influential publications, and emerging themes. In 2023, Wang et al. [15] introduced a method inspired by Elsevier's previous SDG mapping efforts. This approach utilises text mining and n-gram analysis to extract global and local SDG-related keywords from publication metadata, including titles, keywords, and abstracts. The extracted keywords are then sorted by frequency and relevance, followed by a manual review to ensure their meaningfulness. The final list of SDG-related keywords is known as the Auckland list. In 2024, Kashnitsky et al. [7] proposed an alternative method for mapping research to SDGs, which has been adopted by Times Higher Education for its Social Impact rankings. The authors benchmarked existing approaches using established SDG validation datasets. More recently, in 2025, Malheiro and Guedes [10] applied mapping techniques to analyse 15 EPS@ISEP project papers, gathering evidence of sustainability-driven design and alignment with the SDGs. Their study leverages the Auckland list of SDG-related keywords to conduct an initial keyword frequency analysis, verifying the presence of SDG-related terms within the dataset. Subsequently, they perform a more sophisticated SDG category co-occurrence analysis, which involved executing SDG-specific queries to associate keywords with relevant SDG categories within the analysed documents. Inspired by this research, the current work uses keyword mapping to process and detect evidence of ethical concerns in text documents. Based on the conducted search, this study is the first to map ethical evidence in student deliverables using a replicable text mining approach.

3 Proposed method

The main objective of this research is the design of a text mining method to detect evidence of ethics-driven design in EPS@ISEP robotics projects. First, it determines the list of ethics categories and keywords, and then, using that list, applies the category and keyword mapping to the data set of project papers. Figure 1 represents the proposed NLP-based processing pipeline, comprising data collection, pre-processing, processing and visualisation.

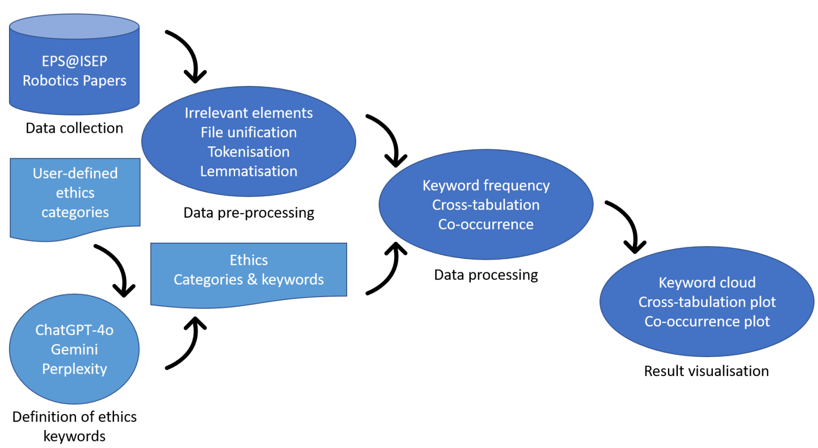

Fig. 1. Processing pipeline

Most of these processing steps rely on KH Coder[3], a computer software package designed for quantitative content analysis and text mining. It allows researchers to explore and extract meaningful insights from textual data, namely word clusters, descriptive statistics like term frequency, term frequency distribution (TF), document frequency distribution (DF), TF-DF plots, word association, and co-occurrence network of words [5].

Data collection downloads and extracts the text of the robotics papers (in PDF format) from the institutional repository, obtaining six text files (TXT).

[3] http://khcoder.net/en/ [Accessed in March 2025].

Definition of the list of ethics-related keywords explores ChatGPT-4o[4], Gemini[5], and Perplexity[6] through prompt engineering together with a set of user-defined ethics categories.

Data pre-processing involves data filtering and cleansing and query preparation:
- (*i*) Removes irrelevant parts from each paper, such as author information, affiliation, figures, tables, acknowledgments, and references, and stores the result in a text file (TXT).
- (*ii*) Unifies the TXT files with the help of KH Coder, where the individual files correspond to sections.
- (*ii*) Applies traditional pre-processing steps, such as stop-word removal, tokenisation (splits the resulting text into individual words and sentences) and lemmatisation (obtains the base word form according to the context), using KH Coder and reusing the default Stanford Part-of-Speech tagger.
- (*iii*) Creates the category queries (coding rules) to be used in the category analyses according to the KH Coder coding syntax. Each query associates the corresponding set of keywords with a given category via Boolean operators, making it possible to identify the presence of ethical keywords and categories simultaneously.

Data processing determines keyword frequency as well as category frequency and co-occurrence using KH Coder:
- (*i*) Calculates the frequency of occurrence of ethics-related keywords in the data set considering that most keywords are compound rather than single words. The results are exported as a CSV file for visualisation.
- (*ii*) Applies the category queries to the data set, providing the input to create: (*i*) the contingency table known as the frequency-based cross-tabulation matrix; and (*ii*) the semantic network also referred to as co-occurrence network.

Result visualisation of the keywords and categories present in the data set:
- (*i*) Cloud of the ethics-related keywords found using an online generator[7].
- (*ii*) KH Coder cross-tabulation bubble graphs showing the relative frequency of categories in individual papers.
- (*iii*) KH Coder co-occurrence network graph showing the coincidence of categories in individual papers.

4 Robotics projects

EPS@ISEP projects are developed by multidisciplinary and multicultural teams and aim to solve real problems that affect individuals, society, or the planet [10]. To date, six teams have used intelligent robotics to tackle problems in the areas of education, entertainment, monitoring, and cleaning, resulting in the Animo, Bro-Fish, Bubbles, GraphBot, MyBird and MopBot solutions.

[4] https://chatgpt.com/ [Accessed in March 2025].
[5] https://gemini.google.com/ [Accessed in March 2025].
[6] https://www.perplexity.ai/ [Accessed in March 2025].
[7] https://www.wordclouds.com/ [Accessed in March 2025].

Animo is a sustainable livestock surveillance system developed in 2023. It aims to help farmers monitor cattle herds over large remote areas by deploying a blimp-based aerial solution to collect real-time data without using thermal engines. Animo is equipped with cameras and sensors to track animal location, behaviour, and health, transmitting data to farmers via a mobile app for remote monitoring and control. The team focused on sustainability and ethical engineering, selecting environmentally friendly materials such as Vectran, Mylar, and Tedlar for the envelope laminate structure and acrylonitrile styrene acrylate plastic for weather-resistant components. The system was designed to reduce costs, improve animal welfare, and minimise environmental impact [1].

Bro-Fish is a biologically inspired swimming robot intended to be an educational toy for children aged between eight and twelve. Designed in 2014, this fishlike robot aims to teach concepts related to mechanics, programming, and the physics of floating objects while fostering interest in technology and sustainability. It features an innovative tail mechanism that mimics the undulating motion of fish to generate propulsion, allowing for controllable swimming directions. The prototype is designed to be customizable, enabling hands-on experimentation with its components, and addresses broader themes of energy efficiency and ocean sustainability, making it a unique tool for playful learning and engagement in science, technology, engineering, and mathematics (STEM) fields [6].

Bubbles is a didactic robotic fish developed in 2016. It aims to introduce children aged between 5 and 10 to robotics and programming through an interactive and educational aquatic toy. The robotic fish is designed to float and move left or right, mimicking real fish movements. It is programmable via a block-based interface (Ardublock), allowing users to create simple commands for motion and LED lighting control. The project emphasises affordability, sustainability, and accessibility, using biodegradable polylactic acid and recyclable components while keeping costs low. The team focused on engineering ethics, sustainability, and legal compliance, ensuring adherence to EU toy safety regulations [12].

GraphBot is a voice-controlled drawing robot created in 2016. The primary objective of the team is to engage young children, particularly girls, in STEM by introducing an interactive and creative tool. With a modular and expandable design, GraphBot offers automated drawing capabilities, user customization, multilingual interface, wireless connectivity, and multisensory feedback (visual or audio). The design and development of GraphBot addresses specifically gender bias and inclusivity and contemplates ethical engineering, honest marketing, sustainability awareness, legal and safety compliance, open-source and affordability [4].

MyBird project from 2014 addresses the design and implementation of a flapping-wing flying robot. The battery-powered prototype, built with lightweight materials, is based on a biplane concept. Inspired by birds and insects, it takes off, flies, and lands without a propeller, operating like an ornithopter. The prototype's key functionalities include manual launching and the ability to fly short distances [3]. It was designed as an educational tool to teach mechanics, programming, and the physics of floating objects to young students. The project emphasizes on sustainability and ecological awareness.

MopBot is an autonomous cleaning robot developed in 2020 to support waste collection and management in large indoor spaces such as shopping malls and universities. The robot is designed to navigate autonomously, detect and collect waste, and optimize cleaning efficiency while reducing human intervention. It features two vertical brushes, a vacuum system, and obstacle detection sensors for effective operation. The project emphasizes sustainability and ethical engineering, using recyclable materials, energy-efficient components, and a sustainable packaging solution that can be repurposed as a battery disposal box. It incorporates safety features, including emergency stop functions and real-time notifications for maintenance needs. Due to the COVID-19 pandemic, the project was completed using simulation tools instead of a physical prototype. Despite challenges in remote collaboration, design adjustments, and component selection, the final design successfully integrates functionality, sustainability, and affordability, making it a viable solution for autonomous cleaning in large-scale indoor environments [14].

5 Experiments and results

5.1 Data set

The data set includes six robotics project papers (see Table 1). These projects, developed by six teams between 2014 and 2023, involved 27 students from 11 countries and 16 different engineering, product design and business majors. The papers share a common structure based on the EPS@ISEP learning process, as the teams receive a template with writing instructions for each section. English language and writing skills are worked on as part of the Communication module and the technical-scientific content is checked by the team of project coaches.

Table 1: Data set.

Project	**Pages**	**Words**	**Source**
Animo	10	3250	Blommestijn *et al.* (2023) [1]
BroFish	8	6199	Ishii *et al.* (2015) [6]
Bubbles	15	6467	Reinhardt *et al.* (2017) [12]
GraphBot	14	5505	Dziomdziora *et al.* (2017) [4]
MyBird	8	5044	Caramin *et al.* (2015) [3]
MopBot	12	4139	Tuluc *et al.* (2021) [14]

The text extracted from the PDF files was purged from the author, affiliation, acknowledgments and references elements and unified into a single TXT file. This file includes the remaining parts of each input paper as sections, making it possible to identify the contribution of each paper individually and globally. The unified file has six sections (corresponding to the six papers), 549 paragraphs and 1609 sentences.

5.2 Keywords

The list of keywords was defined with the help of three public large language models (LLMs) – ChatGPT-4o, Gemini and Perplexity – via prompt engineering. The results, containing single and compound words, were integrated, cleansed of duplicates, and organised under the categories defined by the authors. The twelve ethics categories adopted in this research are Professional Integrity and Responsibility, Public Safety and Welfare, Environmental and Social Impact, Ethical Decision-Making, Legal and Regulatory Compliance, Stakeholder Considerations, Conflict and Resolution, Research and Innovation Ethics, Ethical Codes and Frameworks, Cultural and Global Considerations, Teaching and Ethics Education, and Specific Ethical Issues in Engineering (see Table 3). The list was obtained through the prompt-driven dialogue presented in Table 2.

Table 2: Prompt-driven dialogue.

Who	**Text**
User	"The current research context is that of ethical decision-making by engineering students during their capstone design project. The designed method is based on the detection of evidence of ethical concerns in the work of students through keyword mapping. You are the researcher who defines this list of keywords. Organize the list into the following 12 categories: Professional Integrity and Responsibility, Public Safety and Welfare, Environmental and Social Impact, Ethical Decision-Making, Legal and Regulatory Compliance, Stakeholder Considerations, Conflict and Resolution, Research and Innovation Ethics, Ethical Codes and Frameworks, Cultural and Global Considerations, Teaching and Ethics Education, and Specific Ethical Issues in Engineering. Add all relevant synonyms. What is your final list of categories, keywords and their synonyms to map evidence of ethical concerns in project papers written by engineering undergraduates?"
ChatGPT-4o	"Here is the structured list of categories, keywords, and synonyms to map evidence of ethical concerns in engineering capstone project papers: list of categories, keywords, and synonyms'
Gemini	"Absolutely. Let's build a comprehensive keyword list for ethical concern detection in engineering student capstone projects, organized into 12 categories. Methodology: We'll focus on keywords that suggest consideration of ethical implications, potential conflicts, or the need for responsible decision-making. Synonyms will be included to capture a broader range of language. list of categories, keywords, and synonyms"
Perplexity	"Here's a comprehensive list of categories, keywords, and their synonyms to map evidence of ethical concerns in project papers written by engineering undergraduates: list of categories, keywords, and synonyms"

The final list contains 227 distinct keywords – including both single and compound words – organised under the specified categories[8].

[8] Available at https://www.ave.dee.isep.ipp.pt/˜mbm/EthicsCatsKeys.xlsx.

5.3 Mapping

The mapping of ethical evidence relies on term frequency, category queries, contingency or co-occurrence analyses to characterise the links between ethics categories and the contents of project papers. This technique creates: (*i*) a contingency table, also called a cross-tabulation matrix, containing the observed counts of ethics categories within papers; and (*ii*) a graphical co-occurrence network representation of the frequency of ethical categories in individual papers. The mapping, performed at the sentence level, found 18.84 % of the ethics-related keywords. When considering categories, since the same keyword can belong to multiple categories, this value increases to 28.63 %. Table 3 summarises the keywords found in the data set per category, considering the frequency, percentage, and ratio of keywords found by category.

Table 3: Ethics keywords found by category.

	Category	**Frequency**	**(%)**	**Ratio**
1	Conflict and Resolution	1	0.00	1/14
2	Cultural and Global Considerations	71	4.05	8/24
3	Environmental and Social Impact	113	5.29	12/28
4	Ethical Codes and Frameworks	93	4.11	6/21
5	Ethical Decision-Making	80	3.36	7/23
6	Legal and Regulatory Compliance	30	0.50	6/27
7	Professional Integrity and Responsibility	84	1.00	14/35
8	Public Safety and Welfare	66	0.93	14/36
9	Research and Innovation Ethics	47	2.55	7/28
10	Specific Ethical Issues in Engineering	101	4.48	8/29
11	Stakeholder Considerations	81	2.05	9/28
12	Teaching and Ethics Education	4	0.25	2/12

Figure 2 shows the generated keyword cloud. The size of the words is proportional to their frequency of occurrence in the data set. The keyword cloud provides an overview of the most frequent ethics-related terms found. The top ten words are Sustainability, Experience, Research, Ethics, Environmental, Monitoring, Efficiency, Teamwork, Budget and Safety.

Figure 3 holds the results of the cross-tabulation or contingency analysis between the papers and the ethics categories. The size of the squares is proportional to the number (frequency) of keywords found by category and paper. The papers more aligned with ethics are Animo and MopBot, while the more popular categories considering all papers are Environmental and Social Impact, Specific Ethical Issues in Engineering, and Cultural and Global Considerations, all with a frequency higher than 65 (see Table 3).

Figure 4 displays the results of the co-occurrence analysis between categories and papers. This analysis identifies the commonalities among the six papers considering the different ethics categories. Only three categories are not addressed in all papers: Conflict Resolution is just referred to in Bubbles; Teaching and Ethics Education is referred to in Bubbles, GraphBot and MopBot, and Public Safety and Welfare referred to in Animo, Bubbles and MopBot.

Fig. 2. Ethics-related keyword cloud.

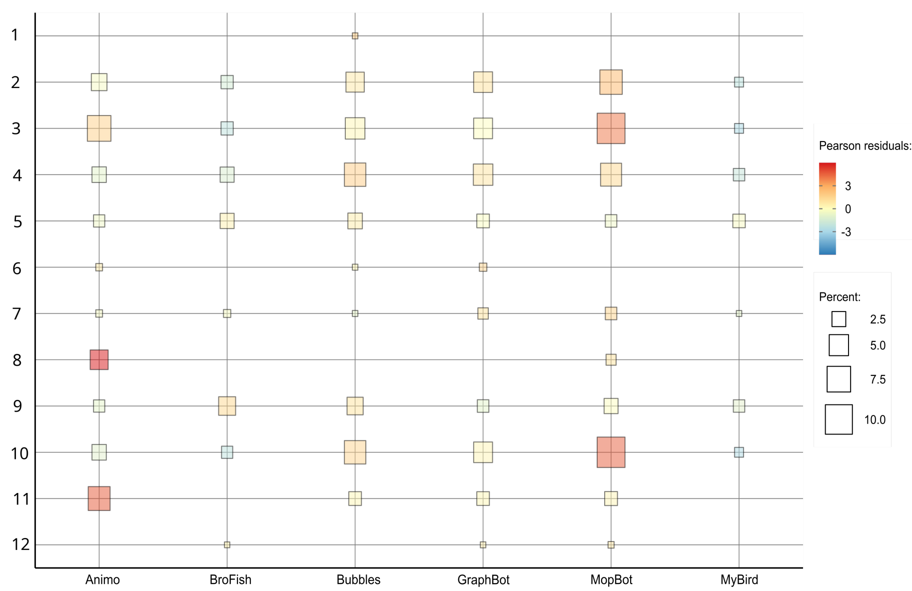

Fig. 3. Cross tabulation of ethics categories per paper.

6 Conclusions

This research successfully applied text mining to evaluate the integration of ethical considerations in EPS@ISEP robotics projects. By developing a novel method that combines prompt engineering with LLMs and traditional text mining techniques, the study was able to systematically identify and extract evidence of ethical concerns in student project papers.

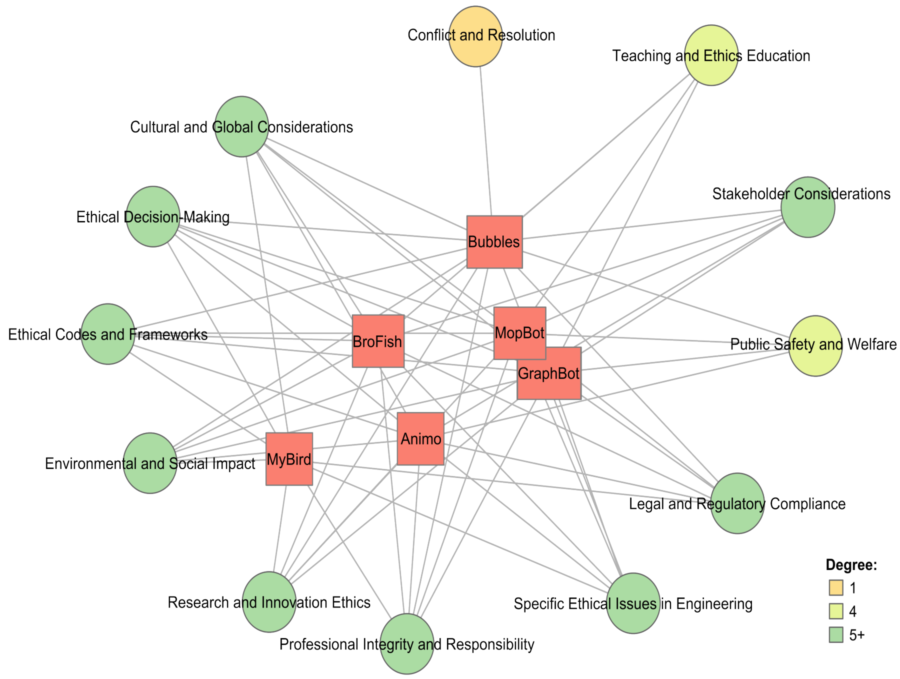

Fig. 4. Co-occurrence of ethics categories in papers.

The analysis of six robotics project papers developed between 2014 and 2023 revealed that 19 % of the keywords related to ethics were present in the data set sentences. The most prominent ethics categories found were Environmental and Social Impact, Specific Ethical Issues in Engineering, and Cultural and Global Considerations, demonstrating that EPS@ISEP effectively promotes ethical awareness in participants. The Animo and MopBot projects showed stronger alignment with ethical principles, suggesting that recent projects may be incorporating more ethics-driven approaches. The co-occurrence analysis indicated that most ethics categories were addressed by all projects, with only three categories (Conflict Resolution, Teaching and Ethics Education, and Public Safety and Welfare) appearing in a subset of projects. This consistent pattern suggests that the EPS@ISEP teams successfully integrated ethical concerns into their robotics projects.

Although ethical concepts are often intangible, the method provided empirical evidence that EPS@ISEP effectively develops technical competencies that incorporate ethical considerations, preparing engineering students to better address complex societal challenges. The results also suggest that it is possible to improve the integration of ethical and sustainability principles during the design phase. The method has potential for broader applications, namely in the monitoring of compliance with sustainability or responsible innovation policies.

However, there are some limitations. The method ignores the context of the keywords and the results strongly depend on the list of ethics categories specified by the user and the list of keywords and the category-keyword association provided by the LLMs. The data set is small and lacks ground truth. Benchmarking the performance of the proposed method was not possible due to the lack of public annotated data sets and the absence in the literature of alternative methods addressing the same problem. Future work should address these issues by further refining the method with more sophisticated NLP techniques, validating the lists of keywords and category-keyword associations, and enlarging and manually annotating the dataset for future benchmarking.

Acknowledgement

This work was partially funded by national funds through the Portuguese funding agency, FCT – Fundação para a Ciência e a Tecnologia (Portuguese Foundation for Science and Technology), within project LA/P/0063/2020 (DOI:10.54499/LA/P/0063/2020 | https://doi.org/10.54499/LA/P/0063/2020).

References

1. Blommestijn, K., Dallongeville, K., Paulsen, M., Mamos, M., Gupta, S., Duarte, A.J., Malheiro, B., Ribeiro, C., Justo, J., Silva, M.F., Ferreira, P., Guedes, P.: Cattle monitoring blimp – an EPS@ISEP 2023 project. In: Gonçalves, J.A.d.C., Lima, J.L.S.d.M., Coelho, J.P., García-Peñalvo, F.J., García-Holgado, A. (eds.) Proceedings of TEEM 2023. pp. 449–459. Springer Nature Singapore, Singapore (2024), https://doi.org/10.1007/978-981-97-1814-6_44
2. Budzinska, G., Hansen, J., Malheiro, B., Fuentes-Durá, P.: European Project Semester. In: Malheiro, B., Fuentes-Durá, P. (eds.) Handbook of Research on Improving Engineering Education With the European Project Semester, chap. 1, pp. 1–22. IGI Global (2022), https://doi.org/10.4018/978-1-6684-2309-7.ch001
3. Caramin, B., Dunn, I., Ney, R., Klawikowski, Y., Duarte, A.J., Malheiro, B., Ribeiro, C., Ferreira, F., Silva, M.F., Ferreira, P., Guedes, P.: Design and implementation of a biologically inspired flying robot – an EPS@ISEP 2014 spring project. In: Proceedings of the 3rd International Conference on Technological Ecosystems for Enhancing Multiculturality. p. 211–218. TEEM '15, Association for Computing Machinery, New York, NY, USA (2015), https://doi.org/10.1145/2808580.2808612
4. Dziomdziora, A., Sin, D.N., Robertson, F., Mänysalo, M., Pattiselano, N., Duarte, A., Malheiro, B., Ribeiro, C., Ferreira, F., Silva, M.F., Ferreira, P., Guedes, P.: Artistic robot – an EPS@ISEP 2016 project. In: Auer, M.E., Guralnick, D., Uhomoibhi, J. (eds.) Interactive Collaborative Learning. pp. 225–238. Springer International Publishing, Cham (2017), https://doi.org/10.1007/978-3-319-50337-0_20
5. Higuchi, K.: KH Coder: Free software for content analysis or text mining. Available at https://khcoder.net/en/ (2024), [Accessed in June 2024]
6. Ishii, A., Heibeck, M., Blazejewski, M., Nybjörk, R., Duarte, A.J., Malheiro, B., Ribeiro, C., Ferreira, F., Silva, M.F., Ferreira, P., Guedes, P.: Design and implementation of a biologically inspired swimming robot – an EPS@ISEP 2014 spring project. In: Proceedings of the 3rd International Conference on Technological Ecosystems for Enhancing Multiculturality. p. 219–226. TEEM '15, Association

for Computing Machinery, New York, NY, USA (2015), https://doi.org/10.1145/2808580.2808613
7. Kashnitsky, Y., Roberge, G., Mu, J., Kang, K., Wang, W., Vanderfeesten, M., Rivest, M., Chamezopoulos, S., Jaworek, R., Vignes, M., Jayabalasingham, B., Boonen, F., James, C., Doornenbal, M., Labrosse, I.: Evaluating approaches to identifying research supporting the United Nations Sustainable Development Goals. Quantitative Science Studies 5(2), 408–425 (05 2024), https://doi.org/10.1162/qss_a_00304
8. Khurana, D., Koli, A., Khatter, K., Singh, S.: Natural language processing: State of the art, current trends and challenges. Multimedia tools and applications 82(3), 3713–3744 (2023), https://doi.org/10.1007/s11042-022-13428-4
9. López-Belmonte, J., Segura-Robles, A., Moreno-Guerrero, A.J., Parra-González, M.E.: Robotics in education: A scientific mapping of the literature in web of science. Electronics 10(3) (2021), https://www.mdpi.com/2079-9292/10/3/291
10. Malheiro, B., Guedes, P.B.: Engineering a sustainable future with EPS@ISEP. In: Filho, W.L., Rebelatto, B.G., Annelin, A., Boström, G.O. (eds.) Competence Building on Sustainable Development, chap. 3, pp. 39–65. World Sustainability Series, Springer, Cham, Switzerland (2025), https://doi.org/10.1007/978-3-031-80380-2_3
11. Malheiro, B., Silva, M., Ribeiro, M.C., Guedes, P., Ferreira, P.: The European Project Semester at ISEP: the challenge of educating global engineers. European Journal of Engineering Education 40(3), 328–346 (2015), https://doi.org/10.1080/03043797.2014.960509
12. Reinhardt, A., Esteban, A.C., Urbanska, J., McPhee, M., Greene, T., Duarte, A., Malheiro, B., Ribeiro, C., Ferreira, F., Silva, M.F., Ferreira, P., Guedes, P.: Didactic robotic fish – an EPS@ISEP2016 project. In: Auer, M.E., Guralnick, D., Uhomoibhi, J. (eds.) Interactive Collaborative Learning. pp. 239–253. Springer International Publishing, Cham (2017), https://doi.org/10.1007/978-3-319-50337-0_21
13. Silva, M.F., Malheiro, B., Ferreira, P., Guedes, P.: Promoting ethical practices in engineering undergraduates. In: Tokhi, M.O., Ferreira, M.I.A., Govindarajulu, N.S., Silva, M., Virk, G.S., Kadar, E.E., Fletcher, S.R. (eds.) Artificial Intelligence, Robots and Ethics, Proceedings of the Fourth International Conference on Robot Ethics and Standards. CLAWAR Association Series on Robot Ethics and Standards, CLAWAR Association, High Wycombe, United Kingdom (2019), https://doi.org/10.13180/icres.2019.29-30.07.002
14. Tuluc, C., Verberne, F., Lasota, S., de Almeida, T., Malheiro, B., Justo, J., Ribeiro, C., Silva, M.F., Ferreira, P., Guedes, P.: The mopbot cleaning robot – an EPS@ISEP 2020 project. In: Auer, M.E., Rüütmann, T. (eds.) Educating Engineers for Future Industrial Revolutions. pp. 79–90. Springer International Publishing, Cham (2021), https://doi.org/10.1007/978-3-030-68198-2_7
15. Wang, W., Kang, W., Mu, J.: Mapping research to the Sustainable Development Goals (SDGs). Available at https://doi.org/10.21203/rs.3.rs-2544385/v3 (2 2023)