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INTERNATIONAL CONFERENCE ON ALIVE ENGINEERING EDUCATION

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The aim of ICAEEdu 2026 is to provide a forum where academicians and professionals from various educational fields can share their knowledge and engage in dialogues on fostering innovation and excellence in Engineering Education. The conference is open to research and practice-oriented papers in all aspects of Engineering Education, including transdisciplinary research and active methodologies.

Contents

1. Enhancing Knowledge Acquisition and Multicultural Adaptability in Higher Education through Active Learning, Virtual Exchange, and AI Tools 1

2. High-Performance Communication in Interdisciplinary Extension: Bridging Engineering, Medicine and Law 3

3. Computational Modeling as an Active Methodology in Operational Research Learning 5

4. Educational Andragogy in Engineering: Active Teaching Methodologies for Multiple Student Intelligences 7

5. Design of a Didactic Continuous Photovoltaic Solar Simulator Using Optical Simulation Software 9

6. AI-Assisted Malware Analysis as a Learning Tool in Computer Engineering Education: A Kernel-Level Monitoring Approach with LLM-Based Inference 11

7. From Industry 4.0 to Industry 5.0: Challenges and Competencies for Engineering Education in the Artificial Intelligence Era 13

8. Studies on Immersive Environments in Engineering Education: Experiences of the CERISE UFG Center of Excellence 15

9. Project to Support and Encourage Academic Activities of Biochemical Engineering Students: Strategies Adopted to Reduce Dropout Rates in The Initial Semesters 17

10. Summaê in the Community: Electrifying Circuits 19

11. Artificial Intelligence Governance and Ethics in Engineering and Computing Education: Curricular Challenges and Essential Competencies 21

12. Materials Traceability in Electrical Infrastructure Works: Development of an Application as a Work-Integrated Learning Experience in Engineering 23

13. Teaching Digital Control through English-Medium Instruction (EMI): A Pedagogical Innovation and Internationalization Experience 25

14. Career in Play: Gamification of the Professional Context in Engineering 27

15. Meaningful Learning According to Carl Rogers: Use of AI 29

16. Confluencing the Meanings of Exact Sciences: Intersectionality and Transformation of the Academic Space 31

17. Ethical Guardrails of Large Language Models as a Barrier to Cybersecurity Education in Engineering Courses: A Comparative Analysis of ChatGPT-4o, Claude Sonnet 3.5, and Gemini 2.5 Pro 33

18. Master Plan: Gamification Applied to Management Education in Engineering 35

19. Ethics, Engineering and Society: Socrates, Archimedes e Pythagoras 37

Enhancing Knowledge Acquisition and Multicultural Adaptability in Higher Education through Active Learning, Virtual Exchange, and AI Tools

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Abstract

Higher education must rapidly evolve to meet changing learner expectations and modern labor market demands. Today's graduates face highly competitive, international environments where companies require practical skills alongside a daily command of artificial intelligence (AI). To address these shifts, this study proposes an integrated educational framework that combines the methodologies of active learning (AL), virtual exchange (VE), and AI-supported learning. This approach enables universities to transition from isolated, conventional assignments toward a more flexible, practice-oriented curriculum. The framework overcomes geographic limitations, allowing student cohorts to collaborate seamlessly across physical boundaries. Through VE, the model stimulates inclusive internationalization and fosters long-term institutional partnerships without the need for travel abroad. Students engage in practical, cross-border case studies that simultaneously sharpen teamwork, oral presentation skills, and cross-cultural empathy. Additionally, the integration of AI tools enhances student autonomy, digital literacy, and critical thinking. Progress within this framework is measured through a multi-layered assessment mechanism. It blends student self-assessments and peer-to-peer feedback with traditional university exams, allowing institutions to rigorously benchmark performance. Ultimately, by unifying AL, VE, and AI, the framework improves knowledge acquisition and ensures graduates seamlessly adapt to dynamic corporate landscapes.

Keywords: Active Learning, Artificial Intelligence, Framework, Teaching Enhancement, Virtual Exchange.

High-Performance Communication in Interdisciplinary Extension:

Bridging Engineering, Medicine and Law

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Abstract

Engineering, medicine and law increasingly operate in complex professional ecosystems shaped by technological acceleration, institutional accountability, public scrutiny, ethical risk, psychosocial exposure and entrepreneurial pressure. These conditions are not only pedagogical challenges; they are also affected by regulatory frameworks that require institutions and organizations to address work-related risks, learning quality, social accountability and extension-based engagement. In the Brazilian context, NR-1 is particularly relevant because it establishes general occupational safety and health management requirements and highlights the need to identify, assess and manage occupational risks, including psychosocial risk factors. NR-17, educational extension regulations and higher-education guidelines also influence the design of training environments by requiring attention to work organization, student formation, community interaction and measurable educational outcomes. The paper examines the cause-and-effect relationships among three professional domains. In engineering, deficient communication may distort requirements, weaken risk explanation, compromise project coordination and reduce innovation transfer. In medicine, communicative insecurity may affect patient safety, informed consent, diagnostic explanation, interprofessional collaboration and trust. In law, ineffective communication may weaken argumentation, mediation, conflict prevention, institutional legitimacy and advocacy. Across the three areas, public-speaking anxiety and low communicative self-efficacy may increase cognitive load, reduce attentional control, impair decision quality and diminish stakeholder engagement. Conversely, structured high-performance communication training may improve clarity, ethical judgment, professional confidence, entrepreneurial initiative and public value creation. The central hypothesis is that extension-based training, when combined with psychological preparation, simulated exposure,

reflective feedback and entrepreneurial action, strengthens students' capacity to communicate technical, clinical and legal knowledge with clarity, responsibility and practical impact. The study adopts a theoretical-analytical and integrative review design. The methodological procedure included: delimitation of the interdisciplinary problem; identification of regulatory requirements with emphasis on NR-1; selection and synthesis of literature on public-speaking anxiety, performance psychology, communication training, virtual reality, vocal stress biomarkers, engineering education, medical communication, legal argumentation, entrepreneurship and university extension; and construction of an interpretive framework relating regulatory demands, professional risks and educational interventions. The analysis focuses on extension activities like applied laboratories where students diagnose problems, design solutions, present projects, interact with communities, negotiate with stakeholders and test communication strategies in realistic contexts. Findings indicate that communicative performance depends on emotional regulation, attentional control, structured practice, contextual adaptation and audience awareness. In engineering, training improves technical presentations, entrepreneurial pitching, teamwork, requirements negotiation and risk communication. In medicine, it supports patient-centered dialogue, informed consent, health literacy and interprofessional coordination. In law, it enhances oral argumentation, negotiation, mediation and public-interest advocacy. Entrepreneurial components, including opportunity recognition, value proposition development, project pitching, stakeholder mapping and resource mobilization, expand the formative scope of extension by transforming communication into an instrument for innovation, employability, social engagement and institutional impact. The proposed framework positions high-performance communication as a transversal competency capable of linking academic formation, professional identity, regulatory compliance, community engagement and entrepreneurial experimentation in knowledge-intensive environments.

Keywords: Entrepreneurial Education, Engineering Education, Extension Programs, Interdisciplinary Communication, Legal Education.

Computational Modeling as an Active Methodology in Operational Research Learning

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Abstract

Operational Research courses in Information Systems programs are traditionally conducted through a strongly mathematical approach inherited from engineering curricula. Although mathematical foundations are essential for understanding optimization methods, this model often creates learning difficulties and distances students from the practical application of the discipline within the professional context of systems analysts. In organizational practice, Information Systems professionals primarily work in the analysis, modeling, design, and development of computational solutions capable of addressing business demands, using algorithms and mathematical models as part of technological solutions rather than acting as mathematical specialists in the business domain itself. This paper presents a pedagogical experience developed in the Operational Research course of the seventh semester of the Information Systems program at the State University of Goiás (UEG), aiming to bring the teaching of the discipline closer to the professional reality of software development. Initially, students reviewed basic mathematical concepts, modeled Linear Programming problems in standard form, solved problems using the graphical method, and developed a conceptual understanding of the Simplex Method. Subsequently, the course adopted a systems analysis and design perspective, in which students were required to develop a computational system capable of solving Linear Programming problems using the Simplex algorithm within the procedural paradigm.The methodological proposal was structured into incremental stages involving system vision, functional and non-functional requirements, data modeling, functional decomposition, structured flowcharts, pseudocode, test planning, interface prototyping, and complete algorithm implementation. The focus shifted from the exclusive manual execution of calculations toward emphasizing the translation of a mathematical model into an organized computational solution consistent with software development and requirements engineering practices.Preliminary observations indicate greater student engagement, improved understanding of the relationship between optimization algorithms and computational systems, and increased participation in practical modeling and implementation activities. The experience suggests that contextualizing Operational Research within software development practice may contribute to reducing historical barriers associated with the discipline, strengthening the integration between theory, computational modeling, and the professional education of systems analysts.

Keywords: Information Systems, Linear Programming, Operational Research, Software Development, Teaching Methodologies.

Educational Andragogy in Engineering:

Active Teaching Methodologies for Multiple Student Intelligences

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Abstract

The educational environment is associated with the words pedagogy and school, but the origin of the word pedagogy comes from the Greek, being paidós (child) plus agogé (to guide), and school, also from the Greek, scholé (leisure), that is, the child is guided in leisure. DE MASI conducted decades of research on work in society, publishing the book "Creative Leisure" in 2000 to recover this meaning, but it would not be for children. Thus, the word pedagogy would not be appropriate, making it necessary to use the word andragogy, whose origin is also from the Greek, andros (adult) plus agogé (to guide), that is, the adult is guided in leisure. Leisure for the Greeks was the time for thinking, that is, when intellectual work occurred. DEWEY published the book "Democracy and Education" in 1916, reinforcing that school does not prepare for life, because it is life itself. Engineering courses receive students who are not children; therefore, they must guide the adult (student) to think about the present, because university is life itself. The objective is to analyze the educational environment of Engineering courses focusing on teaching methodology integrated with student intelligence. The research is exploratory, bibliographic, documentary, qualitative, and non-probabilistic in nature. It also possesses a structuralist character, given that the Engineering program admits adult students who require a teaching method suited to adults—namely andragogy—a concept rarely discussed or even unknown within the university environment. The research revealed that the Law of Guidelines and Bases of National Education (LDB) no. 9.394/1996 is the basis of education in Brazil, and that Article 37 establishes the modality of Education for Young People and Adults, but only on August 14, 2002, was the National Examination for Certification of Competencies of Young People and Adults (ENCCEJA) regulated by MEC Ordinance no. 2.270/2002. Thus, in theory, it would be possible for anyone aged 18 or older to take the ENCCEJA exam (without ever having attended school previously) and achieve the minimum score (50%) required to receive a high school diploma—a passport to direct entry into university. The exam is annual with free registration (to be held on August 23, 2026), consisting of 120 multiple-choice questions divided into 4 subject areas (mathematics, natural sciences, earth sciences, and languages) plus an essay. Those who achieve a score above 50% (approximately) are approved. ILLICH published the book "Deschooling Society" in 1971, presenting various issues in which schools create obstacles to learning, particularly for adult learners. GARDNER published "Frames of Mind: The Theory of Multiple Intelligences" in 1983, where he presents specific aspects that can appear independently (logical; linguistic; kinesthetic; naturalist; intrapersonal; interpersonal; spatial; musical; pictorial). To illustrate the mismatch between teacher and student, it is worth highlighting Nikola Tesla (1856 – 1943), who dropped out of school at the end of his undergraduate studies. In conclusion, teaching in Engineering courses is a challenge, balancing the demands of applying past norms with the changing student profile of the present and the rapid pace of change in the future job market. Understanding Andragogy allows for the expansion of the use of active teaching methodologies and the valuing of the specific, rare, and unique intelligence of each student individually, promoting inclusion.

Keywords: Andragogy, Education, Engineering, Intelligence, Human.

Design of a Didactic Continuous Photovoltaic Solar Simulator Using Optical Simulation Software

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Abstract

This work presents the comprehensive design and computational analysis of a didactic continuous solar simulator specifically engineered for testing photovoltaic modules, utilizing the advanced optical simulation software TracePro 6.0. The primary system was meticulously designed to provide a uniform and controlled irradiance distribution over a large test area of approximately 2 m^2, which is large enough to adequately accommodate standard commercial photovoltaic panels. The physical architecture leverages a robust reflective metallic structure containing an optimized matrix of 16 commercial Philips HPI-T 1000W metal halide lamps arranged in a precise grid of 4 rows of 4 units. Developed specifically for educational and laboratory purposes, this simulator aims to serve as a versatile didactic tool to enable students and researchers to perform the accurate acquisition of I-V and P-V characteristic curves. Furthermore, it allows for the detailed experimental evaluation and analysis of complex real-world operational effects, such as module tilt angle variations, localized structural shading, and surface soiling accumulation on overall photovoltaic performance. The computational simulation rigorously analyzed the complex behavior of 1,600,000 individual light rays incident upon a 2 m x 1 m test plane, which was dynamically adjusted at three distinct vertical distances from the light source: 20 cm, 35 cm, and 50 cm. The numerical results demonstrated that increasing the operational distance causes both the maximum and average irradiance to predictably decrease, while conversely and significantly improving the spatial irradiance uniformity across the entire target surface. The detailed optical analysis identified a slightly asymmetric concentration of light on the right side of the simulator enclosure. This phenomenon was directly caused by the non-centered internal position of the lamps within the pre-fabricated commercial luminaires. To counteract this effect, alternating the positioning orientation of these adjacent luminaires is proposed as a highly practical and cost-effective construction solution. Ultimately, this comprehensive study highlights the crucial and indispensable role of optical simulation software in optimizing complex design parameters and identifying critical structural adjustments prior to embarking on physical construction, thereby directly contributing to the development of more efficient, accurate, and reliable photovoltaic testing equipment.

Keywords: Solar Simulator, Photovoltaic Modules, TracePro, Optical Simulation.

AI-Assisted Malware Analysis as a Learning Tool in Computer Engineering Education:

A Kernel-Level Monitoring Approach with LLM-Based Inference

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Abstract

This paper presents a system that combines kernel-level behavioral tracing with generative AI to support malware analysis as a hands-on learning approach in cybersecurity education. Traditional signature-based detection methods are often insufficient against novel or obfuscated threats, motivating a dynamic, behavior-based approach that pairs low-level system monitoring with LLM-based inference. The system deploys a virtual machine (VM) to host the target software alongside monitoring scripts written in C and bpftrace, capturing events at both the kernel level (system calls, process creation, file access) and user space (network interface activity). Captured events are packaged and transmitted in real time through multiple emulated serial tunnels using AES encryption to preserve confidentiality. On the host side, a reader process decrypts and reassembles the event streams, and an orchestrator batches the consolidated data for delivery to a locally running LLM agent operating under a Retrieval-Augmented Generation (RAG) approach. The agent analyzes the aggregated behavioral data and produces a structured, human-readable report indicating whether the target software is malicious, along with a justification describing its behavioral patterns and probable next actions. Although still under development, preliminary testing showed that the pipeline reliably captured and reconstructed events during operations commonly associated with malware behavior, and that the LLM agent generated coherent and consistent analysis reports. Beyond its technical contributions, the project offers a practical, offline-capable framework for teaching malware analysis, giving engineering students hands-on exposure to systems programming, cryptography, and AI integration, areas rarely combined in traditional cybersecurity coursework, and contributing a replicable approach for embedding applied security research into engineering education.

Keywords: Bpftrace, Cybersecurity, LLM, Malware Analysis, Virtual Machine Monitoring.

From Industry 4.0 to Industry 5.0:

Challenges and Competencies for Engineering Education in the Artificial Intelligence Era

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Abstract

The accelerated expansion of artificial intelligence (AI), cyber-physical systems, automation, connected devices, and data-driven decision-making has reshaped the industrial environment associated with Industry 4.0 and created new challenges for Engineering Education. Although Industry 4.0 emphasizes digitalization, connectivity, process integration, and productivity, Industry 5.0 broadens this perspective by placing human-centricity, sustainability, and resilience at the center of technological development. In this context, engineering programs must prepare professionals who can work with intelligent systems and critically assess their ethical, social, environmental, and organizational consequences. This study analyzes how the transition from Industry 4.0 to Industry 5.0, intensified by the growing use of AI, redefines the competencies expected from future engineers. The guiding hypothesis is that Engineering Education must integrate technical, digital, human, ethical, and socio-environmental competencies to respond to intelligent and collaborative industrial systems. The research adopts a qualitative, bibliographic, and documentary approach. Scientific publications and institutional documents related to Industry 4.0, Industry 5.0, AI, engineering competencies, ethics in technology, and curriculum innovation were analyzed through thematic categorization. The analysis led to a five-axis conceptual framework: digital competencies, human-machine interaction, responsible AI, sustainability and resilience, and pedagogical innovation. The results indicate that Industry 5.0 does not replace Industry 4.0, but complements it by reorienting technological progress toward human and societal value. The findings highlight the importance of data interpretation, systems thinking, interdisciplinary collaboration, ethical judgment, and socio-environmental responsibility, both in contemporary engineering practice and education. They also suggest that content-centered curricula are insufficient when disconnected from real-world problems, active learning, project-based experiences, and critical reflection on technology. The study concludes that the transition toward Industry 5.0 requires an educational model capable of articulating technological excellence with human development, sustainability, and social responsibility, preparing engineers to design responsible, resilient, and human-centered technological solutions.

Keywords: Artificial Intelligence, Engineering Education, Industry 4.0, Industry 5.0, Sustainability.

Studies on Immersive Environments in Engineering Education:

Experiences of the Center of Excellence in Intelligent Wireless Networks and Advanced Services

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Abstract

The incorporation of immersive technologies and artificial intelligence into Engineering education represents a valuable opportunity to enhance active learning and bridge the gap between complex theoretical concepts and practical applications. Contributing to this scenario, the Center of Excellence in Intelligent Wireless Networks and Advanced Services (CERISE UFG) has developed a methodology that integrates virtual reality and an interactive instructor based on ChatGPT to support the teaching and learning process. In this context, the objective of this study is to present the research and experiences conducted by CERISE UFG in the design and implementation of an immersive learning environment for Engineering education, employing virtual reality and ChatGPT as an interactive instructor through a case study on power transformers in an Electrical Engineering course. The proposed methodology is based on an active learning approach that combines immersive three-dimensional environments, natural language interaction with generative artificial intelligence, and assessment activities conducted before and after the learning experience. Students virtually explored the components and operating principles

of power transformers, interacting with the virtual instructor by asking questions and receiving contextualized explanations, complemented by guidance from the course instructor. Qualitative evidence related to student engagement, conceptual understanding, and participant perceptions was collected throughout the study. The system was developed using the Unity game engine, Meta Quest 3 immersive devices, and the OpenAI API, enabling multimodal interaction through natural language. The results demonstrated a high level of acceptance of the proposed methodology among students, increased interest in practical activities, and greater participation during classes. The combination of virtual reality and intelligent interaction enhanced the visualization of internal equipment structures, facilitated the understanding of abstract concepts, and enabled personalized explanations tailored to students' questions. Evidence also suggested improvements in post-intervention assessment performance, motivation to acquire knowledge on the subject, learner autonomy, and collaborative learning. In conclusion, the findings highlight the potential of immersive environments integrated with artificial intelligence as a strategy for Engineering education, contributing to a more interactive learning experience aligned with the demands of digital transformation. This experience developed by CERISE UFG demonstrates that the integration of virtual reality, generative AI, and active pedagogical practices can strengthen the teaching–learning process for complex subjects such as power transformers, while fostering new research initiatives and applications across different fields of Engineering.

Keywords: Engineering Education, Generative Artificial Intelligence, Immersive Environments, Power Transformers, Virtual Reality.

Project to support and encourage academic activities of Biochemical Engineering students:

Strategies adopted to reduce dropout rates in the initial semesters

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Abstract

Student retention has become one of the major challenges faced by higher education institutions, particularly during the first year of undergraduate studies. Article 7 of the National Curriculum Guidelines (DCNs) for Engineering (2019) states that pedagogical projects should include welcoming and academic leveling strategies for incoming students. In line with this guideline, the Project for Encouraging Academic Activities among Biochemical Engineering Students (PAIEB), established in 2010 alongside the creation of the Biochemical Engineering program at FURG, has developed initiatives to investigate and address factors associated with student dropout, especially during the first year of undergraduate education, a period considered decisive for student retention. In an effort to reduce this rate, the institution has implemented initiatives such as the Citizen/Solidarity Welcome Program, which promotes empathy and the exchange of experiences among freshmen, senior students, and faculty members. Within the Biochemical Engineering program, PAIEB organizes discussion circles, thematic workshops, guided

tours, and social integration activities involving freshmen and senior students. These actions aim to familiarize students with the university environment, strengthen interpersonal relationships, encourage peer support, and reduce the uncertainties commonly experienced at the beginning of undergraduate studies. This study is a descriptive, qualitative experience report based on a retrospective analysis of PAIEB's welcoming initiatives, considering the planning, implementation, and evaluation of activities developed within the project over different periods. Primary data were collected through an anonymous online questionnaire administered to incoming students during the Citizen Welcome period, containing multiple-choice and open-ended questions designed to assess students' adaptation difficulties and perceptions of the welcoming activities. Active participation among incoming students was observed, along with greater interaction between students and faculty members and strong engagement in the adaptation process to university life. The results indicate that welcoming initiatives can positively influence the transition to higher education by reducing the challenges associated with university adaptation and promoting student engagement. Therefore, PAIEB is understood as an important strategy that complements institutional retention policies, contributing to a more welcoming academic environment and strengthening student retention throughout the first year of undergraduate studies.

Keywords: Student Retention, Engineering Education, First-Year Students, Welcoming Initiatives, Academic Adaptation.

Summaê in the Community:

Electrifying Circuits

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Abstract

Strengthening engineering education requires innovative pedagogical approaches that stimulate student agency and connect theoretical knowledge with professional practice. The "Summaê" method (a blend of the Portuguese word for "sum" and "hat") proposes the playful integration of challenges and the creation of themed hats. As a development of this technique, "Summaê in the Community" acts as an active learning strategy that integrates technical knowledge through challenges, while incorporating artistic expressions to promote a humanized education and bring the academic community closer to society. Supported by the "Engenharia Viva" Teaching, Research and Extension Center (NIPEE EngVIVA), at UFG, in cooperation with the International Network of Creative Schools (RIEC), two editions of the "Summaê in the Community: Electrifying Circuits" festival were held in 2025. The aim of this study was to investigate how the systematic inclusion of artistic performances, electric circuit challenges to be solved by students under time constraints, and parades for voting on the "best hat" enhance student engagement, retention of theoretical concepts, and consolidation of socio-emotional skills. The methodological strategy comprised three phases: (1) a development stage, in which students designed electrical circuit problems that were subsequently validated by teaching assistants under faculty supervision; (2) an in-person execution stage for each festival, consisting of three sessions; and (3) a post-event stage for results dissemination, certificate issuance, and evaluation. Regarding the results, two festivals were

held, one in each semester of 2025. During phase (2), the highlight of Session I of the first festival was the "Circus Party", which fostered cultural integration between the academic community and acrobatic artists from the Basileu França Circus. In the second festival, the highlight was "Charming Notes", a cello performance by student and musician Emilio Augusto Sanhueza, a member of the Goiás Youth Symphony Orchestra. In Session II of both festivals, student teams resolved challenges proposed by the students themselves throughout the semester, under time pressure, which were evaluated by a panel of faculty members and student teaching assistants. Session III featured parades to select the "best hat". The first edition of the festival attracted forty participants, while the second had thirty-five. Consequently, the primary highlight of the festivals was the active student agency demonstrated through their deep involvement, complemented by the participation of faculty members and the external community. Therefore, the achievement of this study's objective, through collaborative problem-solving under time pressure (Session II) and the integration of cultural activities in two distinct moments of each festival (Sessions I and III), confirmed student engagement, the retention of theoretical electrical circuit concepts, and the consolidation of socio-emotional skills. In conclusion, the festivals successfully fulfilled their pedagogical and university extension missions, while validating the "Summaê in the Community" acts as an active learning strategy capable of developing competencies, soft skills, and attitudes in an engineering discipline.

Keywords: Active Learning Strategies, Electric Circuits, Engineering Education, Summaê in the Community, University Extension.

Artificial Intelligence Governance and Ethics in Engineering and Computing Education:

Curricular Challenges and Essential Competencies

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Abstract

Artificial intelligence has become a central element of contemporary technological development, while concerns about accountability, transparency, human oversight, discrimination, privacy, risk management, and social impact have moved from general ethical principles to regulatory and educational requirements. International regulatory and educational frameworks, including the European Union Artificial Intelligence Act, the UNESCO Recommendation on the Ethics of Artificial Intelligence, the UNESCO AI Competency Framework for Students, and the ACM, IEEE Computer Society, and AAAI Computer Science Curricula 2023, increasingly define expectations related to AI literacy, ethical judgment, human oversight, and the responsible development and use of AI. In Brazil, curricular documents for Engineering and Computing formally articulate humanistic, social, and ethical principles, but AI-specific governance competencies are addressed unevenly across them. This study aims to identify and systematize essential competencies in AI governance and ethics for Engineering and Computing education and to examine how these competencies are addressed in Brazilian curricular documents. The research adopts a qualitative, exploratory, bibliographic, and documentary approach. A preliminary comparative analysis considered four Brazilian references: the National Curriculum Guidelines for Engineering, the National Curriculum Guidelines for Computing, the Brazilian Computer Society reference framework for undergraduate Computing programs, and its 2024 reference framework for the Bachelor's Degree in Artificial Intelligence. These documents were examined in relation to four international references: the UNESCO Recommendation on the Ethics of Artificial Intelligence, the UNESCO AI Competency Framework for Students, Article 4 of the European Union Artificial Intelligence Act, and the Society, Ethics, and the Profession area of Computer Science Curricula 2023. A competency was classified as explicit when directly stated, implicit when inferred from broader principles, partial when only some of its elements were covered, and absent when no relevant coverage was identified. The preliminary findings suggest that the Brazilian documents provide an important ethical and humanistic foundation. The 2024 Brazilian Computer Society framework for the Bachelor's Degree in Artificial Intelligence addresses ethical, legal, and social issues more directly, whereas several AI governance competencies remain less explicit in the broader curricular documents. The least explicit elements concern regulatory literacy, risk classification, human oversight, accountability mechanisms, and the documentation of decisions involving AI. The comparison therefore suggests a gap between broad ethical and social principles and the more operational expectations found in recent AI governance frameworks. Based on these findings, the study proposes four complementary competency dimensions: sociotechnical and critical foundations; justice and fundamental rights; governance, regulation, and risk management; and professional responsibility and sustainability. Ethics is treated as a cross-cutting principle that informs all four dimensions rather than as a separate component confined to one of them. The findings support the explicit and curriculum-wide integration of these competencies. This framework may inform curriculum review, institutional teaching practices, and the preparation of professionals capable of making technically informed and socially responsible decisions about AI.

Keywords: AI Competencies, AI Ethics, AI Governance, Computing Education, Engineering Education.

Materials Traceability in Electrical Infrastructure Works:

Development of an Application as a Work-Integrated Learning Experience in Engineering

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Abstract

Electrical infrastructure works, such as substations and transmission lines, require the continuous movement of materials between purchasing, warehouse logistics, technical reserve, maintenance, and field execution. In the professional context that motivated this study, materials are often purchased for a specific worksite, but once they enter the warehouse they tend to be managed mainly by their material code. This weakens the link between the physical item, the worksite for which it was acquired, its storage location, its logistical movement, its use, and its operational history. The project was developed and documented in 2026 in Cuiabá, Mato Grosso, Brazil, from a real materials-management problem in electrical infrastructure operations. This study analyzes the development of a materials traceability application as a work-integrated learning experience in Engineering, arguing that a real operational problem can become a formative axis when it requires the learner to connect professional practice, logistics management, process modeling, computational thinking, database logic, web development, and managerial decision-making. The research is structured as an applied and descriptive case study, based on the reconstruction of the application development history, inspection of the current system interface, review of technical documentation, and interpretation of the professional context that originated the project. The case resulted in the DMSL/App Estoque, a web-based application currently in real-time operational use by users. Implemented modules include receiving, screening, internal movement, material issue, inventory consultation, QR Code management, offline support, operational history, scheduling, user management, synchronization of reference databases, managerial dashboard, and a dedicated flow for PPE, collective protection equipment, and tools. The application expanded operational traceability by connecting fiscal entry, physical screening, QR-based location, serial or batch control, worksite association, movement records, material issue, and managerial indicators. Although the application was not developed as a formal ISO 55001 certification tool, it is adherent to the principles of ISO 55001:2024 because it supports asset identification, traceability, lifecycle records, operational accountability, and decision-making related to materials used in electrical infrastructure works. The case shows that engineering education can emerge from situated professional challenges when the learner transforms a concrete operational gap into a technological solution. The development of the application was not only a programming activity, but an interdisciplinary learning process linking engineering, logistics, management, digital technologies, and workplace transformation.

Keywords: Asset Management, Computational Thinking, Engineering Education, Materials Traceability, Work-integrated Learning.

Teaching Digital Control through English-Medium Instruction (EMI):

A Pedagogical Innovation and Internationalization Experience

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Abstract

This study reports an English-Medium Instruction (EMI) experience in an undergraduate Digital Control course for Electrical Engineering and Computer Engineering students at the Federal University of Goiás (UFG), Brazil. The elective course follows a compulsory Control Systems course, providing students with the technical background required for Digital Control. The official language in Brazil is Portuguese. Then, EMI was adopted based on the instructor's international academic experience, an institutional internationalization initiative, and previous student interest. The course was offered in 2023/1 and 2025/2 academic semesters, with 21 and 11 students, respectively. Lectures and instructional materials were in English, while formal assessments remained in Portuguese. Classroom observations indicated that most students could follow technical discussions, although some initially showed insecurity when speaking English. An assessment questionnaire completed by part of students (voluntary participation) indicated positive perceptions of course quality and technical learning. The perceived familiarity of students with Digital Control increased, while self-assessed English proficiency remained relatively stable. All respondents reported greater comfort with participating in internationalization activities at UFG. The experience suggests that EMI can feasibly combine technical education and internationalization in undergraduate engineering education. And no students failed in either of the two semesters involved by this EMI experience.

Keywords: Educational Games, Gamification, Professional Ethics, Social Responsibility, Sustainable Development.

Career in Play:

Gamification of the Professional Context in Engineering

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Abstract

Critical reflection on professional actions and their consequences is a fundamental component of ethical education. In Plato's Apology, Socrates presents the examination of one's conduct as essential to a reflective life. This perspective remains relevant to Engineering education, since professional decisions may have technical, social, economic, and environmental consequences. In this context, professional ethics extends beyond compliance with rules and codes. It involves critical judgment, responsibility for decisions, consideration of their consequences, and awareness of the engineer's responsibilities toward individuals, society, and the environment. Active learning strategies, such as gamification, can provide opportunities to explore these principles through simulated professional situations. This paper presents the development of Career in Play, an educational board game designed to promote reflection on professional ethics, social responsibility, sustainability, and the consequences of individual choices. The game incorporates principles related to the 17 Sustainable Development Goals (SDGs) of the United Nations and simulates situations involving career building and professional development. Its mechanics require players to make choices that affect resources, reputation, and progress. These situations encourage participants to consider competing alternatives and their consequences while exercising critical thinking, planning, cooperation, leadership, and responsible decision-making. The initial proposal was evaluated by students enrolled in an Ethics, Engineering and Society course. Primary data were collected through two surveys addressing seven criteria: systemic perspective, practicality, completeness of the proposed idea, innovation, applicability, theoretical foundations, and originality. Each criterion was assessed using three categories: full presence, partial presence, or absence. After the first evaluation, adjustments were made to the proposal and a second survey was conducted using the same criteria. Completeness reached 73% full presence in both evaluations. Originality increased from 18% to 36% full presence. However, in the second evaluation, innovation and originality both registered 45% absence, identifying these criteria as important areas for further development. The evaluations identified strengths and limitations of the proposal and provided guidance for refining its mechanics. Career in Play shows potential as an educational resource for introducing discussions on professional ethics, social responsibility, sustainability, and the consequences of professional decisions within Engineering education. Further development cycles and evaluations involving larger and more diverse groups are required to investigate learning outcomes and the game's educational effectivenesst.

Keywords: Educational Games, Gamification, Professional Ethics, Social Responsibility, Sustainable Developmente.

Meaningful Learning According to Rogers:

Use of AI

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Abstract

Artificial intelligence is becoming increasingly present in everyday life as a tool for exploring thought and ways of managing knowledge. According to Carl Rogers, "...the only learning which significantly influences behavior is self-discovered, self-appropriated learning"; in other words, this refers to meaningful learning, in which the learner gives meaning to what they learn and, based on this, constructs their own knowledge. The question that arises is whether the use of AI can contribute to this process or whether it hinders the process of thinking and the autonomous acquisition of knowledge. The objective is to analyze, based on Carl Rogers theory, whether AI could be a tool in the process of self-discovery in learning or, alternatively, whether it could become an obstacle to such learning. This was an exploratory, bibliographic, documentary, qualitative, and non-probabilistic study. The research revealed that, from a Rogerian perspective, meaningful learning effectively occurs when the learner is at the center of the process; that is, when they actively participate, based on their own experiences, in the construction of their own autonomy. Thus, AI could be used as a tool in the construction of knowledge. On the other hand, if AI is used not as a tool but as a substitute for the processes involved in thinking, it may, conversely, hinder self-discovery, autonomy, and reflection. Meaning is lost, as is the person's authenticity, as the individual no longer knows how to think for themselves. AI can be a highly important support tool for meaningful learning, as it expands the process of research and access to knowledge, as well as the acquisition of skills, provided that the center of this process is occupied by the person who learns and not by AI. When the person is removed from the center and technology takes their place, autonomy, the ability to construct knowledge, and, most importantly, the development of learning based on the meaning that the learner gives to their experiences are lost. In other words, if AI is used as a tool, it can play a very important role in learning. However, if it is used to replace the process of thinking, when this task is delegated to AI, it becomes an obstacle by relegating the learner from the position of active participant to that of a reproducer of content that is unrelated to the individual's own experiences.

Keywords: AI, Health, Human Being, Meaningful Learning, Rogers.

Confluencing the Meanings of Exact Sciences:

Intersectionality and Transformation of the Academic Space

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Abstract

In recent decades, the implementation of affirmative action policies in brazilian public universities has reshaped the logic of access to higher education throughout the country. In Goiás, this transformation is visible in the student composition of traditional programs such as Engineering, which, in addition to being one of the first programs to be institutionalized in the state, has historically attracted predominantly elite student population stratified according to categories such as race, gender, and class. Currently, the Engineering Complex of the Federal University of Goiás (UFG) is also attended by low-income, Black, Indigenous, Quilombola, and students with disabilities, in addition to an increasing presence of women.

Despite the success in implementing public inclusion policies, student diversity remains an institutional challenge, particularly regarding the retention of female students in STEM (Science, Technology, Engineering, and Mathematics) fields. This requires these programs to recognize new student profiles not merely as occupants of available places, but above all as legitimate subjects who produce knowledge. From this perspective, this experience report presents a complex and empathetic pedagogical praxis developed through the offering of the Free Core component Women and Gender Equality in Engineering – MIG, associated with the School of Civil and Environmental Engineering at the Federal University of Goiás (EECA/UFG). The critical analysis focuses on the obstacles associated with the construction of the concept of gender, which resonates both within academia and in the social representation of work. To this end, a mediated pedagogical praxis is adopted, emphasizing dialogical interaction and horizontality in order to raise awareness and engage participants. The proposed theoretical framework unfolds into a practice imbued with meaning through which the study seeks to promote the participatory development of strategies aimed at achieving effective equity. A case study method was used to investigate the experience of offering the MIG Free Core component, which was introduced in the first semester of the 2017 academic year. The evidence demonstrates its appeal to students from different fields, with a predominance of students from engineering programs. The data collected confirm its relevance to a qualified debate on gender, limitations, and development in education and career paths, strategically contributing to broadening the perception of individual and collective phenomena associated with ethnic-racial and gender-related issues. The results indicate a significant contribution to cultural and spatial transformation at the university, impacting the retention and success of participants. Although the component demonstrates cross-cutting demand, there is a prevalence of students from the UFG School of Engineering, whose academic community reflects/intersects gender, race, and class biases, which are embedded within a presumed universalizing neutrality and contributing to addressing persistent structural issues.

Keywords: Diversity, Engineering, Gender Equality, Intersectionality, Pedagogical Praxis.

Ethical Guardrails of Large Language Models as a Barrier to Cybersecurity Education in Engineering Courses:

A Comparative Analysis of ChatGPT-4o, Claude Sonnet 3.5, and Gemini 2.5 Pro

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Abstract

This paper examines whether the ethical guardrails embedded in large language models (LLMs) act as a barrier to cybersecurity education in engineering courses. As LLMs are increasingly used by students and educators as study aids, their built-in content restrictions raise a critical question: do these safeguards hinder legitimate academic use of security-related material? Three widely used models, ChatGPT-4o (OpenAI), Claude Sonnet 3.5 (Anthropic), and Gemini 2.5 Pro (Google), were evaluated using a set of 15 prompts, three per category, distributed across five representative undergraduate cybersecurity topics: malware analysis, network vulnerability scanning, exploit techniques, reverse engineering, and social engineering. This scope was chosen to cover the core categories of a typical undergraduate cybersecurity curriculum while keeping the evaluation feasible for rigorous manual review: each prompt was submitted three times per model across separate sessions and every response was independently classified by two reviewers, so the 15-prompt design already yielded 135 model responses and 270 individual classifications, with disagreements resolved by consensus and the most frequent classification adopted as the final result. Each prompt was explicitly framed in an educational context and submitted to every model under identical conditions, without system prompt modifications or jailbreak attempts. Results show substantial differences across models: ChatGPT-4o was the most permissive (full answer rate of approximately 47%, refusal rate of approximately 20%), Claude Sonnet 3.5 showed an intermediate profile with the lowest refusal rate (approximately 13%), and Gemini 2.5 Pro was the most restrictive (refusal rate of approximately 53%). Across all models, exploit techniques were the most consistently restricted category, while reverse engineering was the most accessible, and educational framing alone did not reliably determine whether models engaged with content at a technically useful level. These findings indicate a persistent tension between current AI safety design and the practical needs of cybersecurity education: because exploit techniques and malware analysis, the topics most dependent on hands-on practice for engineering competency, were also the most consistently restricted, students are systematically pushed toward lower, descriptive levels of engagement instead of applied skill-building, and may be driven toward informal or unmoderated sources of uncertain reliability to complete coursework. These results suggest that locally hosted, open-weight models may offer a more suitable alternative for hands-on coursework in engineering programs.

Keywords: Artificial Intelligence, Cybersecurity Education, Engineering Education, Ethical Guardrails, Large Language Models.

Master Plan:

Gamification Applied to Management Education in Engineering

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Abstract

Engineering education requires not only technical knowledge but also competencies related to planning, organization, decision-making, resource management, and leadership. These competencies are essential for professional practice in complex environments. In The Practice of Management, Peter Drucker presents management as an activity oriented toward objectives and results. He associates the manager's role with functions such as setting objectives, organizing, communicating, assessing performance, and developing people. This perspective highlights the relevance of introducing Engineering students to management concepts that can be applied in their future professional practice. Active learning strategies, such as gamification, can help connect these theoretical foundations with practical situations involving planning and decision-making. This paper presents the development of Master Plan, an educational board game designed to integrate management concepts and competency development with the 17 Sustainable Development Goals (SDGs) of the United Nations. The game incorporates management fundamentals into its mechanics. Planning is exercised through goal setting and strategic choices, while organization involves allocating and managing available resources. Decision-making requires players to evaluate alternatives and their consequences. Control is represented by monitoring how these decisions affect resources, reputation, and progress throughout the game. The dynamics also incorporate ethics, cooperation, sustainability, and social responsibility. The initial version of the project was evaluated by students enrolled in a Fundamentals of Management course. Primary data were collected through a survey covering seven criteria: systemic perspective, practicality, completeness of the proposed idea, innovation, applicability, theoretical foundations, and originality. Each criterion was assessed using three categories: full presence, partial presence, or absence. After the first survey, adjustments were made to the game and a second survey was conducted using the same criteria. Full-presence ratings for innovation, applicability, and originality increased from 33% to 67%. Theoretical foundations increased from 50% to 67%, while completeness of the proposed idea remained at 83%, the highest full-presence result in the second evaluation. Practicality received 33% full presence, 50% partial presence, and 17% absence, indicating that this aspect still requires improvement. The results indicate that the iterative evaluation process contributed to refining the proposal and identifying areas for further development. Master Plan shows potential as an educational resource for integrating management concepts, sustainability, and competency development into Engineering education. Further evaluations involving larger and more diverse groups are required to assess its effectiveness in the learning process.

Keywords: Educational Games, Gamification, Management, Strategic Planning, Sustainable Development.

Ethics, Engineering and Society:

Socrates, Archimedes e Pythagoras

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Abstract

Humanity's challenges increase with each passing day, resulting from social, environmental, cultural, and other changes. However, to understand these challenges, it is necessary to differentiate between ethics and morality. Ethics comes from the Greek "ethos," meaning character, while morality comes from the Latin "moralis," meaning customs. The word character comes from the Greek verb "kraras-sein," meaning to sculpt; thus, human beings have free will to choose and sculpt who they wish to be, within the customs in which they are, or wish to be, embedded. Engineering is intimately linked to society, regardless of the temporal context and/or its complexity, given that its existence, or absence, is understood through the study of art, science, and technology—the fundamental components of engineering. To analyze the interface between Ethics, Engineering, and Society, based on the contributions of Socrates, Archimedes, and Pythagoras. Methodology exploratory, bibliographic, qualitative, and non-probabilistic research. Data analysis uses the functionalist method to investigate ethics as an integral part of the social system, the structuralist method to understand engineering as an implicit part of society, and the phenomenological method to understand the lived experience of the three. The research revealed that Pythagoras, originating from a wealthy family, was born in Samos (570 BC), a Greek island that retains the same name, extremely close to the coast of Turkey, and died in the city of Metapontum (495 BC), a region now belonging to the municipality of Bernalda in southern Italy. Archimedes, from a wealthy family, was born in Syracuse (287 BC), a city on the island of Sicily that retains the same name, located in southern Italy, where he died (212 BC). Socrates, from a humble family, was born in Alopecia (470 BC), a region near Athens, and died in Athens (399 BC), the capital of Greece that incorporated Alopecia, a fact that would cease to exist. In chronological order, first Pythagoras, second Socrates, and third Archimedes, all three being Greeks, including Italy, which was known as Magna Greece. However, Pythagoras was the precursor in bringing, through a solitary journey, knowledge from the East to the West, creating a closed community, living with shared goods and guided by the Golden Verses, which would become known as the Pythagorean Society. Archimedes made several inventions that are unknown to the vast majority of people even today. I will highlight, for example, the helical screw, which, when rotated, allows the continuous transport of substances from one side to the other, or from bottom to top, more efficiently and effectively than many later alternatives, and is known as Archimedes' screw. Finally, Socrates, for whom all human beings can be wise, simply needs to recognize their own ignorance. Facing challenges requires, more and more each day, the ability to think, philosophize, seeking solutions with simplicity, functionality, and economy, where character, inventiveness, and community—that is, ethics, engineering, and society—can be integrated in the preservation of Planet Earth.

Keywords: Education, Engineering, Ethics, Philosophy, Society.

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