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IDEAS'26 Participants have full responsibility for the book content.

FOREWARD

This Book of Abstracts accompanies the IDEAS'26 – International Conference on Innovation, Digital Education, Artificial Intelligence and STEAM and provides a structured overview of its scientific and academic program.

The volume includes the abstracts of the plenary talks and workshops, as well as the abstracts of the peer-reviewed scientific contributions accepted for presentation. It reflects the scope and interdisciplinary nature of the conference, encompassing research and practice in the areas of innovation, digital education, artificial intelligence, and STEAM.

The plenary talks, delivered by invited experts, address key developments and emerging challenges in the field. The workshops complement these contributions by fostering interactive discussion and the exchange of applied knowledge. The collection of scientific abstracts presents original research findings, methodological approaches, and case-based studies, offering insight into current trends and future directions.

This publication serves as a formal record of the contributions presented at IDEAS'26 and as a reference for researchers, academics, and practitioners engaged in the advancement of education and technology.

The Organizing Committee wishes to express its sincere appreciation to all authors for their valuable contributions, to the members of the Scientific Committee for their rigorous review process, and to the keynote speakers and participants for their engagement and commitment. We also gratefully acknowledge the support of the partner institutions whose collaboration has been instrumental to the realization of this event.

It is our expectation that IDEAS'26 will foster meaningful dialogue, promote scholarly exchange, and contribute to the development of innovative and sustainable approaches in education and technology.

We want to express our gratitude to all IDEAS'26 participants. Thank you!

The IDEAS'26 General Chairs

Ana Paula Lopes
Filomena Soares

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INVITED SPEAKERS – PLENARY SESSIONS

- **Prof. Matar Mbaye**

Dean of SCBS,
South Champagne Business School,
Troyes, France



Dean of South Champagne Business School (SCBS) in Troyes, Dr. Matar MBAYE is a sociologist whose work explores the structural transformations driven by digital innovation in education. Formerly a consultant and academic, he has consistently worked at the crossroads of change management, pedagogy, and institutional strategy. Guided by the belief that “*the only tradition worth having is that of change,*” he promotes nevertheless a humanistic vision of higher education that reconciles innovation with meaning, and performance with purpose. His leadership aims to align technology, organisational evolution, and the transformative mission of learning.

Plenary Session

Artificial Intelligence as a mirror in abyme: rethinking learning, recognition, and the ontology of the human

This invited lecture examines artificial intelligence as a mirror in abyme—a recursive reflection of human cognition, culture, and social organisation. Drawing on the work of classical and contemporary thinkers such as M. Mauss, P. Bourdieu, C. Castoriadis and E. Morin, it presents AI as a *fait social total* that reshapes not only the production of knowledge but also the symbolic frameworks underpinning recognition, learning, and institutional legitimacy. In doing so, it raises essential questions about the future of education.

The talk examines three major areas of tension. The first concerns the diminishing role of imagination and the loss of the “invisible” dimensions of human experience—such as emotion, poetic invention, and interpretive nuance—within learning environments that are increasingly data-driven and optimised. The second relates to the sociological divides and cultural marginalisations embedded in algorithmic systems, which call into question the presumed universality of AI and its tendency to produce a global homogenisation of ways of knowing. The third addresses the reconfiguration of certification, validation, and qualification frameworks at a moment when automated processes play a growing role in determining recognition and assessment.

By re-opening the ontological dialogue between human beings and existence, the intervention proposes a renewed understanding of learning as a *dia-poetic* journey—creative, relational, and irreducible to optimisation. It argues that the future of education and knowledge will depend less on the computational power of machines than on humanity’s capacity to preserve imagination, symbolic mediation, and the ethical discernment that give meaning to intelligence.

- **Prof. Renitha Rampersad**

Assistant Dean: Research and Innovation
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Cape Peninsula University of Technology
Cape Town, South Africa



Professor Renitha Rampersad has a DPhil from the University of Zululand, in South Africa. She is the Assistant Dean of Research and Innovation in the Faculty of Business and Management Sciences at the Cape Peninsula University of Technology. Her research on transformation in business, digitalisation, work integrated learning and women mentorship has contributed to co-edited books and authored chapters in journals. She is involved in national and international funded research projects. She leads a multidisciplinary project on transformation of the socio-economic environment which aligns with digitalisation and infrastructural challenges with BRICS countries.

Plenary Session

Reimagining the University: Past Lessons, Current Realities, Future Directions

The future of higher education demands that universities innovate by achieving a critical balance.

The traditional educational model has adapted to accommodate flexible learning arrangements in the post-pandemic world. Due to this higher education has had to adjust to an increasingly uncertain and complex future. These challenges include external pressures, such as globalization, and internal pressures, such as a decrease in funding and blended learning approaches. ED4.0 has placed a strong emphasis on cultivating an entrepreneurial mindset and fostering innovation among learners, achieved through project-based learning, internships, and exposure to real-world problem-solving scenarios. The realisation of ED4.0 depends on contextual variables, resource availability, and institutional priorities, with ongoing developments in technology and education likely to enhance or introduce new trends.

Given that learning journeys are entirely flexible and customizable, universities must remain relevant and must reinvent themselves by adapting and delivering through hybrid models that accommodate both synchronous and asynchronous learning.

This article through a descriptive paradigm will reflect not just what the future may hold, but potentially deeper changes in the relationship between universities and their past, present, and future.

- **Prof. Selver Softic**

Full Professor

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Selver Softic is a full professor specialising in, information processing, data mining and data visualisation, as well application of AI in education and process management. He has extensive experience in digital learning innovation, leading activities in Erasmus+ projects such as Gate2Math and AI-Greener and coordinating international teaching initiatives. His current research and teaching focus includes the integration of AI into higher education, learning analytics, and educational data mining.

Plenary Session

Human-Centered Learning Analytics in Education

This talk explores how Artificial Intelligence can make learning analytics more human-centered in STEAM education. Moving beyond grades and system logs, it highlights how AI can capture engagement, motivation, and sentiment to provide adaptive feedback and empower both students and teachers. The session outlines a visionary roadmap for using learning analytics to enrich the student experience and build bridges across STEAM disciplines.

IDEAS'26 WORKSHOPS

Building Generative AI Courses and Fostering Mobility through Joint Delivery

This interactive workshop invites participants to explore how generative AI can be meaningfully integrated into higher education curricula and how cross-university collaboration can enhance learning opportunities and student mobility.

Drawing on the case of TTK University of Applied Sciences, we will present lessons learned from creating and running the course "Using Generative AI Tools in Academic Studies." The session will highlight key stages in course development, including content creation, pedagogical considerations, and feedback from learners.

A second focus is the joint delivery of courses between institutions. Participants will examine the practicalities of co-teaching across borders—such as coordinating academic calendars, grading practices, and digital environments while reflecting on both the benefits and common obstacles of such collaboration.

The workshop features hands-on activities where participants work in small groups to propose enhancements to the course syllabus and co-design a joint delivery plan. The goal is to leave with a refined course concept and a clear direction for future collaboration, including identifying potential partner institutions and outlining initial steps for launching shared initiatives.

Anne Uukkivi and **Oksana Labanova**

Prof. Anne Uukkivi



Professor, TTK University of Applied Sciences, Centre for Sciences, Estonia. Anne Uukkivi is a professor with a PhD in Information and Communication Science and the Leader of the Research Group of Didactics in Higher Education at TTK University of Applied Sciences. She has designed and taught courses on office software and generative AI tools in education. Her online course has been recognized at the national level. She has organized multiple Blended Intensive Programs (BIPs), promoting student and teacher mobility through joint teaching initiatives with other universities. She has organized several national and international conferences. Currently, she leads an Erasmus+ project and serves as an evaluator for the national e-course quality label competition. Her areas of expertise include AI applications in education, course development, the use of ICT tools

in teaching, and international academic partnerships.

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MSc in Mathematics, is Head of the Centre for Sciences and a mathematics lecturer at TTK University of Applied Sciences. She has extensive experience in teaching STEM subjects and advancing the digital transformation of engineering education. Her expertise includes designing online courses, interactive materials, and using digital and partly AI-based tools to support individual learning paths. She is actively involved in STEM-related national and international projects, promoting student and teacher exchange, especially in engineering. A long-time member of Estonia's e-course evaluation and mathematics exam committees, she has delivered seminars on STEM teaching methodologies, trained

educators in ICT tools, and focuses her research on interactive content and automated assessments for individualised learning for adult learners.

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Building AI-Powered eLearning Resources in Moodle: From Prompting to Automated Test Creation

This hands-on workshop introduces participants to the use of generative AI tools—such as ChatGPT—for designing and implementing eLearning resources in Moodle. The focus will be on leveraging prompting techniques to create quizzes, interactive tests, and course materials that can enhance both teaching efficiency and student engagement.

Participants will gain insights into:

- How to structure prompts for high-quality, pedagogically sound learning resources.
- Best practices for generating Moodle-compatible tests and exercises.
- Strategies for integrating AI-created content into blended and online learning settings.
- How to transform AI-generated Moodle resources into Open Educational Resources (OERs) and publish them on platforms such as the Gate2Math Smart Library.
- Ethical and quality considerations when using AI in education.

In addition to exploring AI-driven course design, the workshop will highlight opportunities for international collaboration and mobility through joint delivery of AI-enhanced modules. Participants will be invited to experiment in small groups by generating Moodle resources, turning them into OERs, and co-developing ideas for cross-university course delivery.

By the end of the session, attendees will leave with practical resources, a roadmap for implementing AI-supported teaching practices in Moodle, and a vision for fostering mobility and open knowledge sharing through AI-based teaching initiatives.

Selver Softic and **Safet Softic**

Prof. Selver Softic



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Selver Softic is a full professor specialising in, information processing, data mining and data visualisation, as well application of AI in education and process management. He has extensive experience in digital learning innovation, leading activities in Erasmus+ projects such as Gate2Math and AI-Greener and coordinating international teaching initiatives. His current research and teaching focus includes the integration of AI into higher education, learning analytics, and educational data mining.

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Let's Improve Moodle Together - A Collaborative Design Workshop

Moodle is a learning platform used by many institutions. Both teachers and learners are familiar with and use this platform in education. However, while the platform provides learners with essential information, it is not particularly appealing and does not necessarily correspond to the usual image of a usable Internet platform.

In this interactive workshop, teachers are invited to make a course page more attractive. Using a current course from CAMPUS 02 University of Applied Sciences, we will show how a Moodle course can be structured so that different topics can be covered as individual lessons. We will present the possibilities for integrating existing Bootstrap elements such as cards and tip tools into the Moodle course and adapting them to your own needs. It will also show how easy it is to integrate and adapt other tools such as interactive GeoGebra parts and H5P elements.

Together with the participants, we will first work out the structure of a course and the possibilities for implementation. Step by step, we will create the individual blocks of the course and explore the possibilities for changing and adapting existing web elements.

The workshop therefore includes practical activities in which participants work in small groups to improve a Moodle course in terms of design and usability. The aim is to design a Moodle course in such a way that it provides a better overview of the individual topics covered in the course and engages learners more effectively with the help of interactive elements.

Eva Schirgi and **Daniela Haumer**

Prof. *Eva Schirgi*



Teaching and Research, CAMPUS 02 University of Applied Sciences, Graz, Austria
Eva Schirgi is a full-time mathematics lecturer at CAMPUS 02 University of Applied Sciences and coordinator for data science. She has designed and delivered courses in mathematics and statistics and created online teaching materials. She is also largely responsible for creating the online course for school mathematics, which is being implemented across all departments at CAMPUS 02 in order to close gaps in school education.

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Daniela Haumer is a project assistant at CAMPUS 02 University of Applied Sciences, supporting various projects within the Department of Information Technology & Business Informatics. She is currently involved in the development and delivery of training programs for children on the fundamentals of artificial intelligence, as well as contributing to projects related to sustainability.

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Interactive OER for STEM: From Idea to Integration

How can we make STEM teaching more engaging without spending weeks developing new materials? How do we find open, high-quality resources that we can actually use — and share legally?

This interactive workshop offers clear answers and practical solutions.

Together, we will explore how to create interactive tasks and visualizations using H5P and GeoGebra, and how to integrate the language of mathematics through LaTeX — step by step and without the need for advanced programming skills. Participants will learn how to turn existing materials or ideas into dynamic, learner-centered experiences that can be easily shared and embedded across digital learning platforms and LMS environments.

During the workshop, participants will learn how to:

- Create interactive exercises and visual STEM activities using H5P, GeoGebra, and other open tools;
- Find high-quality open resources from trusted OER repositories;
- Adapt existing materials to fit their own teaching goals and student needs;
- Understand the essentials of Creative Commons licensing — how to reuse, attribute, and license their own materials responsibly;
- Integrate the created resources into various learning platforms and LMS environments.

After the workshop, each participant will receive an online step-by-step guide — “From Idea to Integration: Creating Interactive OER for STEM” — summarizing the full workflow from idea generation to creation, licensing, and integration.

Whether you’ve never built a digital exercise before or you’re looking for new ways to share your expertise, this session will help you transform your teaching materials into engaging, shareable, and open STEM resources — in less time than you think!

Yevheniia Andriichenko

Yevheniia Andriichenko, MSc



Yevheniia Andriichenko, MSc is a researcher at CAMPUS 02 University of Applied Sciences (Austria) and a doctoral candidate at Graz University of Technology (TU Graz), studying the impact of Open Educational Resources (OER) in higher education. She is one of the key contributors to several Erasmus+ and Austrian national projects, creating and promoting high-quality multilingual OERs and delivering innovative workshops across Europe. Yevheniia also conducts training programs for children on large language models (LLMs) and AI, fostering early digital awareness and creativity. She is a certified OER user (P-2025-028 oerzertifikat.at)

and an active member of the Forum Neue Medien in der Lehre Austria (<https://fnma.at/>), advocating for open, inclusive, and sustainable education in Europe.

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Scientific Contributions



Abstracts



ABSTRACTS – Scientific Contributions

This section comprises the abstracts of all works presented in person during IDEAS'26 International Conference, whether delivered as Oral Communications or Poster presentations. Each contribution provides a succinct account of the research objectives, methodologies, and principal findings shared by the authors, thereby enriching the scientific and academic discourse fostered throughout the event.

Collectively, these contributions illustrate the diversity of perspectives and analytical orientations, in distinct Scientific Areas, that informed the academic discussions throughout this international event.

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A conceptual architecture for optimizing IT Project Management using RPA and AI

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Abstract—The increasing complexity of IT development projects requires new approaches for optimizing project management processes. This paper proposes a conceptual framework for Project Management optimization in IT projects through the integration of Robotic Process Automation and Artificial Intelligence. The framework is structured into three layers: Process Layer, Automation Layer, and Optimization Layer, addressing process design, automated execution, and intelligent decision support. AI-based agents are introduced to analyze project data and generate recommendations for improved planning and resource utilization. A conceptual case study based on an IT project managed using Jira is proposed to illustrate the applicability of the framework. The proposed approach aims to reduce administrative effort, enhance transparency, and support continuous improvement in IT project management.

Keywords—Project Management, Robotic Process Automation, Intelligent Agents, Framework, IT Development projects, Jira

REFERENCES

- Aguirre, S., & Rodriguez, A. (2017). Automation of a business process using robotic process automation (RPA): A case study. *Communications in Computer and Information Science*, 742, 65-71.
- Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M. Thomas, D. (2001). *Manifesto for agile software development*. Agile Alliance.
- Bostan, A. (2024). Optimizing IT Project Management: Leveraging Jira Automation for IT Implementations. *COMMUNICATIONS*.
- Bostan, A. I., & Bologa, A. R. (2023). Insights and proposals for RPA implementations. *Database Systems Journal*, 14(1).
- Brown, T. (2020). Language models are few-shot learners. *Advances in Neural Information*.
- Chou, J. S., Nguyen, N. M., & Hsu, S. C. (2022). AI-based prediction models for project schedule and cost overruns: A systematic review. *Automation in Construction*, 134, 104047.
- Gartner. (2022). Hyperautomation: A framework for business-driven automation. Gartner Research.
- Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), 75-105.
- Highsmith, J. (2009). *Agile project management: Creating innovative products* (2nd ed.). Addison-Wesley Professional.
- Kerzner, H. (2022). *Project management: A systems approach to planning, scheduling, and controlling* (13th ed.). Wiley.
- Lacity, M., & Willcocks, L. (2021). *Robotic process automation and risk mitigation: The definitive guide*. SB Publishing.
- Marnewick, C., & Marnewick, A. L. (2020). Artificial intelligence for project management: The state of the art. *International Journal of Information Systems and Project Management*, 8(4), 5-22.

- McKinsey & Company. (2023). The economic potential of generative AI: The next productivity frontier. McKinsey Global Institute.
- Object Management Group. (2014). Business process model and notation (BPMN), version 2.0.2. OMG.
- Project Management Institute. (2021). A guide to the project management body of knowledge (PMBOK® Guide) (7th ed.). PMI.
- Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
- Schwalbe, K. (2015). *Information technology project management* (8th ed.). Cengage Learning.
- Schwaber, K., & Sutherland, J. (2020). *The Scrum guide: The definitive guide to Scrum: The rules of the game*. Scrum.org.
- Standish Group. (2020). *CHAOS report 2020: Beyond infinity*. Standish Group International.
- Syed, R., Bandara, W., French, E., Stewart, G., Maynard, S. B., & Munro, J. (2020). Robotic process automation: Contemporary themes and challenges. *Computers in Industry*, 115, 103162.
- van der Aalst, W. M. P., Bichler, M., & Heinzl, A. (2018). Robotic process automation. *Business & Information Systems Engineering*, 60(4), 269-272.
- van der Aalst, W. M. P., Carmona, J., Chatain, T., & Taymouri, F. (2023). Process mining: A 360 overview. *ACM Computing Surveys*, 55(5), 1-34.
- Wooldridge, M. (2020). *An introduction to multiagent systems* (2nd ed.). Wiley.

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A Simplified Evaluation Method Used for Unsupervised Learning Algorithms

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Abstract—Professional evaluations for unsupervised learning algorithms are a crystal important and challenging topic due to its input-output specialty. There are no output labels available in unsupervised learning models to work as an evaluation criterion to check and compare the predicted outputs with the actual outputs. In other words, it is relatively difficult to effectively estimate or validate the correctness or efficiency of any unsupervised learning algorithms with regular methods used in supervised learning studies. In this study, we developed a simplified evaluation method by using average or mean values for testing observations and comparing them with the mean values of clustered observations to identify their correctness of their clustering. This method can be used to effectively perform some evaluations for unsupervised learning models. A comparison between our method with some traditional evaluation methods, such as Silhouette Scores, is performed and the comparison result shows that our method is better than that traditional method.

The experimental study confirmed the effectiveness of our evaluation methods used for unsupervised learning algorithms, and the correct evaluation rate is up to 97%.

Keywords—Evaluations of unsupervised learning algorithms, internal validation metrics, Silhouette scores, Calinski-Harabasz index, Davies-Bouldin index, Dunn index, Diabetes dataset

REFERENCES

- [1]. Perry, Patrick O. Stanford University ProQuest Dissertations & Theses, 2009. 3382809 <https://www.proquest.com/openview/13e305db3d4d43c014a00e717dcbbf3f/1?pq-origsite=scholar&cbl=18750>.
- [2]. Julio-Omar Palacio-Niño and Fernando Berzal, 2019, Evaluation Metrics for Unsupervised Learning Algorithms, arXiv eprint, <https://arxiv.org/abs/1905.05667>.
- [3]. Andreas Vlachos, 2011, Evaluating unsupervised learning for natural language processing tasks” Proceedings of EMNLP 2011 Conference on Empirical Methods in Natural Language Processing, Edinburgh, Scotland, UK, pp 35–42 .
- [4]. Garg, Vikas, and Adam T. Kalai, 2018. Supervising unsupervised learning. Advances in Neural Information Processing Systems 31 (NeurIPS 2018).
- [5]. Martin Q. Ma et al, 2023. The Need for Unsupervised Outlier Model Selection: A Review and Evaluation of Internal Evaluation Strategies. SIGKDD Explor. Newsl. 25, 1, pp 19–35. <https://doi.org/10.1145/3606274.3606277>.
- [6]. F. G. Portela, F. Almenares Mendoza and L. C. Benavides, 2019. Evaluation of the performance of supervised and unsupervised Machine learning techniques for intrusion detection, 2019 IEEE International Conference on Applied Science and Advanced Technology (iCASAT), Queretaro, Mexico, pp. 1-8, doi: 10.1109/iCASAT48251.2019.9069538.
- [7]. G. Padmavathi, D. Shanmugapriya and A. Roshni, 2022. Performance Analysis of Unsupervised Machine Learning Methods for Mobile Malware Detection, 9th International Conference on Computing for Sustainable Global Development (INDIACom), New Delhi, India, pp. 201-206, doi: 10.23919/INDIACom54597.2022.9763180.
- [8]. T. T. Khoei, et al, 2024. A Comparative Assessment of Unsupervised Deep Learning Models for Detecting GPS Spoofing Attacks on Unmanned Aerial Systems, 2024 Integrated Communications, Navigation and Surveillance Conference (ICNS), Herndon, VA, USA, pp. 1-10, doi: 10.1109/ICNS60906.2024.10550633.
- [9]. O. Toyin et al., 2024. Comparative Analysis of Unsupervised Machine Learning Models on Early Detection of Breast Cancer, 2024 International Conference on Science, Engineering and Business for Driving Sustainable Development Goals (SEB4SDG), Omu-Aran, Nigeria, pp. 1-7, doi: 10.1109/SEB4SDG60871.2024.10630354.
- [10]. R. Barreto, L. Gomes and Z. Vale, 2024. Smart Solution for Energy Communities: Integrating Demand Response and Unsupervised Learning Evaluation Metrics, IEEE 22nd Mediterranean Electrotechnical Conference (MELECON), Porto, Portugal, pp. 144-149, doi: 10.1109/MELECON56669.2024.10608742.
- [11]. U. Haq et al., 2021. Detection of Breast Cancer Through Clinical Data Using Supervised and Unsupervised Feature Selection Techniques, IEEE Access, vol. 9, pp. 22090-22105, doi: 10.1109/ACCESS.2021.3055806.
- [12]. Y. Zou, C. Liu, H. Shao and D. Zhong, 2023. Unsupervised Palmprint Image Quality Assessment via Pseudo-Label Generation and Ranking Guidance, IEEE Transactions on Instrumentation and Measurement, vol. 72, pp. 1-11, Art no. 5018811, doi: 10.1109/TIM.2023.3288259.
- [13]. <https://fiveable.me/modern-statistical-prediction-and-machine-learning/unit-14/evaluation-metrics-unsupervised-learning-clustering/study-guide/UuzjLvrGcbnj7uhw>.
- [14]. <https://medium.com/@MrBam44/how-to-evaluate-the-performance-of-clustering-algorithms-3ba29cad8c03>.
- [15]. <https://www.kaggle.com/datasets/mathchi/diabetes-data-set>.

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Active and Collaborative Learning through Mathematical Problem Solving in Engineering

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Abstract— This work presents the design and implementation of an activity developed within the Mathematics I curricular unit of the Electrical Engineering – Electrical Power Systems degree at the School of Engineering of the Polytechnic Porto.

The activity was motivated by the intention to integrate active learning methodologies into higher education, encouraging students to assume a more participatory role in the learning process and promoting a deeper understanding of mathematical concepts. It was structured around three compulsory components: the preparation of a written report, the production of an educational video with a clear explanatory and didactic purpose, and an oral presentation delivered in pairs. The production of the video constituted the central element of the pedagogical proposal, as it required students to explain mathematical concepts and the resolution of specific problems in a clear, accurate, and accessible manner. This process encouraged students not only to solve the proposed problem but also to organise their reasoning and communicate mathematical ideas effectively.

A central aspect of the activity was the use of the Padlet platform as a collaborative learning environment. After the production stage, all videos were shared on this platform so that they could be accessed by all students. The use of Padlet played a fundamental role in the activity, as it enabled students to view their peers' work, comment on it, and provide constructive feedback. This interactive space fostered reflection, critical thinking, and collaborative learning, while also encouraging students to engage with different approaches to explaining and solving mathematical problems. Furthermore, the peer-feedback process supported the development of self-regulation in learning and promoted the acquisition of transversal skills, including digital literacy, teamwork, and communication abilities. The use of Padlet also contributed to creating a shared repository of student-produced learning resources, reinforcing the sense of community within the class.

The results suggest increased student motivation, participation, and engagement with the subject. In addition, the need to produce explanatory videos and interact through Padlet appears to promote deeper conceptual understanding, highlighting the potential of digital collaborative platforms and student-generated content as innovative pedagogical strategies in higher education mathematics.

Keywords—Active learning; Collaborative learning; Mathematics; Mathematical problem solving; Engineering; Higher education; Student engagement; Student-generated content.

REFERENCES

- [1] A. Caldeira, S.O. Lopes and A. R. Costa and I. Figueiredo. Learning by Teaching with Videos - An Integration Strategy to Promote Mathematical Communication among Students of Higher Education. In M. Ludwig, S. Barlovits, A. Caldeira, & A. Moura (Eds.), *Research On STEM Education in the Digital Age. Proceedings of the ROSEDA Conference* (pp. 91–98). WTM. DOI: 10.37626/GA9783959872522.0.1, 2023
- [2] A. Caldeira, S.O. Lopes, I. Figueiredo and A.R. Costa. Low-cost videos for learning Mathematics by teaching. In *IGI Global - Developing Technology Mediation in Learning Environments*. Eds. Soares, F., Lopes, A. P., Brown, K., & Uukkivi, A., Chapter 10. Hershey, PA: IGI Global. DOI: 10.4018/978-1-7998-1591-4.ch010, 2020
- [3] C. J. Brame. *Effective Educational Videos: Principles and Guidelines for Maximizing Student Learning from Video Content*. CBE Life Sci Educ. 2016 Winter;15(4):es6. doi: 10.1187/cbe.16-03-0125. PMID: 27789532; PMCID: PMC5132380.
- [4] C. N. C. Lam and H. Habil. Enriching student learning through video-annotated peer feedback activity: A guide. *International Journal of Academic Research in Progressive Education and Development*, 10(3), 46–60, 2021
- [5] D. S. P. Gedera and A. Zalipour. Use of interactive video for teaching and learning. In *ASCILITE 2018 Conference Proceedings* (pp. 362–367). Deakin University, Geelong, Australia: Australasian Society for Computers in Learning in Tertiary Education, 2018.
- [6] E. Bravo, B. Garcia and Simo, P., Enache, M. & Fernandez, V.. Video as a new teaching tool to increase student motivation. 2011 IEEE Global Engineering Education Conference, EDUCON 2011. 638 - 642.
- [7] E. Tsolaki, R. Panaoura, S. Pericleous and M.Charalambides. Repositioning learners as explainers: Peer learning through student-generated videos in undergraduate mathematics. *Education Sciences*, 16(1), 148, 2026. <https://doi.org/10.3390/educsci16010148>
- [8] J., Bobkina, E. D. Romero and M. J. G. Ortiz. Educational mini-videos as teaching and learning tools for improving oral competence in EFL/ESL university students. *Teaching English with Technology*, 20(3), 85-95. 2020.
- [9] M. Kearney and S. Schuck. Spotlight on authentic learning: Student developed digital video projects. *Australasian Journal of Educational Technology*. 22. 189-208, 2006. 10.14742/ajet.1298.
- [10] M. Noetel, S. Griffith, O. Delaney, T. Sanders, P. Parker, B. del Pozo Cruz and C. Lonsdale. Video Improves Learning in Higher Education: A Systematic Review. *Review of Educational Research*, 91(2), 204-236. 2021. <https://doi.org/10.3102/0034654321990713>.
- [11] R. Lima and E.A. P. Saalman. Active Learning in Engineering Education: A (re)introduction. *European Journal of Engineering Education*, 42(1), 1–4, 2017. 10.1080/03043797.2016.1254161
- [12] S. K. Kharatova. Use of innovative technologies in the educational process. *Science and Education*, 3(3), 713-718, 2022.
- [13] P. Simo, V. Fernandez, I. Algaba, N. Salan, M. Enache and M. Albareda-Sambola. Video stream and teaching channels: quantitative analysis of the use of low-cost educational videos on the web. *Procedia Social and Behavioral Sciences*, vol. 2, pp 2937-2941, 2010.

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Advantages and limitations of digital didactic models' adoption in the age of IA

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Abstract — The didactic integration of digital technologies in higher education often fails to achieve its intended impact, as effectiveness depends heavily on the specific methods of implementation. This paper presents a systematic literature review aimed at identifying the most prevalent didactic models adopted by higher education teachers in the context of digital education, while pointing out their respective advantages and limitations.

Following a comprehensive screening of 1919 articles from Scopus, Web of Science and Open Research Europe for the time frame of 2020 to 2024, 19 studies were selected for inclusion. The Technological Pedagogical Content Knowledge framework emerged as the dominant model, featured in 10 of the analysed studies. This was followed by constructivist models in two studies, while seven alternative approaches were represented by a single study each. Notably, only one study addressed the integration of generative artificial intelligence, specifically focusing on the adoption of the didactical tetrahedron regarding ChatGPT in educational activities.

The primary advantages of these didactic frameworks include enabling teachers to tailor instruction to diverse technological tools and student needs, supporting student-centred learning environments, enhancing engagement and assessment processes, and promoting reflective teaching practices. Conversely, several challenges were identified, including inadequate institutional support, disparities in digital competence, the requirement for more reliable assessment tools, and the difficulty of maintaining student motivation within fully online settings.

The findings reveal that significant heterogeneity in model definitions and research contexts limits the comparability

across studies. While Technological Pedagogical Content Knowledge remains the primary framework for digital didactics, underexplored models offer valuable complementary insights into technology-enhanced learning, including generative artificial intelligence. This study concludes that future research should prioritize context-specific adaptations and the exploration of hybrid didactic approaches to better address the complexities of modern higher education.

Keywords - Digital Education; Didactic Models; Didactic Frameworks; Higher Education

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AI-based agent to enhance personalized learning process: a case study

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Abstract— Learning computer programming remains a challenging endeavor for many beginners, often associated with fear, low confidence, and reduced motivation. In the era of generative artificial intelligence, AI based agents offer new opportunities to enhance teaching and learning by providing personalized, context aware support. In fact, the AI-based agent could provide students with more personalized support, focused on the specific content available on Moodle, enabling tailored summaries, clarification of doubts, and the proposal of exercises aligned with course materials.

This study presents the design, implementation, and evaluation of an intelligent educational agent developed to support introductory programming courses in higher education. A systematic literature review informed the pedagogical and technological foundations of the system, guiding the selection of tools based on usability, feedback quality, and alignment with instructional objectives. The resulting agent delivers real time assistance, automated feedback on programming tasks, and personalized learning recommendations grounded in Moodle course content. The results demonstrate that the agent contributes to increased student engagement, enhances the learning process, supports problem-solving processes, and promotes the development of foundational programming skills.

A pilot study with undergraduate students, combining interaction logs, surveys, and academic performance indicators, shows that the agent effectively supports learning and fosters student engagement. The findings highlight the potential of AI driven educational agents when integrated within robust pedagogical frameworks, to improve learning outcomes in programming education. The study also outlines practical implications for the development of adaptive learning support systems and identifies promising directions for future research in intelligent educational technologies.

Keywords— programming learning, teaching methodologies, Generative Artificial Intelligence, AI-based agents

REFERENCES

- [1] Queirós, R., Pinto, M., & Terroso, T. (2020). Computer programming education in Portuguese universities. In First International Computer Programming Education Conference (ICPEC 2020) (Vol. 81, pp. 21:1–21:11). Schloss Dagstuhl – Leibniz-Zentrum für Informatik. <https://doi.org/10.4230/OASlcs.ICPEC.2020.21>
- [2] Pinto, M., Paiva, J. C., & Queirós, R. (2025). *GAMIBOT: Um chatbot educativo gamificado com integração no Moodle para suporte personalizado à aprendizagem prática*. *Revista Multimédia de Investigação em Inovação Pedagógica e Práticas de E-Learning*
- [3] Teresa Terroso and Mário Pinto. The Influence of GenAI on the Evaluation of Computer Programming Students in Higher Education. In 6th International Computer Programming Education Conference (ICPEC 2025). Open Access Series in Informatics (OASlcs), Volume 133, pp. 18:1-18:8, Schloss Dagstuhl – Leibniz-Zentrum für Informatik (2025) <https://doi.org/10.4230/OASlcs.ICPEC.2025.18>
- [4] Isaac Alpizar-Chacon and Hieke Keuning. Student’s use of generative ai as a support tool in an advanced web development course. ITiCSE 2025, Computers and Society, March 2025. URL: <http://arxiv.org/abs/2503.15684>.
- [5] Mary Maher, Yash Tadimalla, and Dhruv Dhamani. An exploratory study on the impact of ai tools on the student experience in programming courses: an intersectional analysis approach. In IEEE Frontiers in Education Conference, pages 1-5, October 2023. URL: <https://doi.org/10.1109/FIE58773.2023.10343037>.
- [6] Generative artificial intelligence in higher education: Evidence from an analysis of institutional policies and guidelines, Computers in Human Behavior: Artificial Humans, Volume 3, 2025, 100121, ISSN 2949-8821, <https://doi.org/10.1016/j.chbah.2025.100121>.
- [7] Cruz, M., Queirós, R., Mascarenhas, D., Ribeiro, E. (2026). Generative AI as a Catalyst for Pedagogical Innovation in Higher Education: A Professional Development Approach. In: Guarda, T., Portela, F., Augusto, M.F. (eds) Advanced Research in Technologies, Information, Innovation and Sustainability. ARTIIS 2025. Communications in Computer and Information Science, vol 2791. Springer, Cham. https://doi.org/10.1007/978-3-032-16848-1_22
- [8] Cruz, M., Queirós, R., Mascarenhas, D., Ribeiro, E. (2026). Communities of Practice and Generative Artificial Intelligence in Higher Education: Pedagogical Innovation, Professional Development, and Reflective Engagement. In: Guarda, T., Portela, F., Augusto, M.F. (eds) Advanced Research in Technologies, Information, Innovation and Sustainability. ARTIIS 2025. Communications in Computer and Information Science, vol 2791. Springer, Cham. https://doi.org/10.1007/978-3-032-16848-1_21

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AI in Higher Mathematics Education: Insights from Europe and Portugal

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Abstract— This article presents a comparative literature review of European research and studies conducted in Portugal on the use of Artificial Intelligence—specifically Generative AI systems—in higher STEM education, with a particular focus on mathematics education. The review maps the current state of knowledge and identifies points of convergence, divergence, and gaps in the literature. Drawing on studies published between 2023 and 2025, it is based on a systematic search of the Scopus, ERIC, and Google Scholar databases.

The analysis examines the methodological approaches adopted across the selected studies, the types of AI technologies employed, the mathematical domains addressed, and the learning outcomes reported. European research demonstrates greater methodological diversity, although it frequently lacks alignment with established principles and theoretical frameworks in mathematics education. In contrast, research conducted in Portugal remains in an early stage, predominantly descriptive, and largely focused on students' and lecturers' perceptions.

Overall, the findings indicate that, despite rapidly growing interest in the integration of Generative AI in tertiary mathematics education, significant gaps persist. This article highlights the need for more rigorous, context-sensitive, and theoretically grounded research—particularly within the Portuguese higher education system.

Keywords— Artificial Intelligence, Generative AI, Higher Education, Mathematics, Mathematics Education, STEM

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REFERENCES

- [1] Dilling, F. "ChatGPT's perspectives on real numbers, straight lines, and probability—A quantitative study on the influence of prompting." *Front. Educ.*, 10:1577322. doi: 10.3389/feeduc.2025.1577322. 2025.
- [2] Schorcht, S., Buchholtz, N., and Baumanns, L. "Prompt the problem – investigating the mathematics educational quality of AI-supported problem solving by comparing prompt techniques." *Front. Educ.* 2024, 9:1386075. doi: 10.3389/feeduc.2024.1386075. . 2024.
- [3] Udías, A., Alonso-Ayuso, A., Alfaro, C., Algar, M. J., Cuesta, M., Fernández-Isabel, A., Gómez, J., Lancho, C., Cano, E. L., Martín de Diego, I., and Ortega, F. "ChatGPT's performance in university admissions tests in mathematics." *International Electronic Journal of Mathematics Education*, 19(4), em0795. doi: 10.29333/iejme/15517. 2024.
- [4] Vintere, A., Safiulina, E., and Panova, O. "AI-Based Mathematics Learning Platforms in Undergraduate Engineering Studies: Analyses of User Experiences." *Proceedings of the 23rd Int. Scientific Conference Engineering for Rural Development*, doi: 10.22616/ERDev.2024.23.TF216. Jelgava, Latvia, 2024.
- [5] Lieberman, G. "The Use and Detection of AI-Based Tools in Higher Education." *Journal of Instructional Research*, 13, pp. 70–80. doi: 10.9743/JIR.2024.13.4. 2024.
- [6] Simon Frieder, Luca Pinchetti, Alexis Chevalier, Ryan-Rhys Griffiths, Tommaso Salvatori, Thomas Lukasiewicz, Philipp Christian Petersen, and Julius Berner "Mathematical capabilities of ChatGPT" *arXiv:2301.13867*. Available online: <https://arxiv.org/abs/2301.13867>. 2023.
- [7] Sánchez-Ruiz, L. M., Moll-López, S., Nuñez-Pérez, A., Moraño-Fernández, J. A., and Vega-Fleitas, E. "ChatGPT Challenges Blended Learning Methodologies in Engineering Education: A Case Study in Mathematics." *Appl. Sci.* 13(10), 6039. <https://doi.org/10.3390/app13106039>. 2023.
- [8] Matzakos, N., Doukakis, S., and Moundridou, M. "Learning Mathematics with Large Language Models: A Comparative Study with Computer Algebra Systems and Other Tools." *International Journal of Emerging Technologies in Learning (iJET)* 18(20), pp. 51–71. <https://doi.org/10.3991/ijet.v18i20.42979>. 2023.
- [9] Martinho, C., and Martins, S. "Artificial Intelligence in Higher Education Mathematics Teaching: Applications, Challenges, and Opportunities." *Proceedings of the 17th Int. Conf. on Education and New Learning Technologies (EDULEARN 25)*, pp. 6163–6167. <https://doi.org/10.21125/edulearn.2025.1516>. 2025.
- [10] Ribeiras, C., Dorotea, N., and Esteves, Y. "Uso e perceção de LLM pelos estudantes e professores do Ensino Superior - Revisão Sistemática da Literatura." *Revista Lusófona De Educação*. 65(65), pp. 85–108. <https://doi.org/10.24140/issn.1645-7250.rle65.04>. 2025.
- [11] Lousado, J. P. "Artificial Intelligence in Higher Education: Fraud and Merit – Assessing Knowledge and Competences in the Age of AI." *Millenium - Journal of Education, Technologies, and Health*, 2(15e), e36511. <https://doi.org/10.29352/mill0215e.36511>. 2024.
- [12] Lérias, E., Guerra, C., and Ferreira, P. "Literacy in Artificial Intelligence as a Challenge for Teaching in Higher Education: A Case Study at Portalegre Polytechnic University." *Preprints* 2024, 2024030754. <https://doi.org/10.20944/preprints202403.0754.v1>. 2024
- [13] Pereira, C. S., Ferreira, M. J., Sobral, S. R., Moreira, F., and Durão, N. "Enhancing higher education in Portugal: Leveraging generative artificial intelligence for learning-teaching process." *Proceedings of the 23rd European Conf. on e-Learning (ECEL 2024)*, Vol. 23 No. 1, pp. 289–298. 2024.
- [14] Cruz, J. P., Oliveira, M. P., and Cação, I. "Teaching and learning Calculus with ChatGPT: benefits and limitations." *ICERI2023 Proceedings*, pp. 456-463. doi: 10.21125/iceri.2023.0175. 2023

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AI: the necessary and the possible regulation

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Abstract— Given the reality of Artificial Intelligence (AI)’s presence in the most diverse spheres of modern life, significantly affecting it in various ways, the law cannot fail to address this new reality. Given the extent that it impacts our lives, AI must be subject to rules; it cannot be a lawless reality, devoid of rules and regulatory principles.

Thus, first and foremost, the aim of this communication is to analyze the fields in which AI currently poses the greatest challenges, namely in the areas of the economy and labor, health, education, and privacy.

Second, starting from the search for a definition of AI that allows for the establishment of the boundaries of the application of the rules governing it, we will seek to critically analyze the regulatory principles of AI, as set forth in the recent REGULATION (EU) 2024/1689 of the European Parliament and of the Council of June 13, 2024, which will enter into force on August 2, 2026.

This EU regulation aims to establish harmonized rules on artificial intelligence through a uniform legal framework, “in particular for the development, placing on the market, putting into service, and use of artificial intelligence systems (AI systems) in the Union,” by setting rules that ensure the use of AI is consistent with the Union’s values, namely democracy, the rule of law, environmental protection, and protection against the harmful effects of AI systems in the Union, without hindering innovation in Europe.

Keywords— artificial intelligence, EU Regulation, harmonization, rule of law

REFERENCES:

- [1] *Antiquia et Nova. Nota sobre a relação entre a inteligência artificial e a inteligência humana*. Dicastério para a Doutrina da Fé e Dicastério para a cultura e Educação. Paulus. 2025.
- [2] Arlindo Oliveira, *A Inteligência Artificial Generativa*. Fundação Francisco Manuel dos Santos, , Lisboa, 2025.
- [3] Francisco Andrade, “A proposta de regulamento europeu para a inteligência artificial”. *Revista da Ordem dos Advogados*, Ano 83, Vol. III-IV, p. 489 – 499, 2023.
- [4] Katerina Yordanova and Natalie Bertels, “Regulating AI: Challenges and the Way Forward Through Regulatory Sandboxes”, *Multidisciplinary Perspectives on Artificial Intelligence and the Law. Law, Governance and Technology Series*. Vol. 58, p. 441-456, May 2022.
- [5] Luís de Lima Pinheiro, “Arbitragem, blockchain e inteligência artificial”. *Revista da Ordem dos Advogados*, Ano 84, Vol. III-IV, p. 625 – 682, 2024.
- [6] Nuno Sousa e Silva, O Regulamento da Inteligência Artificial: análise Introdutória. *Revista da Ordem dos Advogados*, Ano 84, Vol. III-IV, p. 315 – 362, 2024.

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Aligning Higher Education Outcomes with Digital Labour Dynamics and ICT Employment Trends

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As digital transformation advances, traditional labour market metrics fail to capture the complexity of human capital utilisation in the Information and Communication Technology (ICT) sector. This research addresses the growing gap between higher education output and official employment statistics, driven by the emergence of new forms of employment. The study aims to diagnose structural shifts in ICT labour market intelligence and evaluate how digital labour dynamics, such as platform-based engagement and crowd- or collaborative employment, influence perceptions of a shortage of a qualified workforce. The study is based on a statistical analysis conducted in Latvia. The methodology employs a mixed-methods approach integrating secondary statistical data from national labour and education databases with a targeted primary survey of ICT professionals and graduates. The study utilises an analysis of graduate statistics in relation to national vacancy trends. The results point to a statistically significant divergence between the ICT-qualified workforce and the employment variable. Findings reveal that a substantial segment of highly qualified specialists engages in global digital networks and new forms of employment that remain underreported in national accounting and sector productivity metrics. The skill-gap analysis further identifies a mismatch between traditional academic curricula and the autonomous digital competencies required by the global market. The study shows the perceived labour deficit is partially a methodological artefact. To enhance business intelligence and policy effectiveness, national metrics must be adapted to encompass new forms of employment, ensuring accurate human capital valuation and sustainable national competitiveness in the digital era.

Keywords— Labour market intelligence, New Forms of Employment, Qualified workforce metrics, Higher Education outcomes, ICT sector

Application of the Python Programming Language and Artificial Intelligence in Economics

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Abstract—Economists on a daily basis monitor and analyze large volumes of data. In their work, they use various software tools to facilitate data entry, processing, visualization, and analysis. Most of these tools are commercial and require payment for use. In the past, several months were needed to conduct analyses and comparisons of the gross domestic product of several countries. Today, with the help of the Python programming language and artificial intelligence (AI), it is possible to obtain a large amount of economic data from various databases in a much shorter time and to perform their analysis.

The Python programming language has been chosen due to its simplicity, openness, and widespread use. The paper discusses several applications of this programming language in economics. Compared to other programming languages, Python is not the fastest nor the simplest; however, it arguably offers shorter code and easier programming with the assistance of AI. Like any other skill, programming requires patience and persistence from beginners. A facilitating factor in the learning process is the ability to test the invested effort very quickly on a computer.

The paper presents a practical example of a program for analyzing stock price movements, which can be generated with the assistance of AI. The paper presents a practical example of an AI-assisted program designed for the analysis and comparison of gross domestic product across multiple countries. The idea is to demystify the complexity of learning and problem solving, while simultaneously emphasizing the necessity of understanding the basic tools being used in order to efficiently leverage the support of AI technologies.

Keywords—Python, artificial intelligence, economics, analysis, practical example

AUTHOR CONTRIBUTIONS

Srdjan Damjanovic was responsible for writing the introduction, the literature review, and the conclusion of the manuscript. Predrag Katanic developed and implemented the program codes used in the study. Vesna Petrovic selected the economic case studies for which the programs were developed and performed the translation of the manuscript into English. All authors contributed to the overall conception of the work, reviewed the manuscript critically, and approved the final version of the paper.

REFERENCES

V. R. Mulam, "Python in finance: revolutionizing financial services," *International Journal of Research In Computer Applications and Information Technology*, vol. 7 (2), pp. 973–991, 2024.

[1] S. Damjanovic, and P. Katanic "Comparison of Four Programming Languages Used for Communication with Measuring Instruments," *Regionalni razvoj i demografski tokovi zemalja jugoistočne evrope*, vol. 30, pp. 461–473, 2025.

- [2] S. Tang, "Creating a Python platform for students to learn full-stack development of financial applications," *Financial Innovation*, vol. 12 (1), pp. 1–29, 2026.
- [3] Y. Xu, "A Study on the Application of Python in Corporate Financial Analysis," *Frontiers in Business Economics and Management*, vol. 15 (2), pp. 31–36, 2024.
- [4] Y. Qiao, "Research on the Application of Python Big Data in Financial Analysis," *Financial Economics Research*, vol. 2 (2), pp. 7–19, 2025.
- [5] J. Yi, "The Application of Python in Financial Big Data Management and Teaching," *Management*, vol. 8 (3), pp. 52–60, 2025.
- [6] N. Hashimzade, O. Kirsanov, and T. Kirsanova, "Integrating Programming into the Modern Undergraduate Economics Curriculum," *International Review of Economics Education*, vol. 49 (3), pp. 1–12, 2025.
- [7] Z. Yi, X. Cao, Z. Chen, and S. Li, "Artificial Intelligence in Accounting and Finance: Challenges and Opportunities," *IEEE Access*, vol. 11 (21), pp. 129100–129123, 2023.
- [8] R. Bilina, and S. Lawford, "Python for unified research in econometrics and statistics," *Econometric Reviews*, vol. 31 (5), pp. 558–591, 2012.
- [9] F. G. Adams, and E. Kroch, "The computer in the teaching of macroeconomics," *Journal of Economic Education*, vol. 20 (3), pp. 269–280, 2014.
- [10] M. Kuroki, "Using Python and Google Colab to teach undergraduate microeconomic theory," *International Review of Economics Education*, vol. 38, pp. 1–17, 2021.
- [11] B. C. Jenkins, "A Python-Based undergraduate course in computational macroeconomics," *Journal of Economic Education*, vol. 2053 (3), pp. 1–15, 2022.
- [12] C. Goh, Y. Kusnadi, and G. Pan, *The effectiveness of using Python programming approach in teaching financial analytics*, Singapore Management University, 2022, pp. 1–33.
- [13] M. Devan, S. Prakash, and S. Jangoan, "Predictive maintenance in banking: leveraging AI for real-time data analytics," *Journal of Knowledge Learning and Science*, vol. 2 (2), pp. 483–490, 2023.
- [14] G. Pittarello, E. Luini, and M. M. Marchione, "GEMAct: a Python package for non-life (re)insurance modeling," *Annals of Actuarial Science*, vol. 18 (2), pp. 1–34, 2023.
- [15] Ponagantiadarsh, and V. P. Vada, "Real-Time stock market analytics using Python and BigData Tools," *International Journal of Research Publication and Reviews*, vol. 6 (8), pp. 5113–5120, 2025.
- [16] R. Wei, "Data Analysis with Python: Methods, Tools and Practices-Data Processing, Visualization and Prediction Based on Python," *Applied and Computational Engineering*, vol. 178 (1), pp. 226–235, 2025.
- [17] P. Katanic and S. Damjanovic, *Python za ekonomiste*, 1st ed. Fakultet poslovne ekonomije Bijeljina, Bosnia and Herzegovina, 2025, ch. 1, pp. 17–43.

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Artificial Intelligence and Data Analytics in International Logistics: Enhancing Operational Efficiency and Strategic Decision-Making

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Abstract— International logistics has become increasingly complex due to persistent disruptions in global supply chains, cost volatility, and growing sustainability pressures. In response, organisations are progressively incorporating Artificial Intelligence (AI) and data analytics into their operations to enhance efficiency and support more informed managerial decision-making. These technologies are being applied in areas such as demand forecasting, route optimisation, inventory management, and risk mitigation across international supply chains.

This study aims to examine how AI and data analytics are currently being applied in international logistics, with particular emphasis on their contribution to operational performance and decision-making processes. The research adopts a qualitative and exploratory approach, based on a structured review of the literature combined with the analysis of selected real-world applications from logistics and transport organisations.

The analysis suggests that the integration of AI and data analytics is associated with measurable improvements in operational efficiency, particularly in terms of cost reduction, delivery reliability, and enhanced supply chain resilience. At the same time, these technologies appear to support more structured and data-driven strategic decisions in increasingly uncertain environments. However, their effective implementation remains uneven across organisations, with challenges related to data quality, technological integration, organisational readiness, and the availability of specialised skills.

This study contributes to the ongoing discussion on supply chain resilience and the role of digital technologies in management, highlighting the strategic importance of AI-driven approaches in international logistics. It provides insights for both researchers and practitioners, reinforcing the relevance of data-driven managerial decision-making as a key capability in contemporary organisational contexts.

Keywords— International Logistics, Artificial Intelligence, Data Analytics, Supply Chain Management, Managerial Decision-Making, Supply Chain Resilience

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Artificial Intelligence and Global Challenges: Insights from an Exploratory Survey of Public Opinion

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Abstract—The world is facing rapid, vast and profound societal transformations that challenge human confidence of persons and things. Developments in the field of Artificial Intelligence (AI) have been explored in relation to the need to tackle these complex challenges and to generate social good. However, misinformation and disinformation about AI (and generated by AI itself) have been identified as one of the major global risks for the future. This study is part of a broader research project analysing the potential of AI to support complex modes of thinking in the face of current global challenges, examining the potentialities, constraints, and risks [1]. It aims to examine public opinion on AI, specifically representations of AI, its possible impacts, and the trustworthiness of institutions that regulate AI. To achieve this aim, an online survey comprising closed and open-ended questions was conducted within the three-phase model of social representations theory framework [2] in 2024 (N=383). The results of the free association of words shows that AI is mainly associated with the “future”, “robots”, “technology” and “innovation”. Two opposing positions on AI were found; (i) Supporters associate AI with potential benefits in line with technological optimism, such as automation, speed and efficiency; (ii) Critics, stress the degradation of social and human values. These two groups also differ in terms of the likelihood that they would consider using AI and the level of trust they place in the information they obtain from AI use for different purposes, including academic tasks. The results point to the need to stimulate further public initiatives to discuss the potential impacts of AI in society as well as on the role of institutions in its regulation.

Keywords— artificial intelligence, public opinion, positive and negative impacts, use and trust, regulation

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REFERENCES

- A. Teixeira de Melo, L. Renault, L.S.D. Caves, P. Garnett, P.D. Lopes, R. Ribeiro, and F. Santos, “An AI tool for scaffolding complex thinking: challenges and solutions in developing an LLM prompt protocol suite” *Cognition, Technology & Work*, vol. 27, pp. 651–693, July 2025. <https://doi.org/10.1007/s10111-025-00817-6>
- R. Ribeiro, G. Poeschl, and A. C. Santos, “The different sides of the housing crisis in Portugal: A contribution to building inclusive, fair, and effective solutions” *Political Psychology*, vol. 46, pp. 1509–1532, <https://doi.org/10.1111/pops.70025>

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Artificial Intelligence and More-Than-Human Creativity

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Abstract— This theoretical proposal critically examines the debate surrounding artificial intelligence (AI) and the potential replacement of human creativity, arguing that such discussions remain constrained by anthropocentric assumptions about what constitutes creativity. Rather than asking whether AI can replicate or surpass human creativity, the paper interrogates the theoretical foundations of claims about human exceptionalism in creative matters. The dominant positions in the literature tend either to deny AI creativity—arguing that machines lack emotional, intentional, or experiential dimensions central to human creativity [1,2]—or to affirm it by demonstrating that AI systems can perform successfully in psychometric and social evaluations of creativity designed for humans [3]. Both positions, however, rely on human-centered criteria.

This theoretical proposal moves beyond the dichotomy between human and artificial creativity toward a “more-than-human” understanding of creative processes. Existing research on AI-generated art reveals that aesthetic judgments are strongly shaped by anthropocentric biases: people often undervalue artworks labeled as AI-generated despite evaluating them positively when their origin is unknown [4,5]. These findings highlight how perceptions of creativity depend less on intrinsic qualities of the artifact than on socially constructed expectations about authorship and agency [6,7].

To challenge these assumptions, it is introduced the concept of an “Aesthetical Aversion Turing Test,” which evaluates AI creativity through the discomfort or resistance experienced by humans when they discover that a work they admired was produced by a machine. This proposal reframes anthropocentric bias not as an obstacle but as an indicator of shifting boundaries between human and machine creativity. Ultimately, it is argued that AI should not be understood as threatening human creativity but as revealing the historically hybrid, technological, and relational nature of humanness itself. By engaging with AI as a creative agent, humans may expand creative practices and develop new forms of more-than-human creative collaboration [8–10].

Keywords— Artificial intelligence, Creativity, More-than-human, Anthropocentrism

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REFERENCES

- [1] Gruner DT, Csikszentmihalyi M. Engineering creativity in an age of artificial intelligence. In: Lebuda I, Glăveanu VP, editors. *The Palgrave Handbook of Social Creativity Research*. Cham: Springer; 2019. p. 447–462.
- [2] Runco MA. AI can only produce artificial creativity. *Journal of Creativity*. 2023;33(3):100063.
- [3] Guzik EE, Byrge C, Gilde C. The originality of machines: AI takes the Torrance Test. *Journal of Creativity*. 2023;33(3):100065.
- [4] Hitsuwari J, Ueda Y, Yun W, Nomura M. Does human–AI collaboration lead to more creative art? Aesthetic evaluation of human-made and AI-generated haiku poetry. *Computers in Human Behavior*. 2023;139:107502.
- [5] Millet K, Buehler F, Du G, Kokkoris MD. Defending humankind: Anthropocentric bias in the appreciation of AI art. *Computers in Human Behavior*. 2023;143:107707.
- [6] Natale S, Henrickson L. The Lovelace effect: Perceptions of creativity in machines. *New Media & Society*. 2024;26(4):1909–1926. doi:10.1177/14614448221077278.
- [7] Farina M, Lavazza A, Sartori G, Pedrycz W. Machine learning in human creativity: Status and perspectives. *AI & Society*. 2024;39(6):3017–3029. doi:10.1007/s00146-023-01836-5.
- [8] Coeckelbergh M. When machines talk: A brief analysis of some relations between technology and language. *Technology and Language*. 2020;1(1):22–27.
- [9] Coeckelbergh M. *Self-Improvement: Technologies of the Soul in the Age of Artificial Intelligence*. New York: Columbia University Press; 2022.
- [10] Hong JW, Peng Q, Williams D. Are you ready for artificial Mozart and Skrillex? An experiment testing expectancy violation theory and AI music. *New Media & Society*. 2021;23(7):1920–1935.

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Artificial Intelligence and the Changing Conditions of Learning and Knowledge: Insights from a French Business School

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Abstract— This paper begins with a specific empirical observation drawn from a French business school. Based on an analysis of almost 2,000 final dissertation grades collected over four academic years, it identifies two interrelated trends: a general increase in grades and a widening gap between written and oral assessments. These developments occurred as generative artificial intelligence became integrated into students' everyday working practices and gradually established itself as a recurring feature of academic work. Such observations do not, in themselves, establish causality. They nevertheless provide a robust empirical basis for questioning the changing conditions of learning, assessment, and knowledge acquisition in management education.

The paper does not approach this development primarily through the lens of academic integrity. Its central concern lies in the cognitive, intellectual, and ultimately professional consequences of delegating part of academic work to artificial intelligence. Existing research has already highlighted the effects of these tools on learning processes, knowledge incorporation, and what may be described as an illusion of knowledge. Students may produce documents that are formally convincing, well structured, and academically acceptable while engaging less directly in memorisation, conceptual articulation, contextualisation, and critical analysis. What is at stake, therefore, is not only academic performance, but the substance of professional competence. From this perspective, management education risks drifting towards a more pragmatic and empirical model of knowledge, in which acceptable outputs increasingly take precedence over conceptual mastery, analytical capacity, and critical judgement. Business schools are thus confronted with a pressing question: how can they continue to certify outputs without guaranteeing the same degree of intellectual formation?

In this context, the issue extends beyond pedagogy and academic performance. A sociological interpretation suggests that artificial intelligence functions both as an agent of

transformation and as a revealer of the conditions through which management has historically been institutionalised and legitimised. If, from the education stage onwards, future members of the “trustworthy salaried class” lose some of the resources that once grounded their usefulness and legitimacy—structured knowledge, discursive command, and conceptual backbone—their place within the managerial order cannot remain unaffected. The growing reliance on artificial intelligence may therefore signal more than a change in study practices. It may also contribute to a weakening, and perhaps a numerical contraction, of managerial strata, as more future managers come to depend on processed and externalised forms of cognition. From this standpoint, the paper opens a broader reflection on the future of management as a social function in the age of generative AI.

Keywords— Artificial intelligence, , management education, learning, professional competence, symbolic domination

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Artificial Intelligence applied to legal education

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Abstract— The application of Artificial Intelligence (AI) to legal education has enabled the analysis of legal contexts in virtual environments and the implementation of innovative methodologies in the teaching of law.

AI offers a range of fundamental possibilities for teaching, provided it is used by its users ethically and responsibly. AI is profoundly changing the way law is learnt and taught, as it enables the intelligent use of platforms with various capabilities and, in this sense, represents a fundamental tutoring system for students and trainers. Through AI, a considerable volume of supporting information essential to teaching and scientific research is conveyed. It is a tool that facilitates access to information and provides its users with extensive legal knowledge, whilst also ensuring personalised, practical and user-oriented learning. It is also presented as an effective tool that enables skills development.

It has enabled the use of more innovative methodologies in the study and practice of law, facilitated the case method, the application of game theory, the practical analysis of real-life cases (legal clinics) and, ultimately, a new way of thinking about law (design thinking).

Building on these possibilities, legal pedagogy has evolved towards more active models, with the aim of training professionals who are critical, creative and prepared for more complex contexts.

This is particularly the case in legal proceedings where AI enables an analysis of judicial decisions and legal doctrine to identify the direction of case law and thus guide legal practitioners towards the best application of the law. Drawing on available databases, AI ensures a comprehensive analysis and greater predictability of judicial decisions. It can thus be used as a tool for standardising case law, which is fundamental for all its users, as well as for more effective case management and, consequently, the optimisation of legal strategies.

As it is a tool capable of collecting and analysing a whole range of information, it also allows for better legal interpretation in relation to any specific case that the lawyer wishes to see resolved or clarified. It can even serve as a legal simulator, such as a virtual court, thereby ensuring an analysis of legal contexts and interaction between the AI and its user.

As a virtual platform, similar to Moodle, it thus contributes to modern legal education, as well as to the development of legal discussion forums or role-play scenarios; it can even be seen as a hybrid learning mechanism, offering the advantage of a degree of flexibility and greater interaction outside the traditional classroom.

With this new tool, we are moving towards a new paradigm, with a more analytical and predictive approach to teaching, provided, of course, that we are able to make more active and responsible use of these technologies, which can promote learning that is more focused on its target audience.

Keywords— Teaching; learning; methodology; law; interaction

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Artificial Intelligence in Language Teaching: Benefits, Challenges and Teachers' Perspectives

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Abstract—Artificial intelligence has a longer history in education than is often assumed, with early applications dating back to the development of computer-based tutoring systems in the twentieth century. This paper examines the role of artificial intelligence in language teaching, focusing on its pedagogical benefits, limitations, and the perspectives of English language teachers in the Republic of Srpska. The study combines a review of relevant literature with an empirical survey conducted among 48 teachers working in primary and secondary schools. The results indicate that artificial intelligence tools can support personalized learning, enhance language skill development, and improve administrative efficiency by assisting with lesson preparation and assessment. At the same time, teachers express concerns regarding reduced human interaction, ethical issues related to data privacy, and unequal access to technological resources. The findings reveal a generally positive but cautious attitude toward the integration of artificial intelligence in language education, accompanied by a strong need for professional development and institutional support. The study contributes to a clearer understanding of how artificial intelligence can be implemented in language teaching in a balanced and human-centered manner, emphasizing that technology should complement rather than replace the role of the teacher.

Keywords—artificial intelligence, language teaching, personalized learning, educational technology, teacher attitudes.

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REFERENCES

- [1] D. L. Bitzer, P. G. Braunfeld, and W. Lichtenberger, "PLATO: An individualized computer-based education system," University of Illinois, Urbana, IL, 1961.
- [2] K. J. Cios and A. Zapala, "Ethical challenges in artificial intelligence and data mining," *Journal of Intelligent Information Systems*, vol. 56, no. 2, pp. 249–267, 2021.
- [3] Y. K. Dwivedi et al., "Potential and challenges of generative artificial intelligence in education," *Information Systems Frontiers*, vol. 25, no. 1, pp. 1–14, 2023.

[4] L. Floridi and M. Chiriatti, "GPT-3: Its nature, scope, limits, and consequences," *Minds and Machines*, vol. 30, pp. 681–694, 2020.

[5] R. Godwin-Jones, "Emerging technologies: Using mobile tech to develop language skills," *Language Learning & Technology*, vol. 22, no. 3, pp. 1–17, 2018.

[6] W. Holmes, M. Bialik, and C. Fadel, *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning*. Boston: Center for Curriculum Redesign, 2019.

[7] J. Hollingsworth, "Automatic graders for programming assignments," *Communications of the ACM*, vol. 3, no. 10, pp. 528–529, 1960.

[8] C. Kersey and S. Carey, "Adaptive learning technologies in second language acquisition," *Language Learning Journal*, vol. 47, no. 2, pp. 145–160, 2019.

[9] M. Levy and P. Hubbard, "Why call CALL 'CALL'?", *Computer Assisted Language Learning*, vol. 18, no. 3, pp. 143–149, 2005.

[10] G. Stockwell, "Using mobile phones for vocabulary activities," *Language Learning & Technology*, vol. 16, no. 3, pp. 45–66, 2012.

[11] J. Van Dijk, *The Digital Divide*. Cambridge: Polity Press, 2020.

[12] S. Wang and C. Vásquez, "Web 2.0 and second language learning," *CALICO Journal*, vol. 29, no. 3, pp. 412–430, 2012.

[13] B. Zou and M. Thomas, "Teachers' perceptions of artificial intelligence in EFL classrooms," *Computer Assisted Language Learning*, vol. 35, no. 1–2, pp. 175–195, 2022.

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Artificial Intelligence in Non-Financial Reporting: Opportunities and Risks in Theory and Practice

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Abstract

Artificial intelligence (AI) plays a significant role in shaping the future of corporate reporting, including sustainability and environmental, social, and governance (ESG) reporting. A growing body of academic research examines both the opportunities and the risks associated with the application of AI in corporate reporting practices.

AI is already being employed in the presentation of managerial information, the drafting of selected sections of corporate reports, the enhancement of report security, and the analysis of large volumes of textual data. An increasing number of organizations are also recognizing the potential of AI in the analysis and reporting of non-financial information, particularly in the area of ESG reporting.

The use of AI-based algorithms in the generation of non-financial reports may enable the provision of more accurate, comprehensive, and decision-useful information, thereby supporting assessment of organizational business models and long-term sustainable development.

However, the use of AI in non-financial reporting is also associated with numerous challenges, including ensuring transparency and accountability for the information presented, compliance with applicable regulations and ESG reporting standards, as well as data protection and the prevention of manipulative or misleading uses of AI in non-financial reporting.

An additional challenge concerns education in this area, particularly the need to expand academic knowledge and to modify or supplement finance and accounting curricula and course syllabi with content addressing the use of AI in non-financial reporting. Undoubtedly, the primary objective of education on the application of AI in non-financial reporting is to maintain an appropriate balance between traditional approaches to the preparation and analysis of non-financial reports and the use of AI-based solutions.

This article examines the potential benefits and risks associated with the application of AI in non-financial reporting and addresses the issue of transferring academic knowledge in this area. It presents the results of a survey-based study on the potential use of AI in non-financial reporting among various stakeholder groups. The empirical research conducted was exploratory in nature and focused on the respondents' experiences and subjective perceptions.

The authors also sought to address whether stakeholders are prepared for the rational use of AI in non-financial reporting, with an awareness of potential risks and interpretative errors, and whether they expect changes in education and training in this area.

The article addresses a timely and still relatively underexplored area of contemporary accounting, namely the use of AI in non-financial reporting, and presents the results of empirical research identifying both the benefits of AI implementation in reporting and the related educational needs. The article partially fills a research gap and contributes to the ongoing discussion on the use of modern technologies in corporate reporting.

Keywords

non-financial reporting, disclosure quality, artificial intelligence

REFERENCES

- [11] J. Adamek, M. Bąk, and J. Kogut, "Non-financial information in accounting – an opportunity or threat for enterprise," in Proc. 5th Int. Multidisciplinary Scientific Conf. on Social Sciences & Arts SGEM 2018, Albena, Bulgaria, 2018, vol. 5, no. 1.3, pp. 257–268.
- [12] Allianz, A Guide to Cyber Risk: Managing the Impact of Increasing Interconnectivity. Cyber Security in an Interconnected World, Allianz Group Economic Research, 2015. [Online]. Available: <https://www.agcs.allianz.com/content/dam/onemarketing/agcs/agcs/reports/AGCS-Cyber-Risk-Guide.pdf>
- [13] S. Arvidsson, "Disclosure of non-financial information in the annual report: A management-team perspective," J. Intellect. Cap., vol. 12, no. 2, pp. 277–300, 2011.
- [14] J. Ballantine, G. Boyce, and G. Stoner, "A critical review of AI in accounting education: Threat and opportunity," Critical Perspect. Account., vol. 99, p. 102711, 2024.
- [15] B. Bek-Gaik and A. Surowiec, "Financial and non-financial information in an integrated report: Practice of selected Polish listed companies," in Proc. 37th Int. Business Information Management Association Conf. (IBIMA), Cordoba, Spain, May 30–31, 2021, in Innovation Management and Information Technology Impact on Global Economy in the Era of Pandemic, K. S. Soliman, Ed., pp. 7330–7342.
- [16] C. Biener, M. Eling, and J. H. Wirfs, "Insurability of cyber risk: An empirical analysis," Geneva Papers Risk Insur. Issues Pract., vol. 40, no. 1, pp. 131–158, 2015.
- [17] E. Chojnacka and J. Wiśniewska, "Reporting CSR data – The benefits and barriers to involvement in the idea of corporate social responsibility," J. Positive Manag., vol. 8, no. 1, pp. 3–16, 2017.
- [18] P. J. Coram, T. J. Mock, and G. S. Monroe, "Financial analysts' evaluation of enhanced disclosure of non-financial performance indicators," Brit. Account. Rev., vol. 43, no. 2, pp. 87–101, 2011.
- [19] F. Curti, J. Gerlach, S. Kazinnik, M. J. Lee, and A. Mihov, "Cyber risk definition and classification for financial risk management," J. Oper. Risk, vol. 20, 2023.
- [20] C. De Villiers, R. Dimes, and M. Molinari, "How will AI text generation and processing impact sustainability reporting? Critical analysis, a conceptual framework and avenues for future research," Sustainability Account. Manag. Policy J., vol. 15, no. 1, pp. 96–118, 2024.
- [21] Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting, Off. J. Eur. Union, L 322, Dec. 16, 2022.
- [22] Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups, Off. J. Eur. Union, 2014.
- [23] A. Ferens, "Cyberbezpieczeństwo i cyberryzyko w raportach zintegrowanych i sprawozdaniach zarządu operatorów usług kluczowych," Zesz. Teor. Rachunk., vol. 45, no. 2, pp. 31–50, 2021.
- [24] A. Ferens, "Ujawnienie szczególnych obszarów ryzyka w wybranych sprawozdaniach w dobie kryzysu," Zesz. Nauk. Wyzd. Zarz. GWSH, vol. 20, pp. 23–32, 2023.

- [25] L. Gao, T. G. Calderon, and F. Tang, "Public companies' cybersecurity risk disclosures," *Int. J. Account. Inf. Syst.*, vol. 38, p. 100468, 2020.
- [26] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 (General Data Protection Regulation), *Off. J. Eur. Union*, L 119, May 4, 2016, pp. 1–88.
- [27] S. Grima, E. Thalassinos, M. Cristea, M. Kadfubek, D. Maditinos, and L. Peiseniece, Eds., *Digital Transformation, Strategic Resilience, Cyber Security and Risk Management*. Emerald Publishing Limited, 2023.
- [28] A. Haller, M. Link, and T. Groß, "The term 'non-financial information' – A semantic analysis of a key feature of current and future corporate reporting," *Account. Europe*, vol. 14, no. 3, pp. 407–429, 2017.
- [29] P. Hąbek and R. Wolniak, "Factors influencing the development of CSR reporting practices: Experts' versus preparers' points of view," *Inz. Ekon.-Eng. Econ.*, vol. 26, no. 5, pp. 560–570, 2015.
- [30] International Integrated Reporting Council (IIRC), *The International <IR> Framework*, 2021. [Online]. Available: <https://integratedreporting.org/wp-content/uploads/2021/01/InternationalIntegratedReportingFramework.pdf>
- [31] M. La Torre, S. Sabelfeld, M. Blomkvist, L. Tarquinio, and J. Dumay, "Harmonising nonfinancial reporting regulation in Europe: Practical forces and projections for future research," *Meditari Account. Res.*, vol. 26, no. 4, pp. 598–621, 2018.
- [32] F. Manes-Rossi, A. Tiron-Tudor, G. Nicolò, and G. Zanellato, "Ensuring more sustainable reporting in Europe using non-financial disclosure – De facto and de jure evidence," *Sustainability*, vol. 10, no. 4, pp. 1162–1182, 2018.
- [33] R. Mazzotta, G. Bronzetti, and S. Veltri, "Are mandatory non-financial disclosures credible? Evidence from Italian listed companies," *Corp. Soc. Responsib. Environ. Manag.*, vol. 27, no. 4, pp. 1535–1566, 2020.
- [34] D. A. Michałowska, "Sztuczna inteligencja w edukacji i jej implikacje dla podmiotowości uczącej się osoby," in *Świadomość i subiektywność. Zagadnienia filozofii podmiotu*, M. Moryń, Ed. Poznań: Bogucki Wydawnictwo Naukowe; Wydawnictwo Naukowe Wyzd. Filozoficznego UAM, 2025, pp. 205–220.
- [35] N. Ochi, "Reporting of real option value related to ESG: Including complementary systems for disclosure incentives," *Int. J. Financ. Res.*, vol. 9, no. 4, pp. 19–34, 2018.
- [36] B. Odonkor et al., "The impact of AI on accounting practices: A review: Exploring how artificial intelligence is transforming traditional accounting methods and financial reporting," *World J. Adv. Res. Rev.*, vol. 21, no. 1, pp. 172–188, 2024.
- [37] PwC, *Cyber-ruletka po polsku. 5. edycja Badania Stanu Bezpieczeństwa Informacji*, 2018. [Online]. Available: <https://www.pwc.pl/badaniebezpieczenstwa>
- [38] Regulation of the Council of Ministers of 31 October 2018 on the thresholds for recognizing an incident as serious (*Journal of Laws* 2018, item 2180), 2018.
- [39] M. Remlein, D. Nowak, and K. Romanchuk, "Korzyści z wdrażania automatyzacji procesów robotycznych w księgowości," *Zesz. Teor. Rachunk.*, vol. 48, no. 3, pp. 133–153, 2024.
- [40] D. Schatz, R. Bashroush, and J. Wall, "Towards a more representative definition of cyber security," *J. Digit. Forensics Secur. Law*, vol. 12, no. 2, pp. 53–74, 2017.
- [41] K. T. Smith, L. M. Smith, and J. L. Smith, "Case studies of cybercrime and the impact on marketing activity and shareholder value," *Acad. Mark. Stud. J.*, vol. 15, no. 2, pp. 67–86, 2011.
- [42] L. Tarquinio and S. C. Posadas, "Exploring the term 'non-financial information': An academics' view," *Meditari Account. Res.*, vol. 28, no. 5, pp. 727–749, 2020, doi: 10.1108/MEDAR-11-2019-0602.
- [43] E. Thalassinos, M. Kadfubek, and D. Norena-Chavez, "Theoretical essence of organisational resilience in management," in *Digital Transformation, Strategic Resilience, Cyber Security and Risk Management*. Emerald Publishing Limited, 2023, pp. 133–145.
- [44] T. Turzo, G. Marzi, C. Favino, and S. Terzani, "Non-financial reporting research and practice: Lessons from the last decade," *J. Cleaner Prod.*, vol. 345, p. 131154, 2022, doi: 10.1016/j.jclepro.2022.131154.
- [45] R. Von Solms and J. Van Niekerk, "From information security to cyber security," *Comput. Secur.*, vol. 38, pp. 97–102, 2013.
- [46] G. Voss and P. Prewysz-Kwinto, "Financial reporting – Use of financial and non-financial information by entity managers," *Prace Nauk. Univ. Ekon. Wroc.*, vol. 522, pp. 317–328, 2018.
- [47] L. Wu, J. Lamb, and Y. Liu, "Can semi-mandatory non-financial disclosure requirements drive firms to improve ESG performance – Evidence from Chinese listed companies," *Heliyon*, vol. 10, no. 14, p. e34235, 2024, doi: 10.1016/j.heliyon.2024.e34235.
- [48] L. Yang, L. Lau, and H. Gan, "Investors' perceptions of the cybersecurity risk management reporting framework," *Int. J. Account. Inf. Manag.*, vol. 28, no. 1, pp. 167–183, 2020.

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Artificial Intelligence Literacy as a Challenge for Higher Education - A case study at the Portalegre Polytechnic University

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Abstract— This study analyses artificial intelligence (AI) literacy in higher education, using the Portalegre Polytechnic University (PPU) as a case study. The main objective was to assess the level of AI literacy among faculty and students, identifying competences, weaknesses, and pedagogical implications. A psychometrically validated questionnaire was applied, supported by statistical analysis and qualitative interpretation.

The results show an intermediate level of AI literacy in both groups, although with distinct profiles. Faculty members demonstrate greater conceptual and ethical awareness but reveal significant limitations in continuous learning and keeping up with technological advances. Students, on the other hand, display high self-confidence in self-management and resistance to algorithmic persuasion, while showing relevant weaknesses in technical understanding and adaptive learning capacity. The widespread use of AI tools, particularly ChatGPT, confirms their integration in academic practices but raises critical challenges regarding integrity, self-regulation, and assessment.

The study concludes that AI literacy should be considered a strategic priority in higher education, requiring dynamic and multidisciplinary training programs that integrate technical, cognitive, and ethical competences. Such initiatives are essential to foster responsible and critical use of AI in educational contexts.

Keywords— Artificial intelligence literacy, Higher education, Teachers, Students, Ethics, Regulation, Digital education

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REFERENCES

- [49] I. Ajzen, "From intentions to actions: A theory of planned behavior," in *Action Control: From Cognition to Behavior*. Berlin, Germany: Springer, 1985.
- [50] A. M. Alonso-Rodríguez, "Hacia un marco ético de la inteligencia artificial en la educación," *Teoría de la Educación. Revista Interuniversitaria*, vol. 36, no. 2, pp. 79–98, 2024. doi: 10.14201/teri.31821.
- [51] A. W. Bates, *Educar na era digital: Design, ensino e aprendizagem*. São Paulo, Brasil: Artesanato Educacional, 2017.
- [52] A. Carolus, Y. Augustin, A. Markus, and C. Wienrich, "Digital interaction literacy model – Conceptualizing competencies for literate interactions with voice-based AI systems," *Computers and Education: Artificial Intelligence*, vol. 4, 100114, 2023. doi: 10.1016/j.caeai.2022.100114.
- [53] A. Carolus, M. J. Koch, S. Straka, M. E. Latoschik, and C. Wienrich, "MAILS – Meta AI literacy scale: Development and testing of an AI literacy questionnaire based on competency models," *Computers in Human Behavior: Artificial Humans*, vol. 1, no. 2, 100014, 2023. doi: 10.1016/j.chbah.2023.100014.
- [54] D. Cetindamar, K. Kitto, M. Wu, Y. Zhang, B. Abedin, and S. Knight, "Explicating AI literacy of employees at digital workplaces," *IEEE Transactions on Engineering Management*, vol. 71, pp. 810–823, 2024. doi: 10.1109/TEM.2021.3138503.
- [55] D. P. Crowne and D. Marlowe, "A new scale of social desirability independent of psychopathology," *Journal of Consulting Psychology*, vol. 24, no. 4, pp. 349–354, 1960.
- [56] Y. Dai, C.-S. Chai, P.-Y. Lin, M. S.-Y. Jong, Y. Guo, and J. Qin, "Promoting students' well-being by developing their readiness for the artificial intelligence age," *Sustainability*, vol. 12, no. 16, 6597, 2020. doi: 10.3390/su12166597.
- [57] M. Ergen, "What is artificial intelligence? Technical considerations and future perception," *The Anatolian Journal of Cardiology*, 2019.
- [58] A. D. Figueiredo, "Ferramentas e competências para a investigação na era da inteligência artificial," presented at the 4.º *Debate sobre Inovação*, 2024.
- [59] J.-G. Ganascia, *A Inteligência Artificial*. Lisboa, Portugal: Instituto Piaget, 1993.
- [60] C. Holder and V. Khurana, "Artificial intelligence: Public perception, attitude and trust," Bristows, 2018. Available: <https://www.bristows.com/viewpoint/articles/artificial-intelligence-public-perception-attitude-and-trust/>
- [61] M. Hornberger, A. Bewersdorff, and C. Nerdel, "What do university students know about artificial intelligence? Development and validation of an AI literacy test," *Computers and Education: Artificial Intelligence*, vol. 5, 100165, 2023.
- [62] N. Humble and P. Mozelius, "The threat, hype, and promise of artificial intelligence in education," *Discover Artificial Intelligence*, vol. 2, no. 1, p. 22, 2022.
- [63] E. Lérias, C. Guerra, and P. Ferreira, "Literacy in artificial intelligence as a challenge for teaching in higher education: A case study at Portalegre Polytechnic University," *Information*, vol. 15, no. 4, p. 205, 2024.
- [64] D. Long and B. Magerko, "What is AI literacy? Competencies and design considerations," in *Proc. CHI Conf. Human Factors in Computing Systems*, 2020, pp. 1–16.
- [65] H. M. H. Mansoor et al., "Artificial intelligence literacy among university students: A comparative transnational survey," *Frontiers in Communication*, vol. 9, 2024.
- [66] P. Miranda, P. Isaias, and S. Pifano, "Digital literacy in higher education: A survey on students' self-assessment," in *Learning and Collaboration Technologies*, Springer, 2018, pp. 71–87.
- [67] D. T. K. Ng, J. K. L. Leung, S. K. W. Chu, and M. S. Qiao, "Conceptualizing AI literacy: An exploratory review," *Computers and Education: Artificial Intelligence*, vol. 2, 100041, 2021.



- [68] D. T. K. Ng, W. Wu, J. K. L. Leung, and S. K. W. Chu, "Artificial intelligence literacy questionnaire with confirmatory factor analysis," in *Proc. IEEE Int. Conf. Advanced Learning Technologies*, 2023, pp. 233–235.
- [69] A. Nguyen, H. N. Ngo, Y. Hong, B. Dang, and B.-P. T. Nguyen, "Ethical principles for artificial intelligence in education," *Education and Information Technologies*, vol. 28, pp. 4221–4241, 2023.
- [70] L. M. Pereira and A. Lopes, *Máquinas Éticas – Da Moral da Máquina à Maquinaria Moral*. Lisboa, Portugal: Edições Sílabo, 2020.
- [71] Parlamento Europeu, "Resolução sobre inteligência artificial na educação, na cultura e no setor audiovisual," *Jornal Oficial da União Europeia*, 2021.
- [72] European Parliament and Council of the European Union, "Regulamento (UE) 2024/1689 que estabelece regras harmonizadas em matéria de inteligência artificial," *Jornal Oficial da União Europeia*, 2024.
- [73] R. Quivy and L. Van Campenhout, *Manual de Investigação em Ciências Sociais*. Lisboa, Portugal: Gradiva, 2008.
- [74] M. S. Mendiola and E. C. Degante, "La inteligencia artificial generativa y la educación universitaria," *Perfiles Educativos*, vol. 45, pp. 70–86, 2023.
- [75] E. C. Souza et al., "Futuro do ensino superior frente aos desafios da inteligência artificial: Uma revisão bibliográfica," *Revista de Gestão e Secretariado*, vol. 15, 2024.
- [76] L. A. Tavares, M. C. Meira, and S. F. Amaral, "Inteligência artificial na educação: Survey," *Brazilian Journal of Development*, vol. 6, pp. 48699–48714, 2020.
- [77] N. V. Tikhonova and G. M. Ilduganova, "Students' perceptions of artificial intelligence in foreign language teaching," *Higher Education in Russia*, vol. 33, no. 4, pp. 63–83, 2024.
- [78] C. P. Tramallino and A. M. Zeni, "Avances y discusiones sobre el uso de inteligencia artificial en educación," *Educación*, vol. 33, no. 64, pp. 29–54, 2024.
- [79] B. Wang, P.-L. P. Rau, and T. Yuan, "Measuring user competence in using artificial intelligence," *Behaviour and Information Technology*, vol. 42, no. 9, pp. 1324–1337, 2023.
- [80] X. Zhai, "ChatGPT user experience: Implications for education," *SSRN Electronic Journal*, 2022.

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Boothmate: Integrating a Terminology Management Application in Interpreter Training

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Abstract—Terminology preparation is a crucial component within interpreter training, particularly in specialised contexts where cognitive load and time constraints are significant. This study analyses the pedagogical integration of Boothmate, a digital terminology management application, in interpreting practice. The aim of the study is to learn if the tool can enhance students' terminological competence and preparation strategies. The research focuses on the implementation of the platform within a higher education setting, where it was used as part of structured simulated curricular activities designed to emulate professional interpreting scenarios.

The study adopts a mainly quantitative, practice-based approach. Students were required to elaborate, organise, and use thematic glossaries as part of their preparation for interpreting tasks. Data were collected through a survey related to these classroom practices, in which students were asked to provide feedback on the tool's applicability. The methodology focused on guided terminology research, collaborative glossary building, and the use of prepared terminology during simultaneous interpreting tasks in a mock conference scenario.

The results seem to indicate that the use of a dedicated terminology management tool helps students to better prepare interpreting tasks in a more systematic way, improves conceptual understanding of specialised domains, and enhances their ability to retrieve relevant terms under time constraints.

The study concludes that integrating a digital terminology management tool into interpreter training can significantly contribute to the development of professional skills, provided that their use is embedded within a structured and reflective pedagogical framework. These findings have implications for curriculum design and for the incorporation of technology into interpreter training.

Keywords—interpreting, interpreter training, terminology management, boothmate, technology,

REFERENCES

- C. Fantinuoli, "Chapter 7: Computer-assisted Interpreting: Challenges and Future Perspectives", p. 153-174, 2017. https://doi.org/10.1163/9789004351790_009
- C. Semerikov, R. Tarasenko, & S. Amelina, "Conceptual Aspects of Interpreter Training Using Modern Simultaneous Interpretation Technologies", 2021. <https://doi.org/10.31812/123456789/6972>

- F. Pöchhacker and M. Liu, "Interpreting technologized", *Interpreting International Journal of Research and Practice in Interpreting*, vol. 26, no. 2, p. 157-177, 2024. <https://doi.org/10.1075/intp.00112.poc>
- G. Pastor, "Technology solutions for interpreters: the VIP system", *Hermeneus Revista De Traducción E Interpretación*, no. 23, p. 91-123, 2022. <https://doi.org/10.24197/her.23.2021.91-123>
- L. Ortiz and P. Nencini, "Computer-Assisted Interpreting Tools (CAI) and options for automation with Automatic Speech Recognition", *Tradterm*, vol. 32, p. 9-31, 2018. <https://doi.org/10.11606/issn.2317-9511.v32i0p9-31>
- M. Guo, L. Han, & M. Anacleto, "Computer-Assisted Interpreting Tools: Status Quo and Future Trends", *Theory and Practice in Language Studies*, vol. 13, no. 1, p. 89-99, 2022. <https://doi.org/10.17507/tpls.1301.11>
- R. Tarasenko, S. Amelina, C. Semerikov, & L. Shen, "Computer-assisted interpreting systems in the education of simultaneous interpreters", *SHS Web of Conferences*, vol. 142, p. 03003, 2022. <https://doi.org/10.1051/shsconf/202214203003>
- S. Ahmed, "TECHNOLOGY AND ARTIFICIAL INTELLIGENCE IN SIMULTANEOUS INTERPRETING: A MULTIDISCIPLINARY APPROACH", *Cdelt Occasional Papers in the Development of English Education*, vol. 78, no. 1, p. 325-353, 2022. <https://doi.org/10.21608/opde.2022.249945>
- V. Baselli, "Developing a New CAI Tool for RSI Interpreters' Training: a Pilot Study", p. 157-166, 2023. https://doi.org/10.26615/issn.2683-0078.2023_014
- V. Karaban and A. Karaban, "Exploring the potential for CAI implementation in interpreter training in Ukraine", *SHS Web of Conferences*, vol. 105, p. 02002, 2021. <https://doi.org/10.1051/shsconf/202110502002>

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Breaking Barriers: Social, Cultural and Organizational Factors Affecting Girls' Participation in Renewable Energy Careers

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Abstract—The global transition toward renewable energy requires a highly skilled workforce capable of addressing complex technological and environmental challenges. However, despite growing demand for talent in renewable energy and related STEM fields, women remain significantly underrepresented in these sectors. This gender imbalance limits both social equity and the diversity of perspectives necessary for sustainable innovation. Understanding the barriers that prevent girls from pursuing careers in renewable energy is therefore essential. This paper explores the social, cultural, and organisational barriers that influence girls' participation in renewable energy sectors. It is based on a structured literature review and empirical insights gathered from the STAR Girls project, an educational initiative aimed at inspiring girls in STEAM. The project promotes their interest through mentoring, hands-on activities, and exposure to female role models in technical professions. The study addresses the following research question: What social, cultural and organizational barriers limit girls' participation in renewable energy careers, and how can educational initiatives address these challenges? Based on a structured literature review, the paper identifies key factors shaping girls' career choices. At the social and cultural level, gender stereotypes, family expectations, and the lack of visible female role models contribute to reinforcing the perception that technical and energy-related careers are male-dominated fields. At the organizational level, limitations in school curricula, insufficient career guidance, and structural inequalities within technical education systems further constrain girls' engagement with STEM pathways. Building on these insights, the paper proposes a conceptual framework that integrates barriers across three analytical levels: micro (individual perceptions and aspirations), meso (family and school influences), and macro (institutional and cultural norms). This framework seeks to clarify how multiple dimensions interact to shape girls' participation in renewable energy careers. The study concludes by discussing policy and educational implications, highlighting the importance of gender-sensitive educational initiatives, early exposure to STEM fields, and the promotion of female role models to foster greater gender inclusion in the renewable energy sector.

Keywords—Renewable energy careers, Gender gap in STEM, Girls' participation, Social and Organisational barriers, Conceptual framework, Education.

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Competency to Culture: Organisational Factors Influencing the Implementation of Healthcare Quality and Patient Safety Frameworks in South Africa

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Abstract— Background: While competency-based training improves knowledge in healthcare quality and patient safety, translation into practice depends on organisational readiness, leadership support, and system culture. Limited evidence exists on how organisational factors shape the effectiveness of quality improvement (QI) capacity-building initiatives in Low- and Middle-Income Countries (LMICs).

Objective: To identify organisational barriers and enablers influencing the implementation of a healthcare quality and patient safety framework following a structured training intervention in South Africa.

Methods: This study reports the organisational analysis component of a larger mixed-methods evaluation of a national quality and patient safety training programme. Quantitative pre- and post-assessments measured changes in knowledge and confidence (Kirkpatrick Level 2), while qualitative feedback (Level 1) explored organisational contexts influencing application of learning. Thematic analysis identified recurring barriers and enablers, which informed the development of an implementation framework.

Results: Although statistically significant improvements in knowledge were observed across all domains ($p < 0.05$; 42% overall reduction in novice/beginner ratings), qualitative findings revealed substantial organisational constraints. Key barriers included limited resource allocation (29%), lack of incentives (50%), resistance to change (41%), siloed QI activities (38%), and incomplete staff engagement (66%). Enablers included leadership recognition of QI value (73%), supportive organisational culture (63%), and high demand for further quality management systems (QMS) training (66%). These findings informed a contextual implementation framework highlighting the interaction between individual competency, organisational culture, structural supports, and policy alignment.

Conclusion: Training interventions improve competency but are insufficient in isolation. Sustainable implementation of healthcare quality frameworks requires leadership commitment, protected resources, aligned incentives, mentorship

systems, and integration into institutional quality governance structures. Organisational culture emerges as a critical mediator between learning and sustained system improvement.

Keywords— Healthcare quality, patient safety, organisational culture, quality improvement, implementation framework.

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REFERENCES

- [1] World Health Organization, World Bank Group. Delivering Quality Health Services: A Global Imperative. OECD Publishing; 2018. 100 p.
- [2] World Health Organization. Global Patient Safety Action Plan 2021–2030: Towards eliminating avoidable harm in health care [Internet]. Geneva: World Health Organization; 2021. Available from: <https://iris.who.int/bitstream/handle/10665/343477/9789240032705-eng.pdf?sequence=1>
- [3] Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, et al. High-quality health systems in the Sustainable Development Goals era: time for a revolution. *Lancet Glob Health*. 2018 Nov;6(11):e1196–252.
- [4] Moleko W, Naicker V. Bridging competency gaps in healthcare quality and patient safety: a Kirkpatrick-level evaluation of a blended learning intervention in South Africa. *EUREKA Soc Humanit*. 2025 Nov 30;(6):53–62.
- [5] Oleribe OE, Momoh J, Uzochukwu BS, Mbofana F, Adebisi A, Barbera T, et al. Identifying Key Challenges Facing Healthcare Systems In Africa And Potential Solutions. *Int J Gen Med*. 2019 Nov; Volume 12:395–403.
- [6] Couper I, Ray S, Blaauw D, Ng'wena G, Muchiri L, Oyungu E, et al. Curriculum and training needs of mid-level health workers in Africa: a situational review from Kenya, Nigeria, South Africa and Uganda. *BMC Health Serv Res*. 2018 Dec;18(1):553.
- [7] Pillay R. Managerial competencies of hospital managers in South Africa: a survey of managers in the public and private sectors. *Hum Resour Health*. 2008 Dec;6(1):4.
- [8] Giovanelli L, Rotondo F, Fadda N. Management training programs in healthcare: effectiveness factors, challenges and outcomes. *BMC Health Serv Res*. 2024 Aug 7;24(1):904.
- [9] Braithwaite J, Matsuyama Y, Johnson J. Healthcare Reform, Quality and Safety: Perspectives, Participants, Partnerships and Prospects in 30 Countries. London: CRC Press; 2017. 380 p.
- [10] Bhati D, Deogade MS, Kanyal D. Improving Patient Outcomes Through Effective Hospital Administration: A Comprehensive Review. *Cureus [Internet]*. 2023 Oct 26 [cited 2025 Apr 21]; Available from: <https://www.cureus.com/articles/197936->

improving-patient-outcomes-through-effective-hospital-administration-a-comprehensive-review

- [11] Pillay R. High Reliability Healthcare fundamentals of patient safety [Internet]. 2023 [cited 2025 May 11]. Available from: https://fliphtml5.com/cngpj/ftnr/High_Reliability_Healthcare_fundamentals_of_patient_safety_-_Final_MANUAL_2023/56/
- [12] Veazie S, Peterson K, Bourne D. Evidence Brief: Implementation of High Reliability Organization Principles [Internet]. Washington (DC): Department of Veterans Affairs (US); 2019 [cited 2025 May 22]. (VA Evidence-based Synthesis Program Reports). Available from: <http://www.ncbi.nlm.nih.gov/books/NBK542883/>
- [13] Moreno-Domínguez MJ, Escobar-Rodríguez T, Pelayo-Díaz YM, Tovar-García I. Organizational culture and leadership style in Spanish Hospitals: Effects on knowledge management and efficiency. *Heliyon* [Internet]. 2024 Oct 30 [cited 2026 Mar 9];10(20). Available from: [https://www.cell.com/heliyon/abstract/S2405-8440\(24\)15247-4](https://www.cell.com/heliyon/abstract/S2405-8440(24)15247-4)
- [14] Rafi'i MR, Hanif SAM, Bin Daud F. Exploring the link between healthcare organizational culture and provider work satisfaction: a systematic review. *BMC Health Serv Res.* 2025 July 3;25(1):904.
- [15] Atenchong N, Maweu DM, Wanyama PA, Uwimana C, Ewing H, Ndaimani A. Perceptions of Organisational Readiness for Change in Nurse- and Midwifery-Led Quality Improvement Initiatives. *J Healthc Leadersh.* 2025 Dec 26;17:851–61.

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Competing in a Digital Economy: The Role of Globalisation, Digitalisation and Intangible Assets in European High-Tech Firm Performance

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Abstract— This study analyses the impact of globalisation, digitalisation and intangible assets on the performance of European high-tech companies listed on the STOXX600 index. In a context marked by rapid economic and technological change, companies face growing pressure to adopt strategic digital initiatives and develop new business models that ensure long-term competitiveness and sustainability. The research is based on a five-year panel dataset covering 98 companies with 490 observations, enabling an empirical assessment of the relationship between these factors and firm performance.

Globalisation is measured using the KOFGI index, developed by the KOF Institute, which integrates economic, social and political dimensions, including de facto and de jure indicators. The results show that higher levels of globalisation have a positive and significant impact on corporate performance, suggesting that countries' ability to cope with globalised markets leads to better corporate results.

Regarding digitalisation, this is operationalised through content analysis of annual reports, counting the frequency of terms associated with the concept of 'digital'. The results indicate that, in the short term, digitalisation efforts are associated with a negative impact on performance, due to increased costs and the need for intensive resource allocation. However, when combined with high levels of globalisation, digitalisation makes a positive contribution to profitability, mitigating its initial adverse effects.

As regards intangible assets, which include patents, trademarks, copyright and capitalised research and development expenditure, there is also a negative impact in the short term. This result is explained by the uncertainty and risk associated with this type of investment, which are often undervalued by the markets.

In summary, the study concludes that, although digitalisation and intangible assets may penalise performance in the short term, globalisation plays a crucial role in enhancing company value, especially when combined with appropriate digital strategies.

Keywords— Competitiveness, Corporate Performance, Digitalisation, Globalisation, High-tech Companies, Intangible Assets

REFERENCES

- [1] Ferdaous, J., and M. M. Rahman. "The Effects of Intangible Assets on Firm Performance." *American Journal of Business*, vol. 34, no. 3–4, 2019, pp. 148–168.

- [2] Gygli, S., et al. "The KOF Globalisation Index – Revisited." *The Review of International Organizations*, vol. 14, 2019, pp. 543–574.
- [3] Hanelt, A., et al. "A Systematic Review of the Literature on Digital Transformation: Insights and Implications for Strategy and Organizational Change." *Journal of Management Studies*, vol. 58, no. 5, 2021, pp. 1159–1197. <https://doi.org/10.1111/joms.12639>
- [4] Kurtz, H., et al. "Exploring Strategic Orientations in the Age of Digital Transformation: A Longitudinal Analysis of Digital Business Model Patterns." *Wirtschaftsinformatik 2021 Proceedings*, 2021.
- [5] OECD. *Measuring the Digital Transformation: A Roadmap for the Future*. OECD Publishing, 2019. <https://doi.org/10.1787/9789264311992-en>
- [6] Ruel, H., et al. "Digital Business Strategizing: The Role of Leadership and Organizational Learning." *Competitiveness Review*, vol. 31, no. 1, 2020, pp. 145–161. <https://doi.org/10.1108/CR-11-2019-0109>
- [7] Sousa-Zomer, T. T., et al. "Digital Transforming Capability and Performance: A Microfoundational Perspective." *International Journal of Operations and Production Management*, vol. 40, no. 7–8, 2020, pp. 1095–1128. <https://doi.org/10.1108/IJOPM-06-2019-0444>
- [8] Wu, K., and S. Lai. "Intangible Intensity and Stock Price Crash Risk." *Journal of Corporate Finance*, vol. 64, 2020, article 101682. <https://doi.org/10.1016/j.jcorpfin.2020.101682>

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Digital Economy Modeling: The Effects of E-Commerce and ICT on Economic Growth in the EU

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Abstract—Digitalization and e-commerce have become key drivers of modern economic growth. The volume of online transactions has expanded rapidly, with approximately 2.3 billion digital shoppers worldwide in 2021, and global e-commerce sales reaching around USD 27 trillion by 2022. At the same time, European countries exhibit substantial variation in adoption rates. For instance, in 2023, Ireland generated about 14% of business turnover from web sales, compared to less than 5% in Italy and Slovenia. In this context, substantial investments in information and communication technologies (ICT) and the expansion of ICT employment are expected to positively influence productivity and growth as digitalization progresses across national economies. This study develops an econometric growth model to quantify the impact of e-commerce factors on GDP for Belgium, Ireland, Italy, and Slovenia. Specifically, it examines how ICT employment, ICT investment, online ordering activity, and ICT wages contribute to output. The model utilizes a Cobb-Douglas production function augmented by digital economy variables, allowing for country-specific effects and temporal dynamics. Across all four countries, digital-economy variables exhibit positive and statistically significant effects on GDP. In the Cobb-Douglas specification, a 1 percent increase in ICT employment raises GDP by 1.30–1.73% (highest in Slovenia), Internet access elasticities range from 0.23 (Italy) to 0.72% (Slovenia), and ICT investment elasticities span 0.24–1.04% (highest in Belgium). The study provides precise estimates of elasticities and marginal effects for Internet access, ICT employment, and ICT investment – evidence that can directly support policymakers in prioritizing digital transformation strategies to ensure sustainable growth.

Keywords— e-commerce, economic growth, Cobb–Douglas production function, econometrics, GDP, ICT employment, ICT investment

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REFERENCES

- [81] UNCTAD, “Making e-commerce and the digital economy work for all,” 2024. Available: <https://unctad.org/news/making-e-commerce-and-digital-economy-work-all>.
- [82] Eurostat, “Online shopping in the EU keeps growing,” 2025. Available: <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20250220-3>.
- [83] X. Wang, H. Zhang, and M. Shi, “The mediating role of supply chain digitization in the relationship between cross-border e-commerce development and regional economic growth,” *Finance Research Letters*, vol. 75, Art. no. 106830, 2025. Available: <https://doi.org/10.1016/j.frl.2025.106830>.
- [84] F. Xue, “Driving economic transition: The impact of cross-border e-commerce policy on the upgrading of service industry structure,” *Economic Analysis and Policy*, vol. 84, pp. 941–956, 2024. Available: <https://doi.org/10.1016/j.eap.2024.10.001>.
- [85] Y. Liu, M. Zhang, B. Fan, S. Fu, and Y. Liu, “The green side of digital trade: Evaluating the impact of National E-commerce Demonstration Cities policy,” *International Review of Economics & Finance*, vol. 99, Art. no. 104071, 2025. Available: <https://doi.org/10.1016/j.iref.2025.104071>.
- [86] L. Shen, Z. Zhang, and Q. Yang, “Is e-commerce capable to promote mineral resources? Evidence for Belt and Road Initiative countries,” *Resources Policy*, vol. 88, Art. no. 104385, 2023. Available: <https://doi.org/10.1016/j.resourpol.2023.104385>.
- [87] J. Hou and Y. Liu, “Assessing the impact of rural e-commerce on regional poverty alleviation: A spatial spillover analysis,” *International Review of Economics & Finance*, vol. 94, Art. no. 103399, 2024. Available: <https://doi.org/10.1016/j.iref.2024.103399>.
- [88] M. Trujillo and A. Aleán-Romero, “The impact of ICT and e-commerce on employment in Colombia,” *Electronic Commerce Research and Applications*, vol. 65, Art. no. 101378, 2024. Available: <https://doi.org/10.1016/j.elerap.2024.101378>.
- [89] A. Parishev, G. Hristovski, P. Jolakoski, and V. Stojkoski, “E-commerce impact on economic growth,” in *Proc. 1st International Scientific Conference ‘Economic and Business Trends Shaping the Future’*, 2020, pp. 188–198. Available: <http://dx.doi.org/10.47063/EBTSF.2020.0017>.
- [90] L. Anggraeni, S. Tan, J. Junaidi, and E. Achmad, “E-commerce's impact on economic growth,” *Nomico*, vol. 1, pp. 64–76, 2024. Available: <http://dx.doi.org/10.62872/hqfac055>.
- [91] A. Toska and B. Fetai, “The impact of e-commerce on the economic growth of the Western Balkan countries: A panel data analysis,” *International Journal of Sustainable Development and Planning*, vol. 18, no. 3, pp. 935–941, 2023. Available: <https://doi.org/10.18280/ijstdp.180329>.
- [92] M. Ridhwan, A. Suryahadi, J. Rezki, and D. Andariesta, “The impact of COVID-19 on the labour market and the role of e-commerce development in developing countries: Evidence from Indonesia,” *Journal of the Asia Pacific Economy*, vol. 30, no. 1, pp. 84–127, 2023. Available: <https://doi.org/10.1080/13547860.2023.2195710>.
- [93] K. Hayakawa, H. Mukunoki, and S. Urata, “Can e-commerce mitigate the negative impact of COVID-19 on international trade?” *Journal of Economic Research*, vol. 74, pp. 215–232, 2023. Available: <https://doi.org/10.1007/s42973-021-00099-3>.
- [94] R. Novastria and A. Hani, “The impact of e-commerce on tax avoidance in Indonesia: Empirical study on companies registered in Indonesia Stock Exchange,” *Educational Administration: Theory and Practice*, vol. 30, no. 6, pp. 3122–3137, 2024. Available: <http://dx.doi.org/10.53555/kuey.v30i6.5998>.
- [95] J. Argilés, A. Somoza, D. Ravenda, and J. Garcia-Blandon, “An empirical examination of the influence of e-commerce on tax avoidance in Europe,” *Journal of International Accounting, Auditing and Taxation*, vol. 41, Art. no. 100339, 2020. Available: <http://dx.doi.org/10.1016/j.intaccudtax.2020.100339>.
- [96] T. Zatonatska and V. Novosolova, “Modeling of impact of e-commerce on economic development,” *Financial and Credit Activity: Problems of Theory and Practice*, vol. 1, no. 22, pp. 265–274, 2017. Available: <https://doi.org/10.18371/fcaptive.v1i22.110184>.

- [97] T. Zatonatska, O. Liashenko, V. Pakholchuk, and D. Zatonatskiy, "The impact of investments in digital development on employment in the information and communications technology (ICT) sector," in *Proc. 13th International Conference on Advanced Computer Information Technologies (ACIT)*, 2023, pp. 347–351. Available: <https://doi.org/10.1109/ACIT58437.2023.10275644>.
- [98] Forrester, "The global digital economy will reach \$16.5 trillion and capture 17% of global GDP by 2028," 2024. Available: <https://www.forrester.com/blogs/>.
- [99] Eurostat, "ICT sector – value added, employment and R&D," 2024. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_sector_-_value_added,_employment_and_R%26D.
- [100] OECD, "Growth of digital economy outperforms overall growth across OECD," 2024. Available: <https://www.oecd.org/en/about/news/press-releases/2024/05/growth-of-digital-economy-outperforms-overall-growth-across-oecd.html>.
- [101] Eurostat, "E-commerce statistics," 2025. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics.
- [102] Eurostat, "Economy and finance. National accounts (ESA 2010). Annual national accounts. GDP and components." Available: https://ec.europa.eu/eurostat/databrowser/view/nama_10_gdp__c_u_stom_16368136/default/table?lang=en.
- [103] Eurostat, "Economy and finance. National accounts (ESA 2010). Annual national accounts. Population and employment in national accounts." Available: <https://ec.europa.eu/eurostat/databrowser/view/>.
- [104] OECD, "Toolkit. Policy dimensions: Innovation. ICT investment as a share of GDP." Available: <https://goingdigital.oecd.org/indicator/30>.
- [105] Eurostat, "Science, technology, digital society. Digital economy and society. ICT usage in households and by individuals. Connection to the internet and computer use." Available: https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_in_h_custom_16368982/default/table?lang=en.

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Dissemination of Municipal Events - The case of the City Hall of Paredes

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Abstract

The present paper aims to understand how communication and promotion contribute to the success of events organized by municipal councils, with the chosen case study being the Paredes City Council. Nowadays, culture is seen as an essential heritage for communities, as it helps strengthen local identity, brings people together, and stimulates the economy.

Municipal authorities have therefore taken on an increasingly important role in cultural promotion, and communication is one of the only ways for them to connect with citizens.

In this study, the methods of promotion used by the Paredes City Council to publicize its events were investigated, as well as how these methods vary according to the scale of the events.

The work was developed through a theoretical review on public and cultural management and the promotion of municipal events, as well as a practical analysis of the case of Paredes.

The methodology used for the case study was qualitative, involving an analysis of data provided by the Paredes City Council. The research reveals that good municipal communication that is clear and accessible is a key factor in engaging people and plays a vital role in supporting local initiatives.

However, the study demonstrated that there are still challenges to be overcome, even though municipal communication has evolved significantly. In some cases, there is a lack of a more articulated strategic plan that establishes clear objectives and allows for the evaluation of the real impact of outreach actions. The development of an integrated cultural communication plan with clearly established objectives and a good final evaluation could make the city hall's actions even more effective and consistent.

It was evident that there is still room for the adoption of more participatory communication. It is concluded that communication is one of the main factors that, in practical terms, rivals good event organization, and it is what ensures that events become recognized and integrated into the life of the community.

Keywords— Municipal communication; Dissemination; Culture; Paredes

REFERENCES

- [1] Aguilera, I. L. (2000). Cultura y ciudad manual de política cultural municipal. Espanha:
- [2] Araújo, J. F. (2000). Tendências recentes de abordagem à reforma administrativa. Revista Portuguesa de Administração e Políticas Públicas, vol.1, n.º 1, 38-47. Obtido de https://www.researchgate.net/publication/311518628_Tendencias_recientes_de_abordagem_a_Reforma_Administrativa
- [3] Brizuela, J. I., & Rocha, R. (2019). Texto e Contexto da Política Cultural. Em Política Cultural Conceito, Trajetória e Reflexões. Editora da Universidade Federal da Bahia. Obtido de <https://repositorio.ufba.br/bitstream/ri/32115/1/POLITICACULTURAL%20-%20RI.pdf>
- [4] Calabre, L. (2011). Políticas culturais: teoria e práxis. São Paulo: Edições Casa de Rui Barbosa. Obtido de <https://d3nv1jy4u7zmsc.cloudfront.net/wpcontent/uploads/2013/04/Politica-Culturais-Teoria-e-Praxis.pdf>
- [5] Castells, M. (2009). Communication Power. Oxford: Oxford University Press.
- [6] Diefenbach, T. (2009). New Public Management in public sector organizations: the dark side of managerialistic 'enlightenment'. Public Administration, 892-909. doi:10.1111/j.1467-9299.2009.01766.x
- [7] Geertz, C. (1973). A Interrelação das Culturas. Basic Books, Inc.
- [8] Getz, D. (1997). Event Management & Event Tourism. Cognizant Communication Corporation.
- [9] Keaney, E. (2006). Public value and the arts: A literature review. Arts Council England, Londres. Obtido de <http://www.artscouncil.org.uk/documents/publications/phnpzcVVG.pdf>
- [10] Page, S. J., & Connell, J. (2012). The Routledge Handbook of Events. Routledge.

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Driving Innovation and Digital Transformation in Vocational Education: The BT4VET Model and Toolkit

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Abstract— The Business Transformation for Vocational Education and Training (BT4VET) model addresses the need for vocational education and training institutions to adapt to rapidly changing socio-economic and labour market conditions. The purpose of this study is to present a structured model and a set of practical tools designed to support the strategic repositioning of vocational education providers as innovative, sustainable, and service-oriented organizations. The methodology is based on a multi-phase approach that combines institutional profiling, business model development, pilot validation, and feasibility planning. This approach integrates qualitative and quantitative analysis, stakeholder feedback, and iterative testing in real organizational contexts. The BT4VET model is operationalized through a comprehensive toolkit that includes instruments for human resource development, quality assurance, customer satisfaction assessment, marketing and promotion, project planning, performance measurement, and financial management. The principal results highlight the capacity of these tools to enhance managerial competencies, support data-driven decision-making, and foster stronger engagement with enterprises and local ecosystems. Furthermore, the model facilitates the diversification of services and reduces dependence on public funding by promoting entrepreneurial practices within vocational education institutions. The major conclusion is that the BT4VET model provides a scalable and replicable framework that strengthens institutional resilience, improves operational efficiency, and contributes to the broader goals of innovation, sustainability, and socio-economic development in vocational education and training systems.

Keywords— vocational education and training, business transformation, digital tools, strategic management, institutional innovation, sustainability, educational leadership

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REFERENCES

- [1] Financing Technical and Vocational Education: Modalities and Experiences - Accessed 22 August 2025. Retrieved https://unevoc.unesco.org/fileadmin/user_upload/pubs/iug006e.pdf
- [2] FINANCING VOCATIONAL EDUCATION AND SKILLS DEVELOPMENT - A POLICY AREA FOR ETF SUPPORT - Accessed 22 August 2025. Retrieved https://www.etf.europa.eu/sites/default/files/m/EAB88B1CBCA5A5E6C12582480042288D_Financing%20VET%20and%20skills%20development.pdf
- [3] Assessing governance and financing of vocational education strategies - Accessed 22 August 2025. Retrieved https://www.etf.europa.eu/sites/default/files/2020-01/assessing_vet_governance_and_financing_methodology.pdf
- [4] Financing for Technical and Vocational Education and Training - Accessed 22 August 2025. Retrieved <https://documents.worldbank.org/pt/publication/documents-reports/documentdetail/099541405222456804/ih1e05da9bb1a07914f1d1aba518b70035ffcd1>
- [5] A framework to better measure the return on investment from TVET - Accessed 22 August 2025. Retrieved https://www.ncver.edu.au/_data/assets/pdf_file/0026/861308/A-framework-to-better-measure-the-return-on-investment-from-TVET.pdf
- [6] Financing apprenticeships in the EU - Accessed 22 August 2025. Retrieved https://www.cedefop.europa.eu/files/4192_en.pdf
- [7] Funding skills development: the private sector contribution - Accessed 22 August 2025. Retrieved https://unesdoc.unesco.org/ark:/48223/pf0000261984?deliveryName=FCP_2_DM220216
- [8] Understanding the return on investment from TVET. A practical guide - Accessed 22 August 2025. Retrieved <https://unevoc.unesco.org/home/UNEVOC+Publications/lang=en/akt=detail/qs=6309>
- [9] New Cedefop database on financing apprenticeships in the EU - Accessed 22 August 2025. Retrieved <https://www.cedefop.europa.eu/en/tools/financing-apprenticeships>
- [10] Beyond subsidising training costs - Accessed 22 August 2025. Retrieved <https://www.cedefop.europa.eu/en/publications/5606>
- [11] Building Future-Ready Vocational Education and Training Systems - Accessed 22 August 2025. Retrieved https://www.oecd.org/en/publications/building-future-ready-vocational-education-and-training-systems_28551a79-en.html
- [12] Improving evidence on VET: Comparative data and indicators - Accessed 22 August 2025. Retrieved https://www.oecd.org/content/dam/oecd/en/publications/reports/2020/09/improving-evidence-on-vet_612344b6/d43dbf09-en.pdf
- [13] Teachers and Leaders in Vocational Education and Training - Accessed 22 August 2025. Retrieved https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/03/teachers-and-leaders-in-vocational-education-and-training_5641deea/59d4fbb1-en.pdf
- [14] Financing mechanisms for promoting social inclusion in skills and lifelong learning systems: Global overview of current practices and policy options Accessed 22 August 2025. Retrieved - <https://www.ilo.org/publications/financing-mechanisms-promoting-social-inclusion-skills-and-lifelong>
- [15] Financing and incentives for skills development: making lifelong learning a reality? - Accessed 22 August 2025. Retrieved https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_emp/%40ifp_skills/documents/publication/wcms_807524.pdf
- [16] BUILDING BETTER FORMAL TVET SYSTEMS PRINCIPLES AND PRACTICE IN LOW- AND MIDDLE-INCOME COUNTRIES - Accessed 22 August 2025. Retrieved <https://documents1.worldbank.org/curated/en/099071123130516870/pdf/P175566037a5e20650a657068b5152205bf.pdf>
- [17] Industry Engagement in TVET and Skills Development - Accessed 22 August 2025. Retrieved <https://documents1.worldbank.org/curated/en/099813506302531163/pdf/IDU-e89da132-8a31-45d9-9d91-79d3eda209cd.pdf>
- [18] UNESCO Strategy for TVET (2022-2029) - Accessed 22 August 2025. Retrieved https://unevoc.unesco.org/pub/unesco_strategy_for_tvete_2022-2029_discussion_document.pdf

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Emerging Technologies and Active Pedagogies in Initial Teacher Education: Preliminary Findings from a Systematic Review

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Abstract— Initial teacher education is under growing pressure to prepare future teachers for technology-rich classrooms and for pedagogical approaches that promote active student participation. This study presents preliminary findings from a systematic review examining how educational research addresses digital, emerging, and generative technologies in relation to the development of active pedagogies in initial teacher education. The review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol. Peer-reviewed articles published in English or Spanish between 2015 and June 2025 were retrieved from Scopus, Web of Science, and Dialnet using three search strings related to new technologies, generative artificial intelligence, and active pedagogies in initial teacher education. Eligible studies focused on pre-service teachers and teacher educators in European and Latin American contexts. After full screening, 66 articles were included. Preliminary findings indicate that literature pays considerable attention to technology integration in school settings, whereas fewer studies examine how initial teacher education programs prepare pre-service teachers to implement innovative pedagogies supported by emerging technologies. These findings point to a persistent misalignment between teacher education, emerging technologies, and active pedagogies, as technology is often approached as a technical resource rather than as a driver of pedagogical transformation. The study offers an updated overview of research trends and identifies a persistent gap in the preparation of future teachers for innovative classroom practice.

Keywords—initial teacher education, pre-service teachers, emerging technologies, active pedagogies, teacher preparation, systematic literature review, generative artificial intelligence

REFERENCES

- Diaz, P., Hrastinski, S. & Norström, P. How teacher students used digital response systems during student teaching. *Educ Inf Technol* 30, 8953–8978. 2025.
- Gómez Carrasco, C. J., Rodríguez-Medina, J., Chaparro Sainz, Álvaro, & Alonso García, S. Digital resources and teaching approaches in preservice training of History teachers. *Educación XXI*, 25(1), 143–170. 2022.
- Kaimara, P., Fokides, E., Oikonomou, A. *et al.* Pre-service teachers' views about the use of digital educational games for collaborative learning. *Educ Inf Technol* 27, 5397–5416. 2022.

Nieto-Isidro, S., Martínez-Abad, F., & Rodríguez-Conde, M. J. Observed and Self-Perceived Informational Literacy among teachers and future teachers and its relationship with socio-demographic variables. *Revista De Educación*, 396. 2022.

Ozturk, Elif & Turgut, Zeynep. The relationship between prospective teachers' perceived importance of online teaching competencies and their self-efficacy beliefs. *Turkish Online Journal of Distance Education*. 24. 2023.

Piedra Moreno, D. P. Motivational and fun! Preservice teachers' recontextualising of discourses on ICT integration in mathematics in their practicum assignment. *Mathematics Teacher Education and Development*, 26(2), 1–18. 2024

Rodrigues, Ana Luísa. Integrating Digital Technologies in Accounting Preservice Teacher Education: A Case Study in Portugal. *International Journal of Technology and Human Interaction*. 2022

Santos Caamaño, F. J., Vázquez Cancelo, M. J., & Fuentes-Abeledo, E. J. El aprendizaje autodirigido en el marco de las ecologías de formación inicial docente. Resultados de un estudio Delphi. *EDUCAR*, 58(2), 357–372. 2022

Santos Prieto José & Huang, Fang & Olmos, Susana & García-Peñalvo, Francisco & Teo, Timothy. Exploring the unknown: The effect of resistance to change and attachment on mobile adoption among secondary pre-service teachers. *British Journal of Educational Technology*. 50. 2019.

Sergeeva, Olga & Zheltukhina, Marina & Bikbulatova, Goliya & Sokolova, Ekaterina & Digtyar, Olesya & Prokopyev, Alexey & Sizova, Zhanna. Examination of the relationship between information and communication technology competencies and communication skills. *Contemporary Educational Technology*. 2023

Trapero-González, Irene & Díaz, Inmaculada & Ramos Navas Parejo, Magdalena & Romero-Rodríguez, José-María. Examinando las influencias sociodemográficas en la comprensión y preparación de los maestros en formación para enseñar STEM. *Revista Interuniversitaria de Formación del Profesorado*. 2025

Varea, V González- Calvo, G y García Monje, A. Exploring the changes of physical education in the age of Covid-19. *Physical Education and Sports Pedagogy*. 27 (1), 32–42. 2022

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Empowering Graduate Employability Through AI Upskilling: A Case Study on the IPT-INCO Academy Partnership

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Abstract—Artificial Intelligence has become a transversal competency across all sectors, creating an urgent need for higher education graduates to acquire AI-related skills regardless of their disciplinary background. This paper presents a case study of the emerging partnership between the Polytechnic University of Tomar and INCO Academy, aimed at integrating complementary AI training into the learning pathways of final year students and recent graduates. The initiative provides self-paced, asynchronous courses of 35–40 hours, tailored to multiple application domains, including Finance, ICT, Logistics, Public Administration, and Marketing, delivered through INCO’s developing digital platform and supported by international partners such as Google.

In addition to the pedagogical and institutional components of the collaboration, the project includes the implementation of a structured pre and post-training survey aimed at capturing and evaluating how individuals subjectively perceive their own AI literacy and level of engagement. As part of this evaluation, we will integrate the Perceived Artificial Intelligence Literacy Questionnaire as the assessment survey, providing a validated and reliable method for understanding students’ perceived competencies in relation to AI. The results will help establish baseline perceptions before engagement with the INCO Academy modules and evaluate shifts in perceived literacy afterwards, supporting evidence-based insights into the effectiveness of the partnership and informing potential future adjustments to the training offer.

We analyze the expected outcomes of this collaboration, focusing on employability enhancement, alignment with micro-credentialing frameworks, and institutional benefits such as reduced administrative burden and increased strategic visibility in AI education. The study contributes to current discussions on workforce preparedness and innovative models of academia-industry cooperation for digital skills development.

Keywords— Artificial Intelligence, Higher Education, Employability, Digital Skills, Skills Assessment, Academia-Industry Collaboration, Upskilling

REFERENCES


- [1] H. C. P. Ramos, O. C. Caro, E. S. Bardales, L. Q. Huatangari, J. A. C. Trigo, J. L. M. Guevara, and R. C. Santos, “Artificial intelligence skills and their impact on the employability of university graduates,” *Frontiers in Artificial Intelligence*, vol. 8, Art. no. 1629320, Jul. 2025, doi: 10.3389/frai.2025.1629320.
- [2] A. A. Tawara, J. El-Den, E. Gide and Y. Sebastian, “A Systematic Review and Comprehensive Analysis of AI-Enabled Re-Skilling and Upskilling in Education: Transformative Strategies for the Future,” 21st International Conference on Information Technology Based Higher Education and Training (ITHET), Paris, France, 2024, pp. 1–10, doi: 10.1109/ITHET61869.2024.10837638.
- [3] S. Grassini, “A Psychometric Validation of the PAILQ-6: Perceived Artificial Intelligence Literacy Questionnaire,” in *NordiCHI 2024: Nordic Conference on Human-Computer Interaction*, Uppsala, Sweden, Oct. 13–16, 2024, ACM, New York, NY, USA, 12 pp. doi: 10.1145/3679318.3685359.

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Empowering Independent and Critical Learning in High School Students with Learning Disabilities and ADHD: A Mixed-Methods Study on the Impact of Artificial Intelligence

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Abstract— This study examines the impact of Artificial Intelligence (AI) on learning processes among high school students with learning disabilities and ADHD. Using a mixed-methods design (N=105), four dimensions were examined via pre-post questionnaires and qualitative analysis: self-confidence, concentration, organization and time management, and critical thinking. Quantitatively, a slight non-significant increase in self-confidence was found, while qualitative data revealed improvements in self-efficacy, reduced anxiety, and increased autonomy in learning. Concentration showed a statistically significant decrease among younger students (≤ 16 , $p < .05$), compared to stability or slight improvement among older students (≥ 17). Organization and time management showed a moderate non-significant decrease (M: 3.11 \rightarrow 2.92; $t(104) = 1.45$, $p = .151$). Students reported that AI helped them organize information and save time, but did not improve independent planning or prioritization. Correlations were found between variables, including time management and concentration ($r = 0.811$, $p < .001$), time management and organization ($r = 0.616$, $p = .007$), and self-confidence and concentration ($r = 0.510$, $p = .031$). Critical thinking showed relatively low reliability in quantitative measures, while qualitative findings indicated processes such as self-checking, comparing information, and asking questions. At the same time, some students relied on AI-generated responses without critical evaluation. Differences between groups were observed: students with learning disabilities showed emotional improvement, while students without learning disabilities demonstrated relative stability. The findings suggest a contribution of AI primarily at the emotional-motivational level, particularly to self-confidence and autonomous learning, while highlighting the importance of guided and age-appropriate use in educational contexts.

Keywords—Artificial Intelligence, Learning Disabilities, ADHD, Self-Confidence, Critical Thinking, Autonomous Learning

REFERENCES

- [1] T. Adiguzel, M. H. Kaya, and F. K. Cansu, "Revolutionizing education with AI: Exploring the transformative potential of ChatGPT," 2023. <https://doi.org/10.30935/cedtech/13152>
- [2] M. Afzaal et al., "Explainable AI for data-driven feedback to support students self-regulation," *Frontiers in AI*, 2021. <https://doi.org/10.3389/frai.2021.723447>
- [3] E. Alabdulkareem and M. Jamjoom, "Computer-assisted learning for improving ADHD executive functions through gamified interventions," *Entertainment Computing*, vol. 33, 2020. <https://doi.org/10.1016/j.entcom.2020.100341>
- [4] R. A. Barkley, *Attention-Deficit Hyperactivity Disorder: A Handbook for Diagnosis and Treatment*, 4th ed. New York: Guilford Press, 2014.
- [5] P. D. Barua et al., "AI-enabled personalized assistive tools for children with neurodevelopmental disorders," *Int. J. Environmental Research and Public Health*, vol. 19, no. 3, 2022. <https://doi.org/10.3390/ijerph19031192>
- [6] T. K. F. Chiu et al., "Teacher support and student motivation to learn with AI-based chatbot," *Interactive Learning Environments*, 2023. <https://doi.org/10.1080/10494820.2023.2172044>
- [7] S. Cortese et al., "Cognitive training for ADHD: meta-analysis of outcomes from randomized controlled trials," *J. American Academy of Child and Adolescent Psychiatry*, vol. 59, no. 1, pp. 66-75, 2020.
- [8] A. Diamond, "Executive functions," *Annual Review of Psychology*, vol. 64, pp. 135-168, 2013. <https://doi.org/10.1146/annurev-psych-113011-143750>
- [9] G. DuPaul et al., "School-based intervention for adolescents with ADHD: Effects on academic functioning," *Journal of School Psychology*, vol. 87, pp. 48-63, 2021. <https://doi.org/10.1016/j.jsp.2021.07.001>
- [10] P. A. Facione, *Critical Thinking: What It Is and Why It Counts*. Insight Assessment, 2020.
- [11] S. V. Faraone et al., "Attention-deficit/hyperactivity disorder," *Nature Reviews Disease Primers*, vol. 1, no. 1, pp. 1-23, 2015. <https://doi.org/10.1038/nrdp.2015.20>
- [12] W. Holmes, M. Bialik, and C. Fadel, *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning*. Center for Curriculum Redesign, 2022.
- [13] V. H. Jensen et al., "Executive functions and ADHD symptoms predict educational functioning in children with ADHD: A two-year longitudinal study," *Applied Neuropsychology: Child*, 2023. <https://doi.org/10.1080/21622965.2023.2292264>
- [14] U. Kopzhassarova et al., "Enhancement of students independent learning through critical thinking skills development," *Int. J. Environmental and Science Education*, vol. 11, no. 18, pp. 11585-11592, 2016.
- [15] J. A. Kulik and J. D. Fletcher, "Effectiveness of intelligent tutoring systems: A meta-analytic review," *Review of Educational Research*, vol. 86, no. 1, pp. 42-78, 2016. <https://doi.org/10.3102/0034654315581420>
- [16] M. Liu, L. J. Zhang, and C. Biebricher, "Investigating students cognitive processes in generative AI-assisted writing," *Computers and Education*, 2024. <https://doi.org/10.1016/j.compedu.2023.104977>
- [17] O. Noroozi, G. J. J. Biesta, and M. Mulder, "How AI in education can support critical and reflective thinking," *Educational Technology R&D*, vol. 71, no. 3, pp. 1123-1140, 2023. <https://doi.org/10.1007/s11423-022-10175-1>
- [18] N. Pellas, "The role of AI in enhancing writing skills among students with learning disabilities," *Education Sciences*, 2023. <https://doi.org/10.3390/educsci13111155>
- [19] K. Rapti, "The use of artificial intelligence during the educational process for students with attention deficit and hyperactivity disorder," 2023. <https://doi.org/10.30574/wjrbphs.2023.16.2.0459>
- [20] M. Sarid and O. Lipka, "Students with learning disabilities/ADHD in higher education dealing with remote learning," *Frontiers in Psychology*, 2023. <https://doi.org/10.3389/fpsyg.2023.1172771>
- [21] J. Wang and W. Fan, "The effect of ChatGPT on students learning performance and higher-order thinking: A meta-analysis," *Humanities and Social Sciences Communications*, 2025.
- [22] O. Zawacki-Richter et al., "Systematic review of research on AI applications in higher education: where are the educators?" *Int. J. Educational Technology in Higher Education*, vol. 16, pp. 1-27, 2019. <https://doi.org/10.1186/s41239-019-0171-0>

Enabling Artificial Intelligence Transformation in Higher Education: A Qualitative Study of Institutional Best Practices for Teaching and Research Innovation

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Abstract—The rapid integration of generative artificial intelligence into higher education is reshaping learning, teaching, and research practices. While many institutions have introduced artificial intelligence tools at the individual level, there remains limited empirical research on how universities can strategically enable institution-wide transformation. This paper presents a qualitative study-in-progress examining a faculty fellowship initiative designed to facilitate structured artificial intelligence integration across teaching and research domains. The purpose of this study is to identify and conceptualize best practices for enabling sustainable and responsible artificial intelligence transformation within a university setting. Specifically, the research seeks to understand: (1) how differentiated training models influence artificial intelligence adoption across students, staff, and faculty; (2) how structured prompt literacy and workflow-based approaches shape teaching and research applications; and (3) what organizational conditions support or hinder scalable artificial intelligence integration. Data collection includes workshop design documentation, pre- and post-engagement surveys, participant reflections, instructional artifacts, and implementation notes gathered during a full-day institutional workshop targeting diverse stakeholder groups. Guided by digital transformation and organizational change frameworks, the study aims to develop a conceptual model outlining enabling mechanisms for artificial intelligence adoption that balance innovation, governance, and academic integrity. As a work in progress, this paper contributes to emerging scholarship on artificial intelligence transformation in higher education by proposing a structured institutional enablement framework. The findings will inform future empirical analysis and offer actionable insights for universities seeking strategically aligned artificial intelligence integration in teaching and research..

Keywords—Artificial intelligence in higher education; Digital transformation; Faculty development; Organizational change; Teaching innovation; Research enablement

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REFERENCES

- Y. Qian, "Pedagogical applications of generative AI in higher education: A systematic review of current practice and trends," *Educational Technology Research and Development*, vol. 73, pp. 205–224, 2025.
- D. M. Bamasoud, "Adopting Generative AI in Higher Education: A dual-perspective adoption model emphasizing ethical frameworks and institutional readiness," *Journal of Educational Computing Research*, vol. 63, no. 10, pp. 264–289, 2025.
- S. Haroud and N. Saqri, "Generative AI in higher education: Teachers' and students' perspectives on digital literacy, pedagogical support, and transformation," *Multidisciplinary Journal of Education Science*, vol. 12, no. 3, pp. 457–473, 2025.
- A. AAB Jwair, "Generative artificial intelligence in higher education," *Cogent Education*, vol. 12, 2025.
- N. G. Khoza and F. V. van der Walt, "A systematic review on AI-enhanced pedagogies in higher education in the Global South," *Frontiers in Education*, 2025.

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ERGOCHECK: A Digital Application for Ergonomic Postural Assessment Based on Rapid Entire Body Assessment

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Abstract

Work-related musculoskeletal disorders are a major public health concern due to their impact on functional capacity, quality of life, academic performance, and productivity. These conditions are frequently associated with inadequate posture, repetitive movements, physical overload, and insufficient recovery periods. Although several tools are available to assess technical gestures associated with the risk of musculoskeletal injuries, such as the Rapid Entire Body Assessment (REBA), important limitations remain. These include issues related to the accuracy of joint angle measurements, biomechanical artefacts, and differences between assessments conducted in laboratory settings and those performed in real-world task environments. Such limitations highlight the need to develop and validate more robust and ecologically valid methods for the assessment of human movement. In this context, this project aimed to develop ERGOCHECK, a digital application designed to improve ergonomic postural assessment by increasing objectivity, accuracy, and accessibility in risk screening.

Methods: The solution was developed through a mixed-methods approach guided by Design Thinking, including problem identification, ideation, prototyping, and pilot testing. ERGOCHECK captures frontal and lateral photographs, identifies 33 anatomical landmarks using artificial intelligence, calculates joint angles as a digital goniometer, and automatically computes REBA scores, risk levels, and personalized ergonomic recommendations. A pilot study conducted with higher education students enabled a preliminary evaluation of functionality, usability, and practical applicability, while also identifying aspects that require further refinement.

Results: The preliminary results show that ERGOCHECK is a functional and operational application capable of storing user data, while generating standardized reports with postural risk classification. Pilot testing supported the feasibility of the automated workflow usability, report clarity, and the perceived usefulness of ergonomic feedback. User feedback also informed interface refinements and improvements in the consistency of data collection and angle measurement.

Conclusion: ERGOCHECK shows promise as a practical, accessible, and scalable digital tool for ergonomic screening in academic and occupational settings. By reducing the subjectivity associated with manual observational assessment while preserving the strengths of the REBA method, it may contribute to more standardized postural evaluation and prevention of work-related musculoskeletal.

Keywords—ergonomics, postural assessment, digital health, rehabilitation, artificial intelligence, risk prevention.

References

1. Alanazi, S. A., & Kashoo, F. Z. (2025). Musculoskeletal pain among university students and its correlations with risk factors: A cross-sectional study. *Journal of Clinical Medicine*, 14(17).
2. Balogh, D., Cui, X., Mayer, M., Koehncke, N., Dueck, R., & Lang, A. E. (2025). Reliability and agreement during the Rapid Entire Body Assessment (REBA). *PLOS One*.
3. Canever, J. B., Nonnenmacher, C. H., & Lima, K. M. M. (2025). Reliability of range of motion measurements obtained by goniometry, photogrammetry and smartphone applications in lower limb: A systematic review. *Journal of Bodywork and Movement Therapies*, 42, 793–802.

4. Crawford, J. O., Graveling, R., Davis, A., Giagloglou, E., Fernandes, M., Markowska, A., Jones, M., & Fries-Tersch, E. (2020). Work-related musculoskeletal disorders: From research to practice. What can be learnt? Publications Office of the European Union.
5. De Carvalho, D. E., de Luca, K., Funabashi, M., Breen, A., Wong, A. Y. L., Johansson, M. S., Ferreira, M. L., Swab, M., Kawchuk, G. N., Adams, J., & Hartvigsen, J. (2020). Association of exposures to seated postures with immediate increases in back pain: A systematic review of studies with objectively measured sitting time. *Journal of Manipulative and Physiological Therapeutics*, 43(1), 1–12.
6. De Kok, J., Vroonhof, P., Sniijders, J., Roullis, G., Clarke, M., Peereboom, K., van Dorst, P., & Isusi, I. (2019). Work-related musculoskeletal disorders: Prevalence, costs and demographics in the EU. Publications Office of the European Union.
7. ErgoPlus. (s.d.). REBA employee assessment worksheet. <https://ergo-plus.com/reba-assessment-tool-guide/>
8. Health and Safety Executive. (s.d.). Musculoskeletal disorders (MSD) risk assessment resources. <https://www.hse.gov.uk/msd/toolkit.htm>
9. Hignett, S., & McAtamney, L. (2000). Rapid entire body assessment (REBA). *Applied Ergonomics*, 31(2), 201–205.
10. Meng, Y., Xue, Y., Yang, S., Wu, F., & Dong, Y. (2025). The associations between sedentary behavior and neck pain: A systematic review and meta-analysis. *BMC Public Health*, 25(1), Artigo 453.
11. Okezie, O. C., Anamezie, T. H., Nene, J. J., & Okwudili, J. D. (2020). Work-related musculoskeletal disorders among office workers in higher education institutions: A cross-sectional study. *Ethiopian Journal of Health Sciences*, 30(5), 715–724.
12. Parent-Thirion, A., Biletta, I., Cabrita, J., Vargas, O., Vermeulen, G., Wilczyńska, A., & Wilkens, M. (2017). Sixth European Working Conditions Survey: Overview report (2017 update). Publications Office of the European Union.
13. Ravi, B., Kapoor, M., & Player, D. (2021). Feasibility and reliability of a web-based smartphone application for joint position measurement. *Journal of Rehabilitation Medicine*, 53, reliability
14. Schwartz, A. H., Albin, T. J., & Gerberich, S. G. (2019). Intra-rater and inter-rater of the rapid entire body assessment (REBA) tool. *International Journal of Industrial Ergonomics*, 71, 111–116.
16. World Health Organization. (2022) Musculoskeletal conditions.

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Formative Assessment and Digital Portfolio in an Interdisciplinary Context: A Higher Education Experience

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Abstract—Formative and shared assessment offers students feedback on the go and promotes self-regulation. When integrated with project-based learning (PBL), portfolios can structure the formative assessment of transversal competencies and scaffold metacognitive development. However, few studies have examined how reflective portfolios operate in interdisciplinary settings, where students must navigate diverse epistemological backgrounds as they develop competencies. This article explores the role of a reflective digital portfolio as a formative assessment system in an interdisciplinary master's program at a higher education institution. We study how combining structured reflection with a digital portfolio supports self-regulation of learning and the development of personal and social competencies in PBL contexts. A qualitative case study design was adopted, involving 38 students from varied undergraduate backgrounds during the second semester of 2025. Data were collected through written reflections and self-assessments of communication and teamwork competencies and subsequently analyzed using thematic content analysis and lexicometric analysis. Results show that students identified a lack of engagement and a disconnect between theory and practice as limitations in their prior educational experiences. Lexicometric analysis confirmed the centrality of collaboration-related terms and indicated interest in the new formative experience. The portfolio-based reflective cycle supported metacognitive awareness by creating structured moments for students to connect prior experiences with emerging challenges, such as psychological safety, complementary strengths, and shared responsibility. We conclude that digital portfolios can structure self-regulatory processes in formative assessment. Future research should examine the longitudinal development of competencies and perspectives on narrative feedback.

Keywords— formative assessment, digital portfolio, project-based learning, interdisciplinarity, higher education, self-regulation, metacognition

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REFERENCES

- [1] V. M. López-Pastor and Á. Pérez-Pueyo, Coords., *Evaluación Formativa y Compartida en Educación: Experiencias de Éxito en Todas las Etapas Educativas*. León: Universidad de León, 2017.
- [2] E. Panadero, A. Jonsson, and J. Botella, "Effects of self-assessment on self-regulated learning and self-efficacy: Four

meta-analyses," *Educ. Res. Rev.*, vol. 22, pp. 74–98, 2017. doi: 10.1016/j.edurev.2017.08.004

- [3] V. Klenowski, *Developing Portfolios for Learning and Assessment*. London: RoutledgeFalmer, 2002.
- [4] W. N. Bender, *Project-Based Learning: Differentiated Instruction for the 21st Century*. Thousand Oaks, CA: Corwin, 2014.
- [5] M. Scriven, "The methodology of evaluation," in *Perspectives of Curriculum Evaluation*, R. W. Tyler, R. M. Gagné, and M. Scriven, Eds. Chicago: Rand McNally, 1967, pp. 39–83.
- [6] P. Black and D. William, "Assessment and classroom learning," *Assess. Educ.*, vol. 5, no. 1, pp. 7–74, 1998. doi: 10.1080/0969595980050102
- [7] D. J. Nicol and D. Macfarlane-Dick, "Formative assessment and self-regulated learning: A model and seven principles of good feedback practice," *Stud. High. Educ.*, vol. 31, no. 2, pp. 199–218, 2006. doi: 10.1080/03075070600572090
- [8] J. Hattie and H. Timperley, "The power of feedback," *Rev. Educ. Res.*, vol. 77, no. 1, pp. 81–112, 2007. doi: 10.3102/003465430298487
- [9] D. Carless, *Excellence in University Assessment*. London: Routledge, 2015.
- [10] F. L. Paulson, P. R. Paulson, and C. A. Meyer, "What makes a portfolio a portfolio?" *Educ. Leadersh.*, vol. 48, no. 5, pp. 60–63, 1991.
- [11] H. C. Barrett, "Researching electronic portfolios and learner engagement: The REFLECT Initiative," *J. Adolesc. Adult Lit.*, vol. 50, no. 6, pp. 436–449, 2007. doi: 10.1598/JAAL.50.6.2
- [12] J. Zubizarreta, *The Learning Portfolio*, 2nd ed. San Francisco: Jossey-Bass, 2009.
- [13] B. J. Zimmerman, "Becoming a self-regulated learner: An overview," *Theory Pract.*, vol. 41, no. 2, pp. 64–70, 2002. doi: 10.1207/s15430421tip4102_2
- [14] A. F. Repko and R. Szostak, *Interdisciplinary Research*, 4th ed. Los Angeles: Sage, 2020.
- [15] R. K. Yin, *Case Study Research and Applications*, 6th ed. Los Angeles: Sage, 2018.
- [16] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qual. Res. Psychol.*, vol. 3, no. 2, pp. 77–101, 2006. doi: 10.1191/1478088706qp063oa
- [17] E. Gün-Tosik, B. Atasoy, and A. O. Yüksel, "The role of ePortfolios in formative assessment: A systematic literature review," *J. Meas. Eval. Educ. Psychol.*, vol. 14, Special Issue, pp. 299–319, 2023. doi: 10.21031/epod.1276063
- [18] German Research Foundation (DFG). "FAQ: Humanities and Social Sciences — When do I need a statement by an ethics committee?" DFG, 2024. [Online]. Available: <https://www.dfg.de/en/research-funding/proposal-funding-process/faq/humanities-social-sciences>

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From Mobility to Engagement: The Impact of Blended Intensive Programmes on Student Experience and Academic Involvement in Higher Education

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Abstract— This study examines how Blended Intensive Programmes (BIPs) influence student engagement and belonging in higher education. Grounded in Student Engagement Theory and Experiential Learning, the research conceptualises BIPs as high-impact learning experiences that integrate project-based collaboration, intercultural interaction, and real-world problem solving [1] [2]. An exploratory qualitative approach was used, based on semi-structured interviews with 15 Business Communication bachelor's students who participated in BIPs in 2025 and 2026. The data were analysed thematically to explore behavioural, emotional, and cognitive engagement, as well as students' sense of belonging and identification with their programme.

The findings indicate that participation in BIPs increased behavioural engagement through active involvement and collaborative work, strengthened emotional engagement through motivation and enjoyment, and supported cognitive engagement through reflection and application of knowledge. Emotional engagement happened to be the most relevant dimension for BIP participants [3]. Students also reported a stronger sense of belonging and a clearer identification with their academic field. These results are consistent with recent studies showing that BIPs can enhance intercultural learning, student development, and the educational value of short-term international mobility formats [4] [5]. Overall, the study suggests that BIPs should be viewed not only as mobility activities but also as strategic pedagogical initiatives that can improve student experience, motivation, and retention in higher education [1] [6]).

Keywords—blended intensive programs, student engagement, higher education

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REFERENCES

- [1] E. R. Kahu, "Framing student engagement in higher education," *Studies in Higher Education*, vol. 38, no. 5, pp. 758–773, 2013.
- [2] D. A. Kolb, *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice-Hall, 1984.
- [3] J. A. Fredricks, P. C. Blumenfeld, and A. H. Paris, "School engagement: Potential of the concept, state of the evidence," *Review of Educational Research*, vol. 74, no. 1, pp. 59–109, 2004.
- [3] F. J. García-Peñalvo, "Generative artificial intelligence and education: An analysis from multiple perspectives," *Education in the Knowledge Society*, vol. 25, p. e31942, 2024.
- [4] C. Vázquez-Martín, J. M. Ramírez-Hurtado, and E. Vázquez-Cano, "Impact of video game use on fostering creativity in Waldorf school students," *International Journal of Technology in Education*, vol. 8, no. 1, pp. 174–192, 2025.
- [6] V. Tinto, *Leaving College: Rethinking the Causes and Cures of Student Attrition*, 2nd ed. Chicago, IL: University of Chicago Press, 1993.






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From Technology Readiness to Technical Competence: Assessing Accounting Students under the IES 2 Framework

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Abstract — Purpose: The digital transformation in accounting, driven by automation and artificial intelligence, has reinforced the importance of technical skills, particularly in terms of technological adaptation in the training of future professionals. In this context, this study analyses the relation between the technological readiness of higher education students and their perception of technical readiness across the 12 competency areas operationalised from the International Education Standards 2 (IES 2) of the International Federation of Accountants (IFAC).

Method: The research adopts a quantitative approach, based on a structured questionnaire administered to 146 students. The survey comprised three core components: sociodemographic data, self-assessment of technical readiness across the 12 IES 2 competency areas, and application of the Technology Readiness Index (TRI 2.0). Data analysis involved descriptive statistics, reliability analysis and Spearman's correlations, with the aim of examining the association between technological readiness and the perception of technical competencies.

Main Results: Based on the TRI 2.0 model by Parasuraman and Colby (2014), the results reveal a profile characterised by high optimism, moderate innovativeness, relatively low discomfort and high insecurity, reflecting a moderate overall level of technological readiness. At the same time, students report an overall positive perception of their technical readiness, with higher scores in financial accounting and reporting, information and communication technologies, and taxation, and lower scores in auditing. However, no statistically significant association was observed between overall technological readiness and the overall perception of technical competence. Nevertheless, a positive and significant relation was identified between overall technological readiness and competence in information and communication technologies.

Key Conclusions: It is concluded that technological readiness does not automatically translate into a high overall perception of technical competence, although it appears to be associated with areas more directly related to the use of technology. The results reinforce the importance of pedagogical strategies that link the development of technical skills with technological adaptation, in a professional context increasingly marked by technological demands.

Keywords— Technology Readiness; TRI 2.0; IES 2; Accounting Education; Technical Competencies

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REFERENCES

- [1] J. Ballantine, G. Boyce, and G. Stoner, "A critical review of AI in accounting education: Threat and opportunity," *Crit. Perspect. Account.*, vol. 99, art. no. 102711, 2024, doi: 10.1016/j.cpa.2024.102711.
- [2] N. Strydom and A. Mohammadali-Haji, "The accountancy profession and the challenges of artificial intelligence," in *Artificial Intelligence in Accounting, Auditing and Finance: A Guide for Implementation and Use*, M. Adelowotan and C. A. Leke, Eds. Cham, Switzerland: Springer Nature, 2025, pp. 45–61, doi: 10.1007/978-3-031-87368-3_4.
- [3] A. F. Holmes and A. Douglass, "Artificial intelligence: Reshaping the accounting profession and the disruption to accounting education," *J. Emerg. Technol. Account.*, vol. 19, no. 1, pp. 53–68, 2022, doi: 10.2308/JETA-2020-054.
- [4] A. M. Abdo-Salloum and H. Y. Al-Mousawi, "Accounting students' technology readiness, perceptions, and digital competence toward artificial intelligence adoption in accounting curricula," *J. Account. Educ.*, vol. 70, art. no. 100951, 2025, doi: 10.1016/j.jaccedu.2025.100951.
- [5] D. Jackson, G. Michelson, and R. Munir, "Developing accountants for the future: new technology, skills, and the role of stakeholders," *Acc. Educ.*, vol. 32, no. 2, pp. 150–177, 2023, doi: 10.1080/09639284.2022.2057195.
- [6] S. Vitali and M. Giuliani, "Emerging digital technologies and auditing firms: Opportunities and challenges," *Int. J. Account. Inf. Syst.*, vol. 53, art. no. 100676, 2024, doi: 10.15611/2025.45.0.06.
- [7] D. Jackson and C. Allen, "Enablers, barriers and strategies for adopting new technology in accounting," *Int. J. Account. Inf. Syst.*, vol. 52, art. no. 100666, 2024, doi: 10.1016/j.accinf.2023.100666.
- [8] O. A. Larios Soldevilla, V. Mendoza Ibarra, J. R. Moscoso Cuaresma, R. Urdanegui Sibina, D. Stone, A. Huamani Cerrón, and E. A. Pretell Pintado, "Transforming accounting education: integrating technological, soft and research skills in education," *Cogent Educ.*, vol. 12, no. 1, 2025, doi: 10.1080/2331186X.2025.2478304.
- [9] International Federation of Accountants (IFAC), "International Education Standard 2, Initial Professional Development – Technical Competence (Revised)," New York, NY, USA, Mar. 13, 2025. [Online]. Available: <https://www.ifac.org/publications/international-education-standards-2-3-and-4-revised>
- [10] A. Parasuraman and C. L. Colby, "An updated and streamlined Technology Readiness Index: TRI 2.0," *J. Serv. Res.*, vol. 18, no. 1, pp. 59–74, 2015, doi: 10.1177/1094670514539730.
- [11] J. Moll and O. Yigitbasioglu, "The role of internet-related technologies in shaping the work of accountants: New directions for accounting research," *Brit. Account Rev.*, vol. 51, no. 6, art. no. 100833, 2019, doi: 10.1016/j.bar.2019.04.002.
- [12] V. Tsiligris and D. Bowyer, "Exploring the impact of 4IR on skills and personal qualities for future accountants: A proposed conceptual framework for university accounting education," *Acc. Educ.*, vol. 30, no. 6, pp. 621–649, 2021, doi: 10.1080/09639284.2021.1938616.
- [13] I. M. Suarta, I. K. Suwintana, I. G. A. O. Sudiadnyani, and N. P. R. Sintadevi, "Employability and digital technology: What skills

- employers want from accounting workers?," *Acc. Educ.*, vol. 33, no. 3, pp. 274–295, 2024, doi: 10.1080/09639284.2023.2196665.
- [14] H. M. Al-Hattami, A. Al-Bukhrani, N. Ali Almasria, and H. AlGhunaimi, "Exploring student acceptance of digital accounting courses: an empirical analysis," *J. Int. Educ. Bus.*, vol. 19, no. 1, pp. 9–28, 2026, doi: 10.1108/JIEB-01-2025-0009.
- [15] H. M. Amin, R. S. Hassan, H. Ghoneim, and A. S. Abdallah, "A bibliometric analysis of accounting education literature in the digital era: current status, implications and agenda for future research," *J. Financ. Rep. Account.*, vol. 23, no. 2, pp. 742–768, 2025, doi: 10.1108/JFRA-12-2023-0802.
- [16] H. M. Al-Hattami, "Understanding how digital accounting education fosters innovation: The moderating roles of technological self-efficacy and digital literacy," *Int. J. Manag. Educ.*, vol. 23, no. 2, art. no. 101131, 2025, doi: 10.1016/j.ijme.2025.101131.
- [17] P. Tettamanzi, V. Minutiello, and M. Murgolo, "Accounting education and digitalization: A new perspective after the pandemic," *Int. J. Manag. Educ.*, vol. 21, no. 3, art. no. 100847, 2023, doi: 10.1016/j.ijme.2023.100847.
- [18] A. Parasuraman, "Technology Readiness Index (TRI): A multiple-item scale to measure readiness to embrace new technologies," *J. Serv. Res.*, vol. 2, no. 4, pp. 307–320, 2000, doi: 10.1177/109467050024001.
- [19] M. S. Krause, "Associational versus correlational research study design and data analysis," *Qual. Quant.*, vol. 52, no. 6, pp. 2691–2707, 2018, doi: 10.1007/s11135-018-0687-8.
- [20] P. Miksza, J. T. Shaw, L. K. Richerme, P. M. Hash, and D. A. Hodges, "Quantitative descriptive and correlational research," in *Music Education Research: An Introduction*. New York, NY, USA: Oxford University Press, 2023, pp. 241–262, doi: 10.1093/oso/9780197639757.003.0012.

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From Theory to Sales Practice: Master's Students Designing a Chatbot to Improve Seller Efficiency

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Abstract — The widespread incorporation of chatbots into commercial environments is reshaping sales dynamics by streamlining operations, reducing service costs, ensuring constant availability, and enabling more personalized customer interactions [1], [2]. These systems are particularly effective in addressing straightforward customer queries, offering clear and tailored responses without requiring human socioemotional involvement. As adoption expands, however, chatbots increasingly require emotional sensitivity to detect situations that should be escalated to human agents [3]. Technological evolution, from FAQ-based scripts and linear decision trees to generative AI, has significantly broadened conversational depth, adaptability, and integration possibilities across sales processes [4].

In contemporary sales environments, chatbots and conversational AI are now embedded in websites, CRM systems, and messaging platforms to automate inquiries, qualify leads, and support logistical coordination. This reflects a broader shift toward continuous, real-time engagement throughout the sales cycle. Industry reports highlight improvements in responsiveness, reduced waiting times, and enhanced customer experience [5]. Companies such as [6] further illustrate this evolution, noting that AI-powered sales assistants provide immediate insights and actionable recommendations that enhance the cognitive performance of sales professionals.

Within this context, a pedagogical initiative was implemented in the Commercial Planning and Strategy course of the Master's in Management and Commercial Direction at ISCAP-IPP. Over two academic years, slightly fewer than 60 students worked in teams to design a chatbot to support sales operations in a fictional printing company. The assignment included platform analysis, conversational flow mapping, and optional prototype development. This hands-on approach aimed to strengthen students' understanding of sales processes while fostering technological literacy aligned with current industry practices.

Qualitative feedback emphasized the novelty of the assignment, the autonomy it encouraged, and the strong collaborative work developed within teams. Academic outcomes were also notably positive: group project grades exceeded written test averages by 23 percent across both cohorts. These results suggest that integrating practical chatbot development into sales management education enhances engagement, deepens conceptual understanding, and better prepares students for technology-driven commercial environments.

Keywords — chatbots, sales practice, sales management, seller efficiency, artificial intelligence, frequently asked questions, pedagogical methods

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REFERENCES

- Tran, A., Pallant, J., Johnson, L., "Exploring the impact of chatbots on consumer sentiment and expectations in retail". *Journal of Retailing and Consumer Services*, vol. 63, 102718. DOI: 10.1016/j.jretconser.2021.102718 (2021).
- Pratas, J., Amorim, C., Oliveira, Z., Carlos, V., Reis, J.L., "Retail Chatbots' Main Themes and Research over Time: A Bibliometric and Content Analysis". In: Reis, J.L., Zelený, J., Gavurová, B., Santos, J.P.M.d. (eds) *Marketing and Smart Technologies. ICMarkTech 2023. Smart Innovation, Systems and Technologies*, vol 386. Springer, Singapore. Available at https://doi.org/10.1007/978-981-97-1552-7_7 (2024).
- Lajante, M., Del Prete, M., "Technology-infused Organizational Frontlines: When (Not) to use chatbots in retailing to promote Customer Engagement". In Pantano, E. (Ed.) *Retail Futures*, Emerald Publishing Limited, Bingley, 71-84. Available at <https://doi.org/10.1108/978-1-83867-663-620201011> (2020).
- Queirós, R. (2026). *IA e chatbots: um guia prático ao alcance de todos*. FCA Editora.
- Labadze, L., Grigolia, M., & Machaidze, L., "Role of AI chatbots in education: Systematic literature review". *International Journal of Educational Technology in Higher Education*, 20(1), Article 67. Available at <https://doi.org/10.1186/s41239-023-00426-1> (2023).
- Floworks.ai, "AI-powered sales assistants guide". Floworks.ai. Available at <https://blog.floworks.ai/ai-powered-sales-assistants-guide/> (2025).

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Generative Artificial Intelligence and the Formation of Future Communication Professionals- Student Perceptions, Semiotic Mediation and Educational Challenges

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Abstract—The growing presence of generative artificial intelligence (GenAI) in universities is transforming how academic knowledge is accessed, interpreted, and processed by students. Students increasingly rely on AI-based systems to retrieve information, summarize large volumes of content, clarify complex concepts and support academic writing. While these tools clearly improve speed, access to information, and day-to-day study support, they also raise difficult questions about intellectual autonomy, authorship, and the cultivation of critical reasoning.

This paper explores the educational and professional implications of generative artificial intelligence for future communication specialists. The study combines a qualitative investigation of student perceptions with a narrative meta-analysis of recent academic literature on AI in higher education. The empirical part was conducted with undergraduate students enrolled in communication and engineering programs at the University of Medicine, Pharmacy, Sciences and Technology “George Emil Palade” in Târgu Mureș.

The findings show that students perceive GenAI primarily as a practical learning assistant capable of translating dense academic content into more accessible explanations. At the same moment, they express concerns regarding dependency, superficial learning and the weakening of independent analytical effort. The meta-analytical section confirms that AI can improve learning efficiency and engagement when used as a complementary educational resource, but also stresses that its pedagogical value depends on critical and ethically guided integration.

The study argues that generative artificial intelligence should be treated not as a substitute for human cognition, but as a mediated and reflexive instrument that can support, rather than replace, intellectual formation. For communication education in particular, this means preparing students not only to use AI tools effectively, but also to question them, interpret them and situate them responsibly within broader professional and cultural frameworks.

Keywords—generative artificial intelligence, communication education, higher education, digital literacy, AI ethics, media studies, semiotic mediation.

REFERENCES

(Periodical style)

- [1] T. Zawacki-Richter, V. I. Marin, M. Bond, and F. Gouverneur, “Systematic review of research on artificial intelligence applications in higher education – where are the educators?,” *International Journal of Educational Technology in Higher Education*, vol. 16, no. 39, 2019.
- [2] H. Crompton and D. Burke, “Artificial intelligence in higher

education: The state of the field,” *Computers & Education: Artificial Intelligence*, vol. 4, 2023.

- [3] S. Kasneci *et al.*, “ChatGPT for good? On opportunities and challenges of large language models for education,” *Learning and Individual Differences*, vol. 103, 2023.
- [4] S. Tlili *et al.*, “What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education,” *Smart Learning Environments*, vol. 10, no. 15, 2023.
- [5] D. T. Willingham, “Why don’t students like school? Ask the cognitive scientist,” *American Educator*, vol. 33, no. 2, pp. 4–13, 39, Summer 2009.
- [6] M. Farrokhnia, S. K. Banihashem, O. Noroozi, and W. van Merriënboer, “A SWOT analysis of ChatGPT: Implications for educational practice and research,” *Computers & Education: Artificial Intelligence*, vol. 4, 2023.
- [7] A. Dwivedi *et al.*, “So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy,” *International Journal of Information Management*, vol. 71, 2023.
- [8] B. Williamson and R. Eynon, “Historical threads, missing links, and future directions in AI in education,” *Learning, Media and Technology*, vol. 45, no. 3, pp. 223–235, 2020.
- [9] Y. Teng, X. Zhou, and H. Al-Samarraie, “Generative artificial intelligence in education: A systematic review,” *Education Sciences*, vol. 14, no. 1, 2024.
- [10] L. Bălan, C. C. Sigmirean, and collaborators, “The challenge of generative artificial intelligence for future communication professionals: Experiences and usability,” manuscript framework developed for conference submission, 2026.

(Book style)

- [11] R. Luckin, W. Holmes, M. Griffiths, and L. B. Forcier, *Intelligence Unleashed: An Argument for AI in Education*. London, U.K.: Pearson, 2016.
- [12] N. Selwyn, *Education and Technology: Key Issues and Debates*, 3rd ed. London, U.K.: Bloomsbury Academic, 2022.
- [13] E. Mollick, *Co-Intelligence: Living and Working with AI*. New York, NY, USA: Portfolio, 2024.
- [14] M. Castells, *The Rise of the Network Society*, 2nd ed. Oxford, U.K.: Wiley-Blackwell, 2010.
- [15] H. Jenkins, *Convergence Culture: Where Old and New Media Collide*. New York, NY, USA: New York University Press, 2006.
- [16] N. Couldry and U. A. Mejias, *The Costs of Connection: How Data Is Colonizing Human Life and Appropriating It for Capitalism*. Stanford, CA, USA: Stanford University Press, 2019.
- [17] M. Deuze, *Media Work*. Cambridge, U.K.: Polity, 2020.

(Book style with paper title and editor)

[18] S.-M. Bălan and D. David, Eds., *Artificial Intelligence – The Engine of Educational Innovation in Law, Psychology, Medicine, Geography and Economic Sciences*. Bologna, Italy: Filodiritto Editore, 2026.

(Published Conference Proceedings style)

[19] S.-M. Bălan, C. Stanciu, T. Stanciu, and L. Bălan, “Types of digital offences and psychological implications. A forensic–psychological perspective on emerging online aggressions,” in *Artificial Intelligence – The Engine of Educational Innovation in Law, Psychology, Medicine, Geography and Economic Sciences*, S.-M. Bălan and D. David, Eds. Bologna, Italy: Filodiritto Editore, 2026, pp. 155–169.

(Presented Conference Paper style)

[20] C. Sigmirean, “Semiotic mediation of learning through AI: Adapting educational content for the digital mind,” presented at the XXIX EFSS Conference, Sozopol, Bulgaria, 2025.

(Journal Online Sources style)

[21] UNESCO, “Recommendation on the Ethics of Artificial Intelligence,” 2021. [Online]. Available: unesco.org. Accessed: Mar. 14, 2026.

[22] European Commission, “White paper on artificial intelligence: A European approach to excellence and trust,” COM(2020) 65 final,

2020. [Online]. Available: eur-lex.europa.eu. Accessed: Mar. 14, 2026.

[23] Council of Europe, “Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law,” 2024. [Online]. Available: coe.int. Accessed: Mar. 14, 2026.

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Generative Artificial Intelligence in Digital Communication Ecosystems: Educational, Psychological and Consumer Behavior Perspectives across Emerging Generations

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Abstract—The rapid expansion of generative artificial intelligence is transforming digital communication ecosystems and redefining how information is produced, interpreted and consumed in contemporary media environments. In algorithmically mediated platforms, artificial intelligence increasingly functions as a cognitive and communicational infrastructure that shapes learning processes, media practices and consumer behavior.

This study examines the role of artificial intelligence in convergent media environments through a transdisciplinary framework integrating three analytical perspectives: student experiences in communication, engineering and management education; psychological adaptation to algorithmically curated information environments; and the influence of artificial intelligence on consumer behavior within digital media platforms.

Methodologically, the research combines qualitative exploratory analysis with a systematic meta-analytical review of academic literature indexed in Web of Science and Scopus between 2018 and 2025. The meta-analysis follows the PRISMA protocol and examines studies addressing generative artificial intelligence, digital education, algorithmic communication and AI-driven media consumption.

The results indicate that artificial intelligence performs three interconnected roles within digital communication ecosystems: learning assistant, cognitive mediator and behavioral influencer. The analysis also highlights generational differences in media interaction, emphasizing the digital experiences of Generation Z, Generation Alpha and the emerging Generation Beta.

The study argues that educational systems must integrate artificial intelligence literacy, ethical awareness, and critical media competencies to prepare communication professionals capable of navigating increasingly artificial intelligence-mediated communication environments.

Keywords—Artificial intelligence, Generative Artificial Intelligence, Digital communication ecosystems, Digital education, Consumer behavior, Media literacy

REFERENCES

- [1] T. Gillespie, *Custodians of the Internet*. Yale University Press, 2018.
- [2] J. van Dijck, T. Poell, and M. de Waal, *The Platform Society*. Oxford University Press, 2018.
- [3] A. Dwivedi et al., “So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities and challenges of generative conversational AI,” *International Journal of Information Management*, vol. 71, 2023.

- [4] T. Zawacki-Richter, V. I. Marin, M. Bond, and F. Gouverneur, “Systematic review of research on artificial intelligence applications in higher education – Where are the educators?,” *International Journal of Educational Technology in Higher Education*, vol. 16, no. 39, 2019.
- [5] S. Kasneci et al., “ChatGPT for good? On opportunities and challenges of large language models for education,” *Learning and Individual Differences*, vol. 103, 2023.
- [6] D. T. Willingham, “Why don’t students like school? Ask the cognitive scientist,” *American Educator*, vol. 33, no. 2, pp. 4–13, 2009.
- [7] R. Luckin, W. Holmes, M. Griffiths, and L. Forcier, *Intelligence Unleashed: An Argument for AI in Education*. London: Pearson, 2016.
- [8] B. J. Dietvorst, J. P. Simmons, and C. Massey, “Algorithm aversion: People erroneously avoid algorithms after seeing them err,” *Journal of Experimental Psychology: General*, vol. 144, no. 1, pp. 114–126, 2015.
- [9] M. Logg, J. A. Minson, and D. A. Moore, “Algorithm appreciation: People prefer algorithmic to human judgment,” *Organizational Behavior and Human Decision Processes*, vol. 151, pp. 90–103, 2019.
- [10] S. Puntoni, R. Reczek, M. Giesler, and S. Botti, “Consumers and artificial intelligence: An experiential perspective,” *Journal of Consumer Research*, vol. 48, no. 5, pp. 793–809, 2021.
- [11] L. Floridi, *The Ethics of Artificial Intelligence*. Oxford: Oxford University Press, 2020.
- [12] H. Crompton and D. Burke, “Artificial intelligence in higher education: The state of the field,” *Computers & Education: Artificial Intelligence*, vol. 4, 2023.
- [13] J. Twenge, *iGen*. New York: Atria Books, 2017.
- [14] A. McCrindle and E. Fell, *Generation Beta Report*. McCrindle Research, 2023.
- [15] OECD, *Artificial Intelligence and the Future of Skills*. Paris: OECD Publishing, 2021.
- [16] UNESCO, “Recommendation on the Ethics of Artificial Intelligence,” 2021.
- [17] European Commission, “White Paper on Artificial Intelligence,” 2020.
- [18] Council of Europe, “Framework Convention on Artificial Intelligence,” 2024.
- [19] M. Castells, *The Rise of the Network Society*. Oxford: Wiley-Blackwell, 2010.
- [20] N. Couldry and U. A. Mejias, *The Costs of Connection*. Stanford University Press, 2019.
- [21] H. Jenkins, *Convergence Culture: Where Old and New Media Collide*. New York, NY: NYU Press, 2006.
- [22] M. Deuze, *Media Work*. Cambridge, U.K.: Polity Press, 2020.
- [23] B. Williamson and R. Eynon, “Historical threads, missing links and future directions in AI in education,” *Learning, Media and Technology*, vol. 45, no. 3, pp. 223–235, 2020.
- [24] S. Tlili et al., “What if the devil is my guardian angel? ChatGPT as a case study of using chatbots in education,” *Smart Learning Environments*, vol. 10, 2023.
- [25] Y. Teng, X. Zhou, and H. Al-Samarraie, “Generative artificial intelligence in education: A systematic review,” *Education Sciences*, vol. 14, 2024.

- [26] N. Selwyn, *Education and Technology: Key Issues and Debates*, 3rd ed. London, U.K.: Bloomsbury Academic, 2022.
- [27] D. Kahneman, *Thinking, Fast and Slow*. Farrar, Straus and Giroux, 2011.
- [28] E. Pariser, *The Filter Bubble*. Penguin Press, 2011.
- [29] M. Haenlein and A. Kaplan, "Artificial intelligence and robotics: Shaping the future of marketing," *Business Horizons*, vol. 62, pp. 15–25, 2019.
- [30] S.-M. Bălan, Ed., *The Impact of Digitalization and Artificial Intelligence on the Development of Post-Modern Society*. Cluj-Napoca: Presa Universitară Clujeană, 2025.
- [31] M. Prensky, "Digital natives, digital immigrants," *On the Horizon*, vol. 9, no. 5, pp. 1–6, 2001.
- [32] A. McCrindle, *Generation Alpha*. Sydney: McCrindle Research, 2014.
- [33] T.H. Davenport and J. Ronanki, "Artificial intelligence for the real world," *Harvard Business Review*, vol. 96, no. 1, pp. 108–116, 2018.
- [34] K. Cotter, "Playing the visibility game: How digital influencers and algorithms negotiate influence on Instagram," *New Media & Society*, vol. 21, no. 4, pp. 895–913, Dec. 2018, doi: 10.1177/1461444818815684.
- [35] M. boyd, *It's Complicated: The Social Lives of Networked Teens*. Yale University Press, 2014.
- [36] L. Floridi, *The Fourth Revolution*. Oxford University Press, 2014, vol. 5, no. 1, 2019, doi:10.1177/2056305118816yside
- [37] M. Castells and G. Cardoso, Eds., *The Network Society: From Knowledge to Policy*. Washington, DC, USA: Johns Hopkins Center for Transatlantic Relations, 2005
- [38] S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*. Pearson, 2021.
- [39] N. Selwyn, *Education and technology: Key Issues and Debates*. Bloomsbury Publishing, 2021.
- [40] A. Brynjolfsson and A. McAfee, *The Second Machine Age*. W.W. Norton, 2014.
- [41] S. Zuboff, *The Age of Surveillance Capitalism*. Public Affairs, 2019.

- [42] E. Mollick, *Co-Intelligence: Living and Working with AI*. New York: Portfolio, 2024.

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The transdisciplinary composition of the research team, combining expertise in communication studies, psychology and engineering, allows for a comprehensive analysis of artificial intelligence within contemporary digital communication ecosystems.

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Generative Artificial Intelligence in Mathematics Education: Opportunities, Challenges, and Cognitive Implications

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Abstract

Introduction & Methodology

The rapid expansion of Generative Artificial Intelligence (GenAI) has intensified the debate regarding its role in mathematics education and the extent to which it may supplement or displace traditional instructional functions [4]. This paper reports a systematic literature review, conducted according to PRISMA guidelines [9], analysing peer-reviewed research published between 2023 and 2026. The study examines the educational implications of GenAI, with particular focus on mathematical reasoning, proof, and the evolving pedagogical authority of the teacher [1], [5].

Opportunities and Pedagogical Shifts

The review identifies significant opportunities associated with GenAI, such as personalized feedback, adaptive practice, and automated support for complex mathematical explanations [3], [8]. These tools can assist in lesson preparation and provide worked examples that cater to individual learner needs [1]. However, recent research indicates that these technological capabilities do not in themselves justify the substitution of the human educator [4]. Effective mathematical learning remains strictly contingent upon active cognitive engagement and the robust development of executive functions [6].

Cognitive Implications and Applied Quantitative Fields

Particular attention is given to the cognitive implications of AI-mediated learning, specifically the risk of unreflective cognitive offloading versus the potential for deepening conceptual understanding through metacognitive monitoring [2], [8]. This concern is critically relevant in applied quantitative domains, such as Management and Economics, where mathematical proficiency is foundational not only for procedural calculation but for higher-order modelling and strategic decision-making [7]. In higher education contexts, learners are expected to progress beyond basic competence towards abstraction, rigorous proof, and independent problem-solving [5].

Conclusion

The review concludes that GenAI should be understood as an augmentative technology whose value depends on pedagogical frameworks that prioritize verification, justification, and self-regulated reasoning [2], [8]. While offering substantial support for personalization, excessive reliance on AI may reduce opportunities for students to practice essential analytical skills. Ultimately, the benefits of GenAI in mathematics education remain inseparable from the cultivation of human judgement, rigour, and intellectual responsibility.

Keywords— Generative artificial intelligence, mathematics education, systematic literature review, mathematical reasoning, proof, higher education, cognitive implications, management

REFERENCES

- [1] C. Walkington, "The implications of generative artificial intelligence for mathematics education," *School Science and Mathematics*, vol. 125, no. 1, pp. 45–58, 2025, doi: 10.1111/ssm.18356.
- [2] H. Yoon, J. Hwang, K. Lee, K. H. Roh, and O. N. Kwon, "Students' use of generative artificial intelligence for proving mathematical statements," *ZDM – Mathematics Education*, vol. 56, no. 7, pp. 1531–1551, 2024, doi: 10.1007/s11858-024-01629-0.
- [3] M. Turmuzi, S. Azmi, and N. M. I. Kertiyani, "ChatGPT in school mathematics education: A systematic review of opportunities, challenges, and pedagogical implications," *Teaching and Teacher Education*, vol. 170, Art. no. 105286, Jan. 2026, doi: 10.1016/j.tate.2025.105286.
- [4] C. K. Y. Chan and L. H. Y. Tsi, "Will generative AI replace teachers in higher education? A study of teacher and student perceptions," *Studies in Educational Evaluation*, vol. 83, Art. no. 101395, Dec. 2024, doi: 10.1016/j.stueduc.2024.101395.
- [5] M.-J. Lessing and U. I. Ogbonnaya, "Reasoning and proof in mathematics education: A systematic literature review," *Discover Education*, vol. 5, no. 1, Art. no. 12, 2025, doi: 10.1007/s44117-025-01016-1.
- [6] P. P. M. Tette, C. N. G. Justi, and F. R. dos Reis Justi, "The relationship between executive functions and mathematics: A systematic review with meta-analysis of longitudinal studies," *Psicologia: Reflexão e Crítica*, vol. 39, Art. no. 3, 2026, doi: 10.1186/s41155-025-00362-1.
- [7] OECD, PISA 2022 Assessment and Analytical Framework. Paris, France: OECD Publishing, 2023, doi: 10.1787/dfe0bf9c-en.
- [8] B. Pepin, N. Buchholtz, and U. Salinas-Hernández, "A scoping survey of ChatGPT in mathematics education," *Digital Experiences in Mathematics Education*, vol. 11, no. 1, pp. 9–41, Apr. 2025, doi: 10.1007/s40751-025-00172-1.
- [9] M. J. Page et al., "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," *BMJ*, vol. 372, Art. no. n71, 2021, doi: 10.1136/bmj.n71.

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Green ICT in Business Information Technology Education: A Practice-Based Approach

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Abstract— The rapid expansion of digital technologies has intensified the environmental footprint of the information and communication technology sector, while simultaneously positioning digital solutions as key enablers of sustainable development. This tension creates an urgent need to reconsider how future information technology professionals are educated. The purpose of this paper is to describe and critically reflect on how Green Information and Communication Technology principles are embedded into Business Information Technology education at a university of applied sciences.

The approach is descriptive and practice-based, drawing on curriculum integration experiences and structured student reflection activities conducted within existing courses. Sustainability considerations are integrated into teaching in areas such as software development, systems design and digital services as a natural part of core professional content. Key elements include lifecycle thinking, energy-efficient design choices, system longevity and responsible digital decision-making within authentic, work-life-oriented assignments.

Observations from course implementations indicate that students increasingly recognize the environmental implications of digital solutions and begin to connect sustainability with their emerging professional identity. Integrating sustainability into disciplinary teaching appears to strengthen both technical competence and ethical awareness.

The paper concludes that sustainable education in the digital era does not necessarily require large-scale curriculum reform, but rather a systematic integration of

sustainability into everyday teaching practices. These practice-based experiences provide insights for higher education institutions seeking to align digital education with environmental responsibility and long-term societal needs.

Keywords— Green ICT, sustainable education, higher education, professional competence, curriculum integration, sustainability awareness

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Human-Centered Artificial Intelligence in Accounting and Management Education: A Pedagogical Proposal

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Abstract - The rapid expansion of artificial intelligence (AI) highlights the need to move beyond viewing it solely as a technical tool and instead adopt an approach that places human development at the centre of educational practice. This study proposes the introduction of a new discipline in the Accounting and Administration course at the Porto Institute of Accounting and Administration. The aim is to equip students with practical AI skills while strengthening their interpersonal and emotional skills, ensuring that technological progress does not undermine essential human capabilities.

A key consideration is that the impact of AI is not inherently positive; its educational value depends on how it is implemented. When used without ethical guidance, AI can encourage reliance on shortcuts that bypass meaningful learning, thereby weakening students' self-regulation and critical and reflective thinking. Existing research also indicates that excessive engagement with digital technologies can negatively affect well-being, contributing to stress, social isolation, and unhealthy behaviours associated with prolonged screen exposure. To address these risks, the proposed discipline is organised into two core components: AI in learning and human autonomy, and emotional intelligence.

The proposal is based on pedagogical principles that prioritise teaching quality and recognise ethical literacy as a fundamental characteristic of graduates. The teaching methodology is entirely practical and classroom-based, allowing students to work directly with technological tools while participating in human-centred learning activities. The results suggest that a structured and balanced pedagogical design supports the development of cognitive independence, enabling students to critically analyse the results generated by AI rather than accepting them uncritically.

Keywords - Artificial Intelligence in Education, Accounting and Management, Human-Centered Pedagogy, Cognitive Autonomy; Emotional Competencies

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REFERENCES

- [1] Kamalov, F., Santandreu Calonge, D. e Gurrub, I. (2023) 'New era of artificial intelligence in education: towards a sustainable multifaceted revolution', *Sustainability*, 15(12451).
- [2] Alotabi, N. S. e Alsbehri, A. H. (2023) 'Prosper and obstacles in using artificial intelligence in higher education institutions—the potential of AI-based learning outcomes', *Sustainability*, 15(13), 10723.
- [3] Liz-Domínguez, M., Caeiro-Rodríguez, M., Llamas-Nistal, M. e Mikic-Fonte, F. A. (2019) 'Systematic literature review of predictive analysis tools in higher education', *Applied Sciences*, 9(24), 5569.
- [4] Lo, C. K. (2023) 'What is the impact of ChatGPT on education? A rapid review of the literature', *Education Sciences*, 13(4), 410.
- [5] Klimova, B. e Ibna Seraj, P. M. (2023) 'The use of chatbots in university EFL settings: research trends and pedagogical implications', *Frontiers in Psychology*, 14.
- [6] Noroozi, O., Khalil, M. e Banihashem, S. K. (2025) 'Artificial Intelligence in higher education: Impact depends on support, pedagogy, human agency, and purpose', *Innovations in Education and Teaching International*, 62(5), pp. 1425–1430.
- [7] Afzal, A., Rafiq, S. e Sami, A. (2026) 'Faculty Readiness and Ethical Perceptions of Artificial Intelligence Integration in Higher Education Teaching and Assessment', *Higher Learning Research Communications*, 16(1), pp. 1–19.
- [8] Al-Thani, G. (2024) 'Comparative Analysis of Stakeholder Integration in Education Policy Making: Case Studies of Singapore and Finland', *Societies*, 14(7), 104.
- [9] Arranz-Romero, J., Roig-Vila, R. e Cazorla, M. (2026) 'The Convergence of Artificial Intelligence in Measuring Attention and Emotion in Digital Technology-Enhanced Tertiary Education: A Scoping Review', *Education Sciences*, 16(3), 433.
- [10] Bahri, S., Yanto, M., Baryanto e Asad, M. M. (2025) 'The Problems of Indonesian Education Policy with the Change of Curriculum as an Effort to Improve the Ranking of Education Quality in the World', *Journal of Pedagogy and Education Science*, 4(2), pp. 412–428.
- [11] Carroza-Pacheco, A. M., León-del-Barco, B. e Bringas Molleda, C. (2025) 'Academic Performance and Resilience in Secondary Education Students', *Journal of Intelligence*, 13(5), 56.
- [12] Dahlan, S. A. (2026) 'AI in English Language Learning: Balancing Innovation, Opportunity, and Human Connection', *Indonesian Journal of Pedagogy and Teacher Education*, 4(1), pp. 1–9.
- [13] Hou, S.-I. (2026) 'Enhancing Interactive Teaching for the Next Generation of Nurses: Generative-AI-Assisted Design of a Full-Day Professional Development Workshop', *Informatics*, 13(1), 11.
- [14] Izquierdo-Condoy, J. S., Arias-Intriago, M., Tello-De-la-Torre, A., Busch, F. e Ortiz-Prado, E. (2025) 'Generative Artificial Intelligence in Medical Education: Enhancing Critical Thinking or Undermining Cognitive Autonomy?', *Journal of Medical Internet Research*, 27, e76340.

- [15] Izquierdo-Condoy, J. S., Arias-Intriago, M., Montero Corrales, L. e Ortiz-Prado, E. (2026) 'Artificial Intelligence in Medical Education: Transformative Potential, Current Applications, and Future Implications', *JMIR Medical Education*, 12, e77127.
- [16] Lin, Z., Huang, C. e Shi, J. (2026) 'Promoting Holistic Student Development Through Universal School-Based Social-Emotional Learning in China: A Meta-Analysis', *Behavioral Sciences*, 16(3), 368.
- [17] Manik, M., Sudiarta, I. G. P. e Suparta, I. N. (2026) 'The role of artificial intelligence and multimodal approaches in enhancing learning engagement and mathematics conceptual understanding among junior high school students: a systematic literature review', *EDUMATSAINS: Jurnal Pendidikan Matematika dan Sains*, 10(3), pp. 134–149.
- [18] Rizki, L. M., Natalia, S., Nurafni e Suparman. (2025) 'Scientific Academic Writing Skills Among University Students: Results from a Self-Assessment Survey', *EduMatSains: Jurnal Pendidikan Matematika dan Sains*, 9(2), pp. 43–54.
- [19] Talvio, M. e Vuorinen, J. (2026) 'Enhancing Social and Emotional Learning: Insights from Student Teacher Reflections in the UAE and Finland', *Behavioral Sciences*, 16(1), 88.
- [20] Yang, J. (2026) 'AI Communication Tone and Consumer Judgment: The Role of Servant Perception in Behavioral Intentions', *Behavioral Sciences*, 16(2), 253.
- [21] Kamalov, F., Santandreu Calonge, D. e Gurrib, I. (2023) 'New era of artificial intelligence in education: towards a sustainable multifaceted revolution', *Sustainability*, 15(12451).
- [22] Alotabi, N. S. e Alshehri, A. H. (2023) 'Prospects and obstacles in using artificial intelligence in higher education institutions—the potential of AI-based learning outcomes', *Sustainability*, 15(13), 10723.
- [23] Zhai, C., Wibowo, S. e Li, L. D. (2024) 'The effects of over-reliance on AI dialogue systems on students' cognitive abilities: a systematic review', *Smart Learning Environments*, 11(28).
- [24] Shahzad, M. F. et al. (2024) 'Artificial intelligence and social media on academic performance and mental well-being: student perceptions of positive impact in the age of smart learning', *Heliyon*, 10(6).
- [25] Banihashem, S. K. et al. (2024) 'Feedback sources in essay writing: Peer-generated or AI-generated feedback?', *International Journal of Educational Technology in Higher Education*, 21(1), 23.

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Impulsivity, social media addiction, and academic procrastination in higher education students: a multidimensional analysis and moderation of usage time

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Abstract—Excessive social media use has become a central issue in higher education students' academic lives, raising concerns about its impact on behavioral self-regulation, academic performance, and task postponement. Academic procrastination has been extensively studied in relation to problematic technology use patterns and individual traits like impulsivity. However, the underlying mechanisms of these relationships remain unsettled, particularly due to the involvement of diverse psychological domains. This study aims to analyze the relationships between social media dependence, impulsivity, and academic procrastination among university students, while examining the moderating role of time spent on social media in the link between impulsivity and academic procrastination. A quantitative approach was employed, applying a structured questionnaire to a sample of 235 higher education students. The model was tested at the construct level, allowing us to identify different effects between components of social media dependence and academic procrastination. Validated instruments assessed social media dependence, impulsivity, and academic procrastination. Data analysis used partial least squares structural equation modeling (PLS-SEM) via SmartPLS software, evaluating both the measurement and structural models simultaneously. Findings indicate that social media dependence is linked to higher academic procrastination levels, showing that poor control over these platforms negatively affects academic behavior, suggesting a differentiated pattern between their dimensions. Impulsivity also plays a key role in explaining procrastination, especially its attention dimension as the main predictor of task delay. No direct link was found between impulsivity and social media dependence, so this path was removed from the final model due to poor statistical fit. Time spent on social media acted as a selective moderator, strengthening the relationship between attention impulsivity and academic procrastination. The results advance the literature by clarifying psychological mechanisms connecting problematic social media use and individual traits to academic procrastination. Practically, efforts to reduce procrastination should prioritize building attention control and digital self-regulation skills over strategies solely focused on limiting social media time. These insights are especially relevant in higher education, characterized by high academic autonomy and exposure to highly stimulating digital environments.

Keywords—Social Media, Academic Procrastination, Students, Impulsivity, Social Media Addiction, Structural Equation Modeling

REFERENCES

- [106] P. Steel, "The nature of procrastination: a meta-analytic and theoretical review of quintessential self-regulatory failure," *Psychological Bulletin*, vol. 133, no. 1, pp. 65–94, 2007.
- [107] L. J. Solomon and E. D. Rothblum, "Academic procrastination: frequency and cognitive-behavioral correlates," *Journal of Counseling Psychology*, vol. 31, no. 4, pp. 503–509, 1984.
- [108] P. Steel and K. B. Klingsieck, "Academic procrastination: Psychological antecedents revisited," *Australian Psychologist*, vol. 51, no. 1, pp. 36–46, 2016.
- [109] F. Svartdal, S. Granmo, and F. S. Færevaaag, "On the behavioral side of procrastination: Exploring behavioral delay in real-life settings," *Frontiers in Psychology*, vol. 9, p. 746, 2018.
- [110] M. P. González-Brignardello and Á. Sánchez-Elvira Paniagua, "Dimensional Structure of MAPS-15: Validation of the Multidimensional Academic Procrastination Scale," *International Journal of Environmental Research and Public Health*, vol. 20, no. 4, p. 3201, 2023.
- [111] J. H. Patton, M. S. Stanford, and E. S. Barratt, "Factor structure of the Barratt impulsiveness scale," *Journal of Clinical Psychology*, vol. 51, no. 6, pp. 768–774, 1995.
- [112] S. Chanpen, C. Pornnoppadol, A. Vasupanrajit, and Q. Dejatiwongse Na Ayudhya, "An Assessment of the Validity and Reliability of the Social-Media Addiction Screening Scale (S-MASS)," *Siriraj Medical Journal*, vol. 75, no. 3, pp. 167–180, 2023.
- [113] C. S. Andreassen, T. Torsheim, G. S. Brunborg, and S. Pallesen, "Development of a Facebook addiction scale," *Psychological Reports*, vol. 110, no. 2, pp. 501–517, 2012.
- [114] Y. Sun and Y. Zhang, "A review of theories and models applied in studies of social media addiction and implications for future research," *Addictive Behaviors*, vol. 114, p. 106699, 2021.
- [115] D. J. Kuss and M. D. Griffiths, "Social Networking Sites and Addiction: Ten Lessons Learned," *International Journal of Environmental Research and Public Health*, vol. 14, no. 3, p. 311, 2017.
- [116] S. L. Lian, X. J. Sun, Z. K. Zhou, C. Y. Fan, G. F. Niu, and Q. Q. Liu, "Social networking site addiction and undergraduate students' irrational procrastination: The mediating role of social networking site fatigue and the moderating role of effortful control," *PLoS One*, vol. 13, no. 12, p. e0208162, 2018.
- [117] A. Suárez-Perdomo, Z. Ruiz-Alfonso, and Y. Garcés-Delgado, "Profiles of undergraduates' networks addiction: Difference in academic procrastination and performance," *Computers & Education*, vol. 181, p. 104459, 2022.
- [118] K. C. Nwosu, D. O. Ikwuka, M. U. Onyinyechi, and G. C. Unachukwu, "Does the Association of Social Media Use with Problematic Internet Behaviours Predict Undergraduate Students' Academic Procrastination?," *Canadian Journal of Learning and Technology*, vol. 46, no. 1, 2020.
- [119] L. T. X. Ch'ng and P. Y. S. Hoo, "Relationship between social media addiction levels and academic procrastination among undergraduate students in Malaysia: Grit as the mediator," *Advanced Journal of Social Science*, vol. 11, no. 1, pp. 13–27, 2022.

- [120]D. Rozgonjuk, M. Kattago, and K. Täht, "Social media use in lectures mediates the relationship between procrastination and problematic smartphone use," *Computers in Human Behavior*, vol. 89, pp. 191–198, 2018.
- [121]A. Meier, L. Reinecke, and C. E. Meltzer, "'Facebocrastination'? Predictors of using Facebook for procrastination and its effects on students' well-being," *Computers in Human Behavior*, vol. 64, pp. 65–76, 2016.
- [122]A. Cudo, M. Torój, M. Demczuk, and P. Francuz, "Dysfunction of self-control in Facebook addiction: Impulsivity is the key," *Psychiatric Quarterly*, vol. 91, no. 1, pp. 91–101, 2020.
- [123]K. L. Chung, I. Morshidi, L. C. Yoong, and K. N. Thian, "The role of the dark tetrad and impulsivity in social media addiction: Findings from Malaysia," *Personality and Individual Differences*, vol. 143, pp. 62–67, 2019.
- [124]J. Fowler, M. J. Gullo, and R. A. Elphinston, "Impulsivity traits and Facebook addiction in young people and the potential mediating role of coping styles," *Personality and Individual Differences*, vol. 161, p. 109965, 2020.
- [125]N. Dezhkam, M. R. Zarbakhsh Bahri, and A. Khaneh Keshi, "The effect of impulsivity on addition and addictive tendencies: a meta-analysis," *Journal of Health Reports and Technology*, vol. 8, no. 3, p. e120846, 2022.

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Integrated Management Model for Photovoltaic Projects: Optimizing Control - Financial, Planning and Execution

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Abstract—The management of photovoltaic (PV) projects is characterized by high technical and logistical complexity, coupled with resource volatility. This study addresses the critical fragmentation among planning, execution, and financial control processes, which leads to information silos, administrative burden on project managers, and delayed strategic decisions, ultimately compromising project profitability. The main objective was to develop and propose a conceptual integrated management model for the PV sector, operationalized via a prototype tool in Microsoft Excel, to effectively articulate these three dimensions. A qualitative methodology was employed, centered on a single case study within a sector company.

Data collection involved documentary analysis (10 projects) and direct observation of project managers' work. The critical literature review reveals that while robust project management frameworks (PMBOK, PRINCE2) and control methodologies (Earned Value Management - EVM) are available, their practical application and integration within the specific PV context remain underexplored, indicating a significant research gap.

The proposed model synthesizes and adapts the principles of PMBOK, EVM metrics, and Balanced Scorecard (BSC) perspectives to the sector's specificities. It is concluded that implementing this integrated model, supported by a real-time monitoring tool, significantly enhances performance visibility, deviation anticipation, and decision-making effectiveness, thereby strengthening the economic sustainability of PV companies.

Success will be evaluated through specific KPIs that reflect the effectiveness of the integration. To ensure sustainability and continuous improvement, the following feedback mechanisms will be implemented:

- Quarterly Performance Reviews
- Lessons Learned Reports
- User Satisfaction Surveys
- Technological Evolution

This research contributes an applied conceptual framework and a phased implementation plan, proposing future research lines for the empirical validation of the model in other contexts.

Keywords—Photovoltaic Project Management; Integrated Management; Earned Value Management (EVM); Financial Control






REFERENCES

- [1] Aarseth, W., Rolstadås, A., Andersen, B., & Ahola, T. (2017). Project governance and stakeholder management in complex projects. *International Journal of Project Management*, 35(5), 760–773. <https://doi.org/10.1016/j.ijproman.2017.04.008>
- [2] Ahlemann, F., El Arbi, F., Kaiser, M. G., & Heck, A. (2013). A process framework for enterprise project management: Integrating

- project, program and portfolio management. *Project Management Journal*, 44(5), 21–34. <https://doi.org/10.1002/pmj.21362>
- [3] Almeida, F., & Ferreira, J. J. (2023). *Gestão de projetos em energias renováveis*. Lidel.
- [4] Badewi, A. (2016). The impact of project management (PM) and benefits management (BM) practices on project success: Towards developing a project benefits governance framework. *International Journal of Project Management*, 34(4), 761–778. <https://doi.org/10.1016/j.ijproman.2015.10.010>
- [5] Biesenthal, C., & Wilden, R. (2014). The tension of being a project business: Project management in a multi-project environment. *International Journal of Project Management*, 32(4), 572–583. <https://doi.org/10.1016/j.ijproman.2013.10.007>
- [6] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- [7] Chen, Y.-Q., Zhang, S.-B., & Liu, L.-S. (2018). Research on the integration of project management based on BIM and Earned Value Method. *IOP Conference Series: Earth and Environmental Science*, 153, 062054. <https://doi.org/10.1088/1755-1315/153/6/062054>
- [8] Freeman, R. E., Harrison, J. S., Wicks, A. C., Parmar, B. L., & de Colle, S. (2010). *Stakeholder theory: Concepts and applications*. Cambridge University Press.
- [9] Gajera, K. (2023). Digital transformation in project management: Overcoming data fragmentation.
- [10] García-López, J. (2022). Supply chain risk management in renewable energy projects. *Energy Policy*, 160, 112678. <https://doi.org/10.1016/j.enpol.2021.112678>
- [11] Gürel, E., & Tat, M. (2017). SWOT analysis: A theoretical review. *The Journal of International Social Research*, 10(51), 994–1006.
- [12] IEA. (2022). Renewable energy market update – May 2022: Outlook for 2022 and 2023. International Energy Agency. <https://www.iea.org/reports/renewable-energy-market-update-may-2022>
- [13] IEA. (2023). Renewables 2023: Analysis and forecast to 2028. International Energy Agency. <https://www.iea.org/reports/renewables-2023>
- [14] IRENA. (2021). Renewable power generation costs in 2021. International Renewable Energy Agency. <https://www.irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021>
- [15] Santos, P. M., Teixeira, J. G., & Silva, F. J. (2020). Challenges in the management of photovoltaic energy projects: A systematic review. *Journal of Cleaner Production*, 265, 121743. <https://doi.org/10.1016/j.jclepro.2020.121743>
- [16] Schindler, J., & Hilletoth, P. (2021). Project management in the renewable energy sector: A systematic literature review. *Renewable and Sustainable Energy Reviews*, 135, 110200. <https://doi.org/10.1016/j.rser.2020.110200>
- [17] Silva, M., Fernandes, J., & Pinto, A. (2022). Challenges in photovoltaic project management: A systematic literature review. *Journal of Cleaner Production*, 380(Part 2), 135–148. <https://doi.org/10.1016/j.jclepro.2022.135148>

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Integrating Podcasts in Higher Education Teaching: A Digital Strategy to Promote Active Learning in a Physiotherapy Course

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Abstract—Introduction: Digital learning tools have increasingly been integrated into higher education to support student-centered and active learning approaches. Among these tools, podcasts offer a flexible and accessible way to reinforce course content and promote autonomous learning. **Purpose of the research:** This study aimed to analyze the use of podcasts as a pedagogical strategy to support knowledge revision and consolidation in a first-year Physiotherapy course unit (Research in Physiotherapy I). **Materials and Methods:** Five podcast episodes were developed by the teaching staff throughout the semester. Each episode synthesized the main lecture topics and served as a revision resource before the assessment. After listening to each podcast, students completed a short questionnaire assessing their understanding of the content and their perception of the usefulness of the resource. **Principal results:** The study involved 140 first-year physiotherapy students from two campuses of the same higher education institution. Students reported positive perceptions regarding the use of podcasts as a resource for reviewing key concepts and preparing for assessments. Many participants indicated that the podcasts supported engagement with course content and facilitated the consolidation of methodological concepts addressed during lectures. Additionally, students reported using podcasts as a complementary tool for autonomous study. **Conclusions:** The integration of podcasts into teaching practice appears to be a promising digital strategy for supporting active learning in physiotherapy education. As a complementary resource, podcasts may reinforce theoretical content, support student engagement, and provide a flexible tool for revision, highlighting their potential as an innovative methodological approach in higher education.

Keywords— Podcasts; Active learning; Higher education; Physiotherapy education; Digital pedagogy; Teaching innovation.

REFERENCES

- [126] N. Gardiakos, M. Chau, and E. Arruzza, "The role of podcasts in allied health education: A scoping review on engagement and learning outcomes," *Radiography*, vol. 31, no. 5, p. 103022, Aug. 2025, doi: 10.1016/j.radi.2025.103022.
- [127] D. Baecker, "Introducing audio podcasts into a practical laboratory course for pharmacy students as a novel tool for performance assessment," *Pharmacy*, vol. 11, no. 1, p. 12, Jan. 2023, doi: 10.3390/pharmacy11010012.
- [128] A. Chin, A. Helman, and T. M. Chan, "Podcast use in undergraduate medical education," *Cureus*, vol. 9, no. 12, p. e1930, Dec. 2017, doi: 10.7759/cureus.1930.
- [129] N. Alselaiti, "Enhancing student engagement and learning outcomes through education technologies in medical education," *World Journal of Advanced Research and Reviews*, vol. 19, no. 3, pp. 1356–1367, Sept. 2023, doi: 10.30574/wjarr.2023.19.3.1922.
- [130] A. Vu, S. Diec, E. M. Wang, N. Rosario, S. Davis, T. Guerrero, and J. Wollen, "The impact of podcasts on knowledge, engagement, and empathy outcomes in pharmacy education," *Pharmacy Education*, vol. 25, no. 1, pp. 442–449, 2025, doi: 10.46542/pe.2025.251.442449.

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Integrating Professional Software in Financial Accounting Higher Education: Academic Performance and Student Perceptions

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Abstract—The growing digitalization of the accounting field has made it more important to connect higher education with actual professional practices. This connection is especially crucial through the use of technology in teaching and assessment. Previous research shows the value of experiential learning [1] and the need for changes in accounting education [2]. It highlights the importance of developing practical and tech-related skills. In this context, a teaching model has been used in financial accounting courses for the bachelor’s degree in accounting and administration. This model incorporates professional management software in classroom activities and ongoing assessments. One of the three assessment components requires students to complete tasks using this software. Also, part of the teaching involves hands-on experience with the same tool. This method aims to strengthen the link between theoretical knowledge and practical application. Initial evidence points to better academic performance from students after this model was introduced. Also, earlier studies show that using accounting software helps students learn and is seen positively by students as useful preparation for their careers [3-4](Boulianne, 2014; Stainbank et al., 2023). This study uses a mixed-methods approach. It looks at trends in academic performance and gathers first-year students’ views through a questionnaire, and analyzed the historic results in the financial accounting courses. The focus is on learning outcomes, engagement, and perceived relevance to their future jobs. The findings aim to add to the discussion on innovation in accounting education by providing evidence on the effectiveness of using professional software in teaching and assessment.

Keywords—Accounting education; experiential learning; professional software; continuous assessment; student perceptions

REFERENCES

- Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Prentice-Hall.
- Albrecht, W. S., & Sack, R. J. (2000). *Accounting Education: Charting the Course through a Perilous Future*. American Accounting Association.
- Boulianne, E. (2014). “Impact of accounting software utilization on students’ knowledge acquisition: An important change in accounting education.” *Journal of Accounting & Organizational Change*, 10(1), 22–48.
- Stainbank, L. J., Jankeeparsad, T. R., & Algu, A. (2023). “Using Accounting Software for Teaching and Learning in a Second-Year Accounting Course.” *The African Journal of Information Systems*, 15(1).

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Jigsaw in Higher Education Spanish Teaching: Development of Collaborative Skills in Tourism and Secretariat

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Abstract—The Jigsaw method is a type of cooperative learning technique where each student or group will work on one area of the content, then share their findings with all other classmates [1, 2]. This fosters positive interdependence (students rely on others), individual accountability (each student has ownership over their learning), and joint construction of learning (students learn together) [3, 4].

The purpose of this study is to examine how Jigsaw contributes to the development of twenty-first-century skills in the Spanish language in a higher-education program in the areas of secretariat and tourism [5]. To determine if Jigsaw positively impacted twenty-first-century skills such as communication and collaboration, leadership, conflict resolution, writing in Spanish, and transferable skills to the workplace, the researcher developed a survey that was administered at the end of the second semester.

The research methodology included an exploratory case study design and consisted of forty-eight participants. Two instruments were used to collect the data including a close-ended questionnaire and a semi-structured interview consisting of open-ended questions regarding the students' experiences, challenges encountered, and perceived usefulness for future application. The instructional approach included cooperative work with the Jigsaw model based on task division, individual accountability, and peer knowledge sharing [6, 7].

The results indicated that most of the students had a positive perception of the Jigsaw method, with the most significant strengths being in the collaborative and social-emotional aspects of the strategy. Specifically, the students reported that they found the clarity of task assignment, sense of shared responsibility, ability to resolve conflicts, and the relationship between collaborative work and internship settings/and/or future workplaces as the most positive aspects of the Jigsaw method [8, 9]. However, the perceived increases in writing in Spanish, technical vocabulary, and grammatical accuracy were somewhat lower than those identified by the students for the collaborative/social-emotional skills. The study concludes that the Jigsaw method may be a useful teaching strategy in higher-education programs that include applied languages due to its potential to promote collaboration, adaptability, sense of responsibility, and application of classroom concepts to real-world situations [10]. Nevertheless, additional pedagogical strategies need to be developed to enhance the technical writing skills of students who are instructed using the Jigsaw method.

Keywords—Jigsaw; cooperative learning, Spanish as a Foreign Language, higher education, transversal skills, collaboration, employability.

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REFERENCES

- [1] W.-L. Chang and V. Benson, "Jigsaw teaching method for collaboration on cloud platforms," *Innovations in Education and Teaching International*, vol. 59, no. 1, pp. 24–36, 2022. <https://doi.org/10.1080/14703297.2020.1792332>
- [2] A. Stanczak et al., "Do jigsaw classrooms improve learning outcomes? Five experiments and an internal meta-analysis," *Journal of Educational Psychology*, vol. 114, no. 6, pp. 1461–1476, 2022. <https://doi.org/10.1037/edu0000730>
- [3] M. R. Keramati and R. M. Gillies, "Advantages and challenges of cooperative learning in two different cultures," *Education Sciences*, vol. 12, no. 1, Article 3, 2022. <https://doi.org/10.3390/educsci12010003>
- [4] J. Fernandez-Rio, S. Rivera-Pérez, and D. Iglesias, "Cooperative learning interventions and associated outcomes in future teachers: A systematic review," *Revista de Psicodidáctica (English ed.)*, vol. 27, no. 2, pp. 118–131, 2022. <https://doi.org/10.1016/j.psicoe.2022.04.001>
- [5] S. Chan, S. Maneewan, and R. Koul, "Cooperative learning in teacher education: A means to foster learning motivation and academic engagement among EFL pre-service teachers," *European Journal of Teacher Education*, vol. 47, no. 4, pp. 658–675, 2024. <https://doi.org/10.1080/02619768.2022.2117026>
- [6] Y. Liu, A. Thurston, and X. Ye, "Technology-enhanced cooperative language learning: A systematic review," *International Journal of Educational Research*, vol. 124, Article 102314, 2024. <https://doi.org/10.1016/j.ijer.2024.102314>
- [7] M. Tamimy, N. Rashidi, and J. H. L. Koh, "The use of cooperative learning in English as foreign language classes: The prevalence, fidelity,

and challenges,” *Teaching and Teacher Education*, vol. 121, Article 103915, 2023. <https://doi.org/10.1016/j.tate.2022.103915>

[8] G. Camacho-Minuche, V. Espinoza-Celi, and E. Ulehlova, “Cooperative language learning elements to enhance social skills in English classrooms: A case study,” *Higher Education, Skills and Work-Based Learning*, vol. 11, no. 5, pp. 1116–1129, 2021. <https://doi.org/10.1108/HESWBL-08-2020-0176>

[9] T. Tadesse, H. Ware, A. Asmare, and R. M. Gillies, “Enhancing student engagement and outcomes: The effects of cooperative learning in an Ethiopian university’s classrooms,” *Education Sciences*, vol. 14, no. 9, Article 975, 2024. <https://doi.org/10.3390/educsci14090975>

[10] E. Vives et al., “Learning with jigsaw: A systematic review gathering all the pieces of the puzzle more than 40 years later,” *Review of Educational Research*, vol. 95, no. 3, pp. 339–384, 2025. <https://doi.org/10.3102/00346543241230064>

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Leadership as a Driver of Digital Innovation in Higher Education: A Conceptual Mapping of Emerging Dimensions

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Abstract— Digital Transformation (DT) has reshaped the landscape of higher education, demanding new forms of leadership capable of guiding institutions through technological, pedagogical, and organizational change. This study examines how scientific literature conceptualizes the relationship between leadership and DT within higher education, with a particular focus on how these dynamics influence innovation in teaching, learning, and institutional development.

The research follows a bibliometric review of scientific publications indexed in Scopus between January 2020 and December 2024, applying the PRISMA protocol to ensure transparency and methodological rigor. After screening and eligibility procedures, the selected corpus was analyzed through factorial mapping of co-occurring terms, enabling the identification of conceptual clusters and emerging knowledge structures.

The analysis reveals three interconnected dimensions that shape current understandings of digital innovation in academic contexts. The educational and institutional digital dimension highlights the growing relevance of digital curricula, hybrid learning environments, and the development of digital competencies among educators and future leaders. This dimension underscores how higher education institutions have become laboratories for digital innovation, particularly accelerated by the pandemic context.

The technological and operational dimension reflects the integration of emerging digital technologies, information systems, and innovation processes that support new models of educational delivery. These operational foundations create the conditions under which pedagogical innovation becomes viable.

The strategic and organizational dimension emphasizes the pivotal role of leadership in aligning institutional vision, culture, and sustainability goals with digital transformation initiatives. Leadership emerges not merely as a facilitator of technology adoption, but as a strategic actor shaping value-driven and future-oriented educational models.

Overall, the findings offer a conceptual map that positions leadership as a key driver of digital innovation in higher education, contributing to the design of sustainable, learner-centered, and technologically enhanced educational ecosystems.

Keywords— Digital Transformation, Leadership, Higher Education, Digital Innovation, Bibliometric Analysis, Hybrid Learning, Digital Competencies

REFERENCES

- J. Laufer, A. Leiser, B. Deacon, P. Perrin de Brichambaut, B. Fecher, C. Kobsda, and F. Hesse, "Digital higher education: a divider or bridge builder? Leadership perspectives on edtech in a COVID-19 reality," *International Journal of Educational Technology in Higher Education*, vol. 18, no. 1, p. 51, 2021, doi: 10.1186/s41239-021-00287-6.
- G. Rodríguez-Abitia and G. Bribiesca-Correa, "Assessing digital transformation in universities," *Future Internet*, vol. 13, no. 2, p. 52, 2021, doi: 10.3390/fi13020052.
- S. Bartsch, E. Weber, M. Büttgen, and A. Huber, "Leadership matters in crisis-induced digital transformation: how to lead service employees effectively during the COVID-19 pandemic," *Journal of Service Management*, vol. 32, no. 1, pp. 71–85, 2020, doi: 10.1108/josm-05-2020-0160.
- B. Hinings, T. Gegenhuber, and R. Greenwood, "Digital innovation and transformation: An institutional perspective," *Information and Organization*, vol. 28, no. 1, pp. 52–61, 2018, doi: 10.1016/j.infoandorg.2018.02.004.
- P. C. Verhoef, T. Broekhuizen, Y. Bart, A. Bhattacharya, J. Qi Dong, N. Fabian, and M. Haenlein, "Digital transformation: A multidisciplinary reflection and research agenda," *Journal of Business Research*, vol. 122, pp. 889–901, 2021, doi: 10.1016/j.jbusres.2019.09.022.
- G. Schiuma, E. Schettini, F. Santarsiero, and D. Carlucci, "The transformative leadership compass: six competencies for digital transformation entrepreneurship," *International Journal of Entrepreneurial Behaviour & Research*, vol. 28, no. 5, pp. 1273–1291, 2022, doi: 10.1108/ijeb-01-2021-0087.
- S. L. Zulu and F. Khosrowshahi, "A taxonomy of digital leadership in the construction industry," *Construction Management and Economics*, vol. 39, no. 7, pp. 565–578, 2021, doi: 10.1080/01446193.2021.1930080.
- J. Jameson, N. Romyantseva, M. Cai, M. Markowski, R. Essex, and I. McNay, "A systematic review and framework for digital leadership research maturity in higher education," *Computers and Education Open*, vol. 3, p. 100115, 2022, doi: 10.1016/j.caeo.2022.100115.

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Making STEAM Tangible: The Rural Makerspace Initiative “Technik für Kinder Vulkanland” in Austria

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Abstract—Access to education in science, technology, engineering, arts and mathematics (STEAM) remains unevenly distributed, particularly in rural regions where opportunities for hands-on technical learning are often limited. At the same time, many children and adolescents hold outdated perceptions of technical and craft-related professions, which can influence their educational choices and reduce interest in technical careers. Innovative educational approaches are therefore needed to connect traditional skills, digital technologies and real-world problem solving in ways that make STEAM learning accessible and engaging.

This paper presents the initiative Technik für Kinder Vulkanland, a rural makerspace located in the Styrian region of southeastern Austria. The initiative provides a professionally equipped workshop where children and adolescents aged 7 to 15 can explore technical and craft skills through hands-on activities. The workshop includes multiple workstations with tools and materials as well as access to machines and digital components such as sensors, light-emitting diodes (LEDs) and simple automation elements. By combining traditional craftsmanship with modern technologies, the makerspace creates learning experiences that connect manual skills with contemporary technological developments.

The paper focuses on the conceptual design of the workshop and the educational programs developed for this environment. Activities are structured around project-based and exploratory learning formats that encourage participants to design and build their own objects and prototypes. Programs are designed to gradually introduce technical concepts while maintaining a strong emphasis on creativity, experimentation and collaborative problem solving.

A distinctive feature of the initiative is its intergenerational mentoring approach. Many mentors are experienced craftspeople or technicians who guide participants in developing their projects and share practical insights from their professional backgrounds. This mentoring model connects local knowledge with informal learning and strengthens links between young people, regional industries and technical professions.

By presenting the structure and educational principles of this rural makerspace initiative, the paper aims to illustrate how community-based learning environments can make STEAM education more tangible and accessible. The initiative also seeks to challenge gender stereotypes in technical fields and actively encourages the participation of girls. The concept demonstrates how makerspaces can contribute to sustainable education by linking traditional craftsmanship, digital technologies and future-oriented skills.

Keywords—makerspaces, project-based learning, rural innovation, informal learning environments

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of the mentors, whose engagement constitutes the foundation of the project’s intergenerational learning model.

REFERENCES

- [131] Avendano-Urbe, B.E., Lombana-Bermudez, A., Flórez, L.V., Chaparro, E., Hernandez-Morales, A.C., Archbold, J., et al.: Engaging scientific diasporas in STEAM education: The case of Science Clubs Colombia. *Frontiers in Research Metrics and Analytics* 7, 898167(2022). <https://doi.org/10.3389/frma.2022.898167>
- [132] Blikstein, P.: Digital fabrication and “making” in education: The democratization of invention. In: Walter-Herrmann, J., Büchling, C. (eds.) *FabLabs: Of Machines, Makers and Inventors*, pp. 1–21. Transcript, Bielefeld (2013).
- [133] Blikstein, P., Worsley, M.: Children are not hackers: Building a culture of powerful ideas, deep learning, and equity in the maker movement. In: Pepler, K., Halverson, E., Kafai, Y. (eds.) *Makeology: Makerspaces as Learning Environments*, Vol. 1, pp. 64–79. Routledge, New York (2016).
- [134] Boy, H., Sieben, G.: *Kunst & Kabel: Konstruieren. Programmieren. Selbermachen*. kopaed, München (2017).
- [135] Braun, V., Clarke, V.: Using thematic analysis in psychology. *Qualitative Research in Psychology* 3(2), 77–101 (2006).
- [136] Bunke-Emden, H.: Potenziale von Making-Aktivitäten in informellen Lernumgebungen für die Medienpädagogik. *Medienimpulse* 58(4) (2020). <https://doi.org/10.21243/mi-04-20-11>
- [137] Byun, S., Meece, J.L., Irvin, M.J.: Rural–nonrural disparities in postsecondary educational attainment revisited. *American Educational Research Journal* 49(3), 412–437 (2012). <https://doi.org/10.3102/0002831211416344>
- [138] Cain, E.J., Valauri, A., Perry, J.R., DeLoach, A.: Exploring how rural schools and communities influence the academic journeys of college students in STEM majors. *The Rural Educator* 45(3), 15–33 (2024). <https://doi.org/10.55533/2643-9662.1417>
- [139] Davies, S., Seitamaa-Hakkarainen, P.: Research on K–12 maker education in the early 2020s – a systematic literature review. *International Journal of Technology and Design Education* 35, 763–788 (2025). <https://doi.org/10.1007/s10798-024-09921-6>
- [140] González-González, C.S., Martín-González, R., Mora, A., Toledo-Delgado, P.A., Navarro-Adelantado, V.: Creativity and making in education: The role of makerspaces and digital fabrication. In: Thoring, K., Badke-Schaub, P. (eds.) *Handbook of Research on Using Global Collective Intelligence and Creativity to Solve Wicked Problems*, pp. 143–163. IGI Global (2021).
- [141] Grandl, M., Bunke-Emden, H., Dietsch, D., Ebner, M., Narr, K., Schaffert, A., Schön, S.: *MAKER DAYS for kids*. *Medienpädagogik* 56, 281–313 (2024). <https://doi.org/10.21240/mpaed/56/2024.01.25.X>
- [142] Grissmer, D., Grimm, K.J., Aiyer, S.M., Murrah, W.M., Steele, J.S.: Fine motor skills and early comprehension of the world: Two new

- school readiness indicators. *Developmental Psychology* 46(5), 1008–1017 (2010). DOI: 10.1037/a0020104
- [143] Halverson, E.R., Sheridan, K.M.: The maker movement in education. *Harvard Educational Review* 84(4), 495–504 (2014). <https://doi.org/10.17763/haer.84.4.34j1g68140382063>
- [144] Hill, P.W., McQuillan, J., Hebets, E.A., Spiegel, A.N., Diamond, J.: Informal science experiences among urban and rural youth. *Journal of STEM Outreach* 1(1) (2018).
- [145] Kaplan, M.S.: Intergenerational programs in schools: Considerations of form and function. *International Review of Education* 48(5), 305–334 (2002).
- [146] Lange, B., Bürkner, H.-J.: Flexible value creation: Conceptual prerequisites and empirical explorations in open workshops. *Geoforum* 88, 96–104 (2018).
- [147] Martin, L.: The promise of the maker movement for education. *Journal of Pre-College Engineering Education Research* 5(1), Article 4 (2015).
- [148] Nixon, J., Halverson, E., Stoiber, A.: Exploring making through mobile emergent technologies: Makerspace education in rural communities. WCER Working Paper No. 2021-1. University of Wisconsin-Madison (2021).
- [149] Papert, S.: *Mindstorms: Children, Computers, and Powerful Ideas*. Basic Books, New York (1980).
- [150] Papert, S.: *The Children's Machine: Rethinking School in the Age of the Computer*. Basic Books, New York (1993).
- [151] Quintana-Ordorika, A., Garay-Ruiz, U., Portillo-Berasaluce, J.: A systematic review of the literature on maker education and teacher training. *Education Sciences* 14(12), 1310 (2024).
- [152] Rouse, R., Gillespie Rouse, A.: Taking the maker movement to school: A systematic review of preK–12 school-based makerspace research. *Educational Research Review* 35, 100413 (2022).
- [153] Sandelowski, M.: Whatever happened to qualitative description? *Research in Nursing & Health* 23(4), 334–340 (2000).
- [154] Sheridan, K.M., Halverson, E.R., Litts, B.K., Brahm, L., Jacobs-Priebe, L., Owens, T.: Learning in the making: A comparative case study of three makerspaces. *Harvard Educational Review* 84(4), 505–556 (2014). <https://doi.org/10.17763/haer.84.4.brr34733723j648u>
- [155] Smith, A., Fressoli, M., Thomas, H.: Grassroots innovation movements: Challenges and contributions. *Journal of Cleaner Production* 63, 114–124 (2014).
- [156] Taylor, A., Hurley, P., Connolly, C.: Making community: The wider role of makerspaces in public life. *Geoforum* 70, 117–125 (2016).
- [157] Wang, X., Young, G.W., Iqbal, M.Z., McGuckin, C.: The potential of extended reality in rural education's future – perspectives from rural educators. *Education and Information Technologies* 29, 8987–9011 (2024).
- [158] Wood, D., Bruner, J.S., Ross, G.: The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry* 17(2), 89–100 (1976).

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Mathematical Modelling and Optimisation in Sustainability Education Using the Horton Equation

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Abstract— Understanding and accurately modelling water infiltration in soil is essential for many environmental and agricultural applications, including efficient irrigation management and soil characterisation. One of the classical models used to describe the temporal behaviour of soil infiltration is the Horton equation. Although widely used due to its simplicity and its capacity to represent the infiltration process, some of its parameters are difficult to estimate directly from field observations because they depend on soil properties. Consequently, parameter estimation becomes a key challenge when applying the Horton model to real data.

This work focuses on estimating the parameters of the Horton equation using experimental data and numerical optimisation techniques. The study was developed within the context of a pedagogical activity in which students explored how mathematical modelling and optimisation methods can be combined to calibrate models based on real measurements. The process began with the collection of experimental data describing the infiltration of water into the soil, providing the empirical basis required for model calibration.

After data collection, a mathematical model based on the Horton equation was used to represent the infiltration behaviour over time. As the model contains parameters that cannot be measured directly, the calibration task was formulated as a nonlinear optimisation problem. The objective was to determine the parameter values that minimise the discrepancy between the model predictions and the observed experimental data. To achieve this, different numerical optimisation methods were implemented and analysed, allowing their performance in estimating the parameters to be compared.

The results enabled students to identify the set of parameters that provides the best fit between the Horton model and the experimental data. Furthermore, comparing the different optimisation methods made it possible to evaluate their performance.

Beyond the mathematical results, this work highlights the value of interdisciplinary approaches in education. The activity integrates concepts from mathematics, computing, hydrology, and environmental sciences, helping students understand how quantitative tools can be applied to real-world problems related to sustainable water management. The activity supports education for sustainability by encouraging critical thinking about the responsible use of natural resources and the role of mathematics in addressing current environmental challenges.

Keywords—Optimization, Infiltration, Horton Equation, Interdisciplinarity, Sustainable Education

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REFERENCES

- [1] K. Maass, V. Geiger, M. R. Ariza, et al., “The role of mathematics in interdisciplinary STEM education,” *ZDM—Mathematics Education*, vol. 51, pp. 869–884, 2019. doi: 10.1007/s11858-019-01100-5.
- [2] OECD, *An Evolution of Mathematics Curriculum: Where It Was, Where It Stands and Where It Is Going*. Paris: OECD Publishing, 2024. doi: 10.1787/0ffd89d0-en.
- [3] T. Saad, “Applying mathematical models in water management and irrigation projects,” *International Journal of IT, Engineering and Applied Sciences Research*, vol. 6, no. 12, 2017.
- [4] J. Sarkkula, M. Keskinen, J. Koponen, M. Kumm, J. Nikula, V. Olli, and M. Virtanen, “Mathematical modelling in integrated management of water resources: Magical tool, mathematical toy or something in between?,” in *Democratizing Water Governance in the Mekong Region*, L. Lebel, J. Dore, D. Rajesh, and Y. Koma, Eds. Mekong Press, 2007, pp. 127–156.
- [5] V. Tomašić and B. Zelić, *Environmental Engineering: Basic Principles*. Berlin: De Gruyter, 2018. doi: 10.1515/9783110468038.
- [6] B. Tóth, O. Guerrero-Bustamante, M. Murillo, J. Duque, and R. Polo-Mendoza, “Development of mathematical and computational models for predicting agricultural soil–water management properties (ASWMPs) to optimize intelligent irrigation systems and enhance crop resilience,” *Agronomy*, vol. 15, no. 4, p. 942, 2025. doi: 10.3390/agronomy15040942.
- [7] K. Beven, “Robert E. Horton’s perceptual model of infiltration processes,” *Hydrological Processes*, vol. 18, no. 17, pp. 3447–3460, 2004.
- [8] J. Nocedal and S. J. Wright, *Numerical Optimization*, 2nd ed. New York: Springer, 2006.
- [9] R. Fletcher, *Practical Methods of Optimization*, 2nd ed. Chichester, U.K.: Wiley, 1987.
- [10] S. Boyd and L. Vandenberghe, *Convex Optimization*. Cambridge, U.K.: Cambridge University Press, 2004.
- [11] J. E. Dennis Jr. and R. B. Schnabel, *Numerical Methods for Unconstrained Optimization and Nonlinear Equations*. Philadelphia, PA: SIAM, 1996.

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Negotiating Concepts and Terms with the Machine: AI, Translation Technologies, and the Learning of Portuguese as a Global Language

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Abstract— This presentation examines the case of Erasmus students at ISCAP enrolled in Portuguese as a Foreign Language (PFL) courses (levels A1 and A2), focusing on the experimental integration of artificial intelligence (AI) and machine translation (MT) within a language learning framework. Grounded in principles from terminology studies—particularly the relationship between terms, concepts, and knowledge organization—the study explores how learners engage with domain-specific vocabulary and conceptual structures through technologically mediated environments. Drawing on data collected through classroom observation, student presentations, and qualitative analysis, the research investigates how AI and MT tools influence the development of terminological competence, understood as the ability to identify, interpret, and appropriately use terms within specific conceptual systems. Special attention is given to processes of term variation, conceptual negotiation, and the representation of knowledge across languages. The study addresses two central questions: how does the integration of AI and MT reshape learners’ access to and construction of conceptual knowledge in a semi-guided learning context, and how do these tools contribute to students’ understanding of Portuguese as a global language embedded in diverse communicative and cultural domains? Findings suggest that while AI and MT facilitate access to language resources and support the recognition of conceptual relations, they also introduce challenges related to ambiguity, inconsistency, and decontextualized term usage. These limitations highlight the crucial role of human mediation—particularly that of educators—in guiding learners through processes of conceptual clarification, validation, and contextualization. The study ultimately argues for a concept-oriented approach to the integration of emerging technologies in language education, emphasizing that effective learning depends not only on access to linguistic data, but on the structured understanding of the conceptual systems they represent. In this context, terminology serves as a critical interface between language, knowledge, and technology, reinforcing the enduring relevance of human expertise in AI-enhanced learning environments.

Keywords— Portuguese as a Foreign Language; Machine Translation; Terminology; Concept; Term

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Pecha Kucha in Higher Education Spanish Teaching: Oral Communication and Professional Skills in Secretariat and Tourism

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Abstract— The concept of Pecha Kucha has its roots in Japan as a presentation technique in which speakers use twenty images to illustrate their ideas, with only twenty seconds allocated to each slide [1]. Therefore, it is a method for the rapid dissemination of ideas and promotes effective communication and audience participation through the integration of visual and audio elements at a fixed rate [2, 3].

Moreover, the Pecha Kucha methodology lends itself well to developing students' ability to communicate effectively in spoken Spanish within higher education programmes in the areas of Secretariat and Tourism [4]. The aim of this study was to examine whether students perceived Pecha Kucha as a valuable tool for improving their spoken communication skills in Spanish, including their ability to synthesize information, select appropriate visual support, manage time and apply the knowledge gained to real-world professional contexts [5].

This study adopted a single exploratory case study design with a sample of forty-eight (48) students. Data were collected after the second semester through two instruments: a closed-item survey used to gather quantitative data and semi-structured interviews with open-ended questions designed to explore learning experiences, perceived difficulties and possible future applications of the Pecha Kucha method.

Students were required to prepare and deliver short oral presentations in Spanish using the 20 × 20 format. This structure enabled them to practise concise communication, integrate visual and auditory elements into their presentations and maintain a consistent pace of speech while presenting [6, 7].

Overall, the results indicated a very positive perception among students regarding the capacity of Pecha Kucha to improve their spoken Spanish skills. Students also reported improvements in their ability to synthesize information, respect the presentation time limits, organize visual aids effectively and demonstrate critical thinking during their presentations [8, 9].

Many participants also recognised the applicability of the Pecha Kucha method to their future careers in Secretariat and Tourism, identifying workplace situations such as meetings and communication with different audiences. However, some students reported difficulties in maintaining continuous speech and expressed concerns about their self-confidence when speaking publicly.

The findings suggest that Pecha Kucha represents a distinctive and multidimensional approach to teaching and learning that can support the development of communication,

conciseness and employability skills in higher education programmes focused on applied language studies [10].

Keywords— Pecha Kucha, Spanish as a Foreign Language, oral communication, higher education, Secretariat and Tourism, multimodal presentation, employability skills.

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REFERENCES

- [1] V. Beltrán-Palanques and M. Querol-Julián, "The genre of PechaKucha presentations: Analysis and implications for enhancing multimodal literacy at university," *English for Specific Purposes*, vol. 75, pp. 102–118, 2024. <https://doi.org/10.1016/j.esp.2024.05.002>
- [2] W.-C. Chen, "Verbal-visual skill-building and perceptual changes in English presentation," *English for Specific Purposes*, vol. 77, pp. 71–85, 2025. <https://doi.org/10.1016/j.esp.2024.10.002>
- [3] R. Gray, "Multimodality in the classroom presentation genre: Findings from a study of Turkish psychology undergraduate talks," *System*, vol. 99, Article 102522, 2021. <https://doi.org/10.1016/j.system.2021.102522>
- [4] Z. Stephenson, N. Johnson-Glauch, and S. Cruchley, "Interventions and facilitators of oral assessment performance in higher education: A systematic review," *Assessment & Evaluation in Higher Education*, vol. 50, no. 7, pp. 1140–1153, 2025. <https://doi.org/10.1080/02602938.2025.2504621>
- [5] S. Yin, J. Fan, Y. Jin, and P. Stapleton, "Towards a framework of critical thinking for assessing EAP speaking," *Journal of English for Academic Purposes*, vol. 71, Article 101426, 2024. <https://doi.org/10.1016/j.jeap.2024.101426>

[6] A. M. Ducasse and A. Brown, "Rhetorical relations in university students' presentations," *Journal of English for Academic Purposes*, vol. 63, Article 101251, 2023. <https://doi.org/10.1016/j.jeap.2023.101251>

[7] L. Palmour, "Assessing oral presentations: An analysis of score-reaching dialogue between EAP practitioners," *Journal of English for Academic Purposes*, vol. 62, Article 101210, 2023. <https://doi.org/10.1016/j.jeap.2022.101210>

[8] M. A. Joseph and J. Natarajan, "A comparison of students' satisfaction, performance, and preferences regarding PowerPoint and PechaKucha presentations: A quasi-experimental study," *Nurse Education Today*, vol. 116, Article 105425, 2022. <https://doi.org/10.1016/j.nedt.2022.105425>

[9] S. J. Haramba, W. C. Millanzi, and S. A. Seif, "Effects of Pecha Kucha presentation pedagogy on nursing students' presentation skills: A quasi-experimental study in Tanzania," *BMC Medical Education*, vol. 24, Article 952, 2024. <https://doi.org/10.1186/s12909-024-05920-2>

[10] S. J. Haramba, W. C. Millanzi, and S. A. Seif, "Enhancing nursing student presentation competences using Facilitatory Pecha Kucha presentation pedagogy: A quasi-experimental study protocol in Tanzania," *BMC Medical Education*, vol. 23, Article 628, 2023. <https://doi.org/10.1186/s12909-023-04628-z>

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Positioning the Open Educational Smart Campus (OESC): A comparative analysis of open educational platforms

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Abstract Open education has emerged as a key approach to promoting learning opportunities and supporting lifelong learning for all [1,2]. In line with global policy agendas, such as Sustainable Development Goal 4 (quality education), the open availability of educational resources has become increasingly important [3]. However, effective implementation depends not only on the availability of Open Educational Resources (OER) but also on digital platforms capable of organizing, curating, and delivering them [4]. Within this context, this study presents a comparative analysis of open educational platforms, with the dual aim of positioning the Open Educational Smart Campus (OESC) [5] within the current landscape of digital open education and informing its future redesign. The OESC is an open digital space accessible to the wider community, where OERs are available and can be annotated by users, reinforcing collaborative knowledge practices. These OERs are shared respecting the FAIR principles: findability, accessibility, interoperability, and reusability. OESC also features an e-learning space, supporting the development of accessible courses for diverse audiences and fostering the sustainability of educational research and pedagogical practices [6]. The analysis is grounded in the Cape Town Open Education Declaration principles [7], which conceive open education as extending beyond OER to encompass open technologies that facilitate collaborative and flexible learning, the open sharing of teaching practices, and new approaches to assessment, accreditation, and collaborative learning. Platforms were selected based on the following criteria: i) online open access availability; ii) provision of OER, preferably under open licenses; and iii) support for user collaboration, such as comments, feedback, or co-authorship. Where present, the integration of artificial intelligence features was also considered. The resulting sample comprises six platforms, a deliberately small sample suited to a qualitative comparative design, enabling a more in-depth examination of each platform's characteristics and functionalities, rather than statistical generalisation. The outcome of this study is the development of a comparative analysis framework for educational platforms, intended both to analyse existing platforms and to guide the design of digital environments aligned with open education principles. Furthermore, the study examines the potentialities and constraints of the OESC, positioning it within the broader ecosystem of open educational platforms and informing the platform's future redesign, supporting improvement of its features and capacity to foster open education practices, potentially enhanced through the integration of AI-driven functionalities.

Keywords
open education, OER, comparative study, artificial intelligence

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REFERENCES

- [1] Wiley, D., & Hilton III, J. L. (2018). Defining OER-Enabled Pedagogy. *The International Review of Research in Open and Distributed Learning*, 19(4). <https://doi.org/10.19173/irrodl.v19i4.3601>
- [2] Hodgkinson-Williams, C. A., & Trotter, H. (2018). A Social Justice Framework for Understanding Open Educational Resources and Practices in the Global South. *Journal of Learning for Development*, 5(3). <https://doi.org/10.56059/jl4d.v5i3.312>
- [3] McGreal, R. (2017). Special Report on the Role of Open Educational Resources in Supporting the Sustainable Development Goal 4: Quality Education Challenges and Opportunities. *The International Review of Research in Open and Distributed Learning*, 18(7). <https://doi.org/10.19173/irrodl.v18i7.3541>
- [4] UNESCO. (2019). Recommendation on open educational resources (OER). <https://www.unesco.org/en/legal-affairs/recommendation-open-educational-resources-oer>
- [5] Universidade de Aveiro. (2026.). Open Educational Smart Campus (OESC). <https://www.ua.pt/pt/oesc>
- [6] Batista, B., & Marques, M. M. (2025). Users' perceptions about the Open Educational Smart Campus (OESC) in a higher education institution. *INTED2025 Proceedings*, 6628-6633.
- [7] Cape Town Open Education Declaration. (2017). Cape Town Open Education Declaration 10th anniversary: Ten directions to move open education forward. <https://www.capetowndeclaration.org/wp-content/uploads/cpt10-booklet.pdf>



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Project-Based Innovation Education Through University-Industry Collaboration: A Course Design and Learning Outcomes Analysis

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Abstract— This study examines a student-centered innovation course implemented through collaboration between Aydın Adnan Menderes University (Faculty of Economics and Administrative Sciences, Nazilli), the University's Project and R&D Coordination Office, and the Nazilli Chamber of Commerce. The course, titled *UTIF303 Innovation Management*, has been conducted for three consecutive years and integrates theoretical instruction with applied project-based learning. The main purpose of this research is to analyze the instructional design, implementation process, and learning outcomes of the course and to evaluate its contribution to students' innovation competencies within the framework of sustainable education.

The study adopts a mixed-method case study design. Empirical data were collected through rubric-based project evaluations and learning outcome assessments. Quantitative data consist of scores assigned to project reports, posters, prototypes, and oral presentations using standardized evaluation rubrics. Qualitative data were obtained through instructor observations and process-based evaluation of student performance. Following theoretical instruction, students develop innovation projects under faculty supervision. Each project produces three outputs: a written project report, a project poster, and a prototype. Projects that pass preliminary evaluation are presented at a public "Project Market" event attended by local administrators, business representatives, academics, media, and community members. The most recent implementation, held on January 20, 2026, included 45 student projects, of which 13 received awards. The findings suggest that integrating project-based learning with university-industry collaboration provides an effective model for sustainable innovation education.

Keywords— Innovation education, project-based learning, university-industry collaboration, student-centered learning, higher education

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Promoting Mathematics Learning Through an Interdisciplinary STEAM Approach

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Abstract - Contemporary scientific and technological developments demand a paradigm shift in education, calling for methodologies that prepare students with the skills necessary to face the challenges of a globalized society. This research examines how an interdisciplinary approach grounded in the STEAM model (Science, Technology, Engineering, Arts, and Mathematics) can enhance the learning of Mathematics in the third cycle of basic education. The study sought to position Mathematics as a structural axis within a practical and contextualized framework, responding to students' frequent questioning about the real-world usefulness of abstract mathematical concepts. Additionally, the project aimed to promote collaborative work, strengthen spatial reasoning and computational thinking, and foster creativity through the integration of multiple disciplinary areas.

The methodology followed a case-study design involving two seventh-grade classes. The project, entitled "*From Geometry to Poetry: a journey of Art, Sound, and Mathematics in the creation of 3D Birdhouses*," integrated Mathematics, Information and Communication Technologies, Portuguese, Music, and Visual Arts. In Mathematics, students used dynamic geometry software to plan geometric figures and calculate areas and angles. In Information and Communication Technologies, they transferred these plans to 3D modeling tools for subsequent printing. Parallel activities included creative writing, digital sound manipulation, and the construction of an artistic exhibition tree. Assessment was formative, supported by specific rubrics and continuous feedback addressing both the creative process and the final technical product.

The results show a clear increase in student motivation and engagement, with learners recognizing the role of Mathematics in practical and creative contexts. Although most students demonstrated competence in digital modeling tools, some difficulties emerged in the manual application of area formulas, highlighting the need to teach students to analytically validate software-generated results. For teachers, the experience represented a positive step toward pedagogical innovation, though logistical challenges—such as the lack of aligned schedules for collaborative planning—were identified.

In conclusion, the integrated STEAM approach proved effective in fostering meaningful learning and developing essential social and interpersonal skills for the twenty-first century, aligning with students' interests and deepening their understanding of Mathematics.

Keywords - Interdisciplinary Learning, Mathematics Teaching, Pedagogical Innovation, STEAM Education.

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<https://doi.org/10.54499/UID/PRR/04106/2025>

REFERENCES

- [159] G. Yakman, "STEAM education: An overview of creating a model of integrative education," in *Proc. Pupils' Attitudes Towards Technology (PATT-19) Conf.*, Salt Lake City, UT, 2008.
- [160] J. Bazler and M. L. Van Sickle, *Cases on STEAM education in practice*. IGI Global, 2017. doi: 10.4018/978-1-5225-2334-5.
- [161] Portugal. Ministério da Educação, "Despacho n.º 6478/2017, de 26 de julho — Perfil dos alunos à saída da escolaridade obrigatória," *Diário da República*, 2.ª série, n.º 129, 2017. [Online]. Available: https://www.dge.mec.pt/sites/default/files/Curriculo/Projeto_Autonomia_e_Flexibilidade/perfil_dos_alunos.pdf
- [162] Direção-Geral da Educação, "Aprendizagens essenciais do 7.º ano de escolaridade – Matemática," Ministério da Educação, 2025. [Online]. Available: <https://www.dge.mec.pt/noticias/aprendizagens-essenciais-de-matematica>
- [163] C. Kivunja, "Do you want your students to be job-ready with 21st century skills? Change pedagogies: A paradigm shift from Vygotskian social constructivism to critical thinking, problem solving and Siemens' digital connectivism," *International Journal of Higher Education*, vol. 3, no. 3, pp. 81–91, 2014. doi: 10.5430/ijhe.v3n3p81.
- [164] C. Quigley, D. Herro, C. Shekell, H. Cian, and L. Jacques, "Connected learning in STEAM classrooms: Opportunities for engaging youth in science and math classrooms," *International Journal of Science and Mathematics Education*, vol. 18, pp. 1441–1463, 2020. doi: 10.1007/s10763-019-10034-z.
- [165] D. Aguilera and J. Ortiz-Revilla, "STEM vs. STEAM education and student creativity: A systematic literature review," *Education Sciences*, vol. 11, no. 7, p. 331, 2021. doi: 10.3390/educsci11070331.
- [166] M. Aslam, A. K. H. Alghamdi, A. A. Abid, and T. Kumar, "Integrating STEM in mathematics education: Impact on learning outcomes," *Education Research International*, vol. 2023, pp. 1–10, 2023. doi: 10.1155/2023/112233.
- [167] H. A. Eshaq, "The effect of using STEM education on students' mathematics achievement," *Journal of Pedagogical Research*, vol. 8, no. 1, pp. 75–82, 2024. doi: 10.33902/JPR.202423476.

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Scaffold or shortcut? Integrating AI into the English Language Classroom

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Abstract—As Artificial Intelligence (AI) tools and agents become ubiquitous in all aspects of our personal and professional lives, this inevitably brings about profound changes in teaching methodologies and student assessment in Higher Education Institutions (HEI), impacting learning workflows. In this context, banning Large Language Models (LLM) such as ChatGPT, Gemini and Claude, is both impractical and counterproductive, potentially leaving students underprepared for a technologically mediated world. This challenge is particularly clear in language education, where Large Language Models (LLM) directly engage with the core object of study – language itself. Therefore, it is paramount we explore how AI can be meaningfully integrated into language learning environments while promoting ethical awareness, cognitive engagement, as well as effective learning outcomes. In this survey-based study, English language learners from two different bachelor's programs at ISCAP - International Trade and Administrative Assistance and Translation - are presented with two argumentative writing tasks on course-related topics: one completed using ChatGPT support and another without it. Following task completion, participants fill out a survey and provide structured feedback on their experiences, perceived learning outcomes, ethical considerations, and levels of motivation. To examine the relationship between student perceptions and actual performance, survey results are measured against the quality of the writing assessed through double marking in line with specific criteria: task achievement; organization and coherence; language use; critical thinking; originality. The findings aim to contribute to ongoing debates on the role of AI in higher education, particularly in language learning contexts, by informing more balanced and effective integration strategies.

Keywords—Artificial intelligence, second language learning, digital assessment; teaching methodologies

REFERENCES



- Divekar, R., Drozdal, J., Chabot, S., Zhou, Y., Su, H., Chen, Y., Zhu, H., Hendler, J., & Braasch, J. (2021). Foreign language acquisition via artificial intelligence and extended reality: design and evaluation. *Computer Assisted Language Learning*, 35, 2332 - 2360. <https://doi.org/10.1080/09588221.2021.1879162>.
- AlTwijri, L., & Alghizzi, T. (2024). Investigating the integration of artificial intelligence in English as foreign language classes for enhancing learners' affective factors: A systematic review. *Heliyon*, 10. <https://doi.org/10.1016/j.heliyon.2024.e31053>.
- Poláková, P., & Klimova, B. (2024). Implementation of AI-driven technology into education – a pilot study on the use of chatbots in foreign language learning. *Cogent Education*, 11. <https://doi.org/10.1080/2331186x.2024.2355385>.

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Servant Leadership and Quality Culture in Higher Education Institutions

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Abstract— Contemporary higher education institutions operate in an environment shaped by internationalisation, increased accountability, stakeholder expectations, and continuous quality enhancement requirements. In such a context, leadership approaches that foster trust, participation, and shared responsibility are becoming increasingly important. This paper examines the potential of servant leadership as a framework for strengthening quality culture in higher education institutions.

The purpose of this conceptual study is to analyse how leadership practices oriented toward service, empowerment, ethical responsibility, and stakeholder engagement can contribute to the development of a sustainable quality culture. The study is based on a structured review and synthesis of literature in the fields of servant leadership, academic leadership, and quality management in higher education. Through conceptual analysis, the paper develops an integrative framework linking servant leadership principles with core dimensions of quality culture, including shared values, collaborative governance, continuous improvement, and institutional learning.

The findings suggest that servant leadership can create conditions conducive to the development of participatory and trust-based academic environments in which faculty members, administrative staff, students, and external stakeholders actively contribute to quality enhancement processes. By aligning leadership practices with institutional mission and collective values, servant leadership may strengthen institutional coherence, academic autonomy, and long-term organisational effectiveness. The paper concludes that servant leadership represents a relevant and promising approach for higher education institutions seeking to embed quality as a shared organisational culture..

Keywords—Servant Leadership; Quality Culture; Higher Education Institutions; Stakeholder Engagement; Academic Leadership

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Simulation-Based Learning in Accounting Education: Developing Professional Competencies in an AI-Conscious Pedagogical Framework

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Abstract— This paper outlines the pedagogical model that shapes the Business Simulation Project (BSP) I and II, two integrative course units delivered in the third year of the Bachelor's Degree in Accounting and Administration at Porto Accounting and Business School. Designed to bridge academic learning with the practical demands of the labour market, these units place students at the centre of a fully simulated business environment, fostering the acquisition of technical, ethical, and professional competencies required in contemporary accounting practice. Grounded in Problem-Based Learning and practice-driven simulation, the BSP units rely on laboratory settings where students manage a virtual company throughout its complete operational cycle. Using Enterprise Resource Planning software, electronic banking tools, and tax authority simulators, students perform tasks that mirror real organisational processes, including legal incorporation, initial accounting records, inventory and capital management, payroll processing, more complex financial operations, and full compliance with tax obligations. Through these activities, learners gain increasing autonomy in preparing financial statements, producing management reports, and meeting statutory deadlines, capabilities that reinforce their readiness for professional practice and for the Certified Accountants Association admission. The role of Artificial Intelligence (AI) within these course units. Although the ERP system employed already incorporates automated and semi-automated functionalities, the introduction of AI-powered tools into the learning process has been intentionally postponed. This decision reflects a pedagogical commitment to safeguarding the development of core technical and transversal competencies, particularly critical reasoning, professional judgement, and analytical decision-making. While AI has the capacity to streamline tasks traditionally performed by accountants, its premature integration risks diminishing students' engagement with foundational accounting processes that these units are designed to strengthen. As such, the incorporation of AI is being carefully assessed to ensure alignment with the intended learning outcomes and the broader professional expectations of the accounting field. Overall, the immersive pedagogical approach adopted in these courses cultivates a holistic understanding of business management and promotes the integration of knowledge across functional domains. By combining simulation, active learning, and professional authenticity, these courses ensure that future accountants graduate with the technical proficiency, technological adaptability, and ethical awareness required in a rapidly evolving professional landscape.

Keywords— Business Simulation; Accounting Education; Problem-Based Learning; Critical Reasoning; Artificial Intelligence in Education; Experiential Learning

REFERENCES

- [1] Barbosa, N. M., Maruyama, V. S. T., Vilefort, W., & Nasu, V. H. (2025). Artificial Intelligence (AI) in Accounting Education: A Scientometric Assessment. *Journal of Information Systems and Technology Management*, 22. <https://doi.org/10.4301/S1807-1775202522014>
- [2] Zhou, A., & Luo, Y. (2025). Exploring the impact of generative AI on student learning in accounting. *Journal of Accounting Education*, 72, 100982. <https://doi.org/10.1016/j.jaccedu.2025.100982>
- [3] Hsu, C.-Y., & Wu, T.-T. (2023). Application of Business Simulation Games in Flipped Classrooms to Facilitate Student Engagement and Higher-Order Thinking Skills for Sustainable Learning Practices. *Sustainability*, 15(24), 16867. <https://doi.org/10.3390/su152416867>
- [4] Huang, Y.-M., Silitonga, L.M. and Wu, T.-T. (2022) Applying a Business Simulation Game in a Flipped Classroom to Enhance Engagement, Learning Achievement, and Higher-Order Thinking Skills. *Computers & Education*, 183, 104494. <https://doi.org/10.1016/j.compedu.2022.104494>
- [5] Ciudad Gómez, A. (2024). Flipped classroom in financial accounting: analysis of student perception. *Journal of Management and Business Education*, 7(1), 37–53. <https://doi.org/10.35564/jmbe.2024.0003>
- [6] Zakaria, M., Maat, S. and Khalid, F. (2019) A Systematic Review of Problem Based Learning in Education. *Creative Education*, 10, 2671-2688. <https://doi.org/10.4236/ce.2019.1012194>
- [7] Muhammad Fadhly Rizky Octavio and Falikhatur. (2024). New learning method with ERP business simulation game: What can we learn? User perception. *Journal of Contemporary Accounting*, 6(2), 69-82. <https://doi.org/10.20885/jca.vol6.iss2.art1>
- [8] Arity, V., Vesty, G., Moloney, B. (2023). *Digitized Simulation and Gamified Pedagogy in a First Year Accounting Core Subject*. In: Rana, T., Svanberg, J., Öhman, P., Lowe, A. (eds) *Handbook of Big Data and Analytics in Accounting and Auditing*. Springer, Singapore. https://doi.org/10.1007/978-981-19-4460-4_16

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Social emotional skills and gender stereotypes

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Abstract— Social and emotional competencies are a fundamental aspect of human development and an increasingly recognised factor in contemporary educational processes. These competencies significantly contribute to academic success, psychological well-being, social participation and the capacity to navigate an ever-changing job market. Their dynamic and malleable nature also makes them particularly responsive to educational interventions, especially in the early stages of schooling.

In this context, an analysis of the social-emotional skills of students around the age of eleven, inspired by the Big Five theoretical model and the OECD-SSES framework, examined nine dimensions: curiosity, creativity, persistence, responsibility, sociability, assertiveness, empathy, resilience to stress, and optimism. These competencies were measured alongside information on students' cognitive abilities and socioeconomic backgrounds to better understand the relationships among personal development, family context, and educational outcomes.

The results revealed notable differences related to gender, region, and socioeconomic status. On average, girls demonstrate higher levels of responsibility and empathy, whereas boys tend to score higher in assertiveness, sociability, and stress resilience. Analysis of gender stereotypes also indicates that such representations are present and established by the age of eleven, with a higher prevalence among boys. This is particularly relevant as it can influence perceptions of social roles and guide future educational choices.

From a regional perspective, a distinctive pattern emerges: while Southern Italy traditionally records weaker cognitive learning outcomes, it shows higher average levels of certain socio-emotional skills. This 'reversed geography' suggests the presence of socio-emotional capital that does not always align with traditional maps of educational inequalities.

Keywords — social-emotional skills; gender stereotypes; gender differences; regional inequalities; social-emotional development.

REFERENCES

- [1] Bian, L., Leslie, S. J., & Cimpian, A. (2018). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science*, 355(6323), 389–391. <https://doi.org/10.1126/science.aah6524>
- [2] Breda, T., & Napp, C. (2019). Girls' comparative advantage in reading can largely explain the gender gap in math-related fields. *Proceedings of the National Academy of Sciences*, 116(31), 15435–15440. <https://doi.org/10.1073/pnas.1905779116>
- [3] Cadinu, M., Maass, A., Rosabianca, A., & Kiesner, J. (2005). Why do women underperform under stereotype threat? Evidence for the role of negative thinking. *Psychological Science*, 16(7), 572–578. <https://doi.org/10.1111/j.0956-7976.2005.01577.x>
- [4] Carvalho Silva, R., Vezzoli, M., Menesello, V., Meattini, M., Sartori, R., & Minelli, A. (2024). Everything changes but nothing changes: Gender stereotypes in the Italian population. *Archives of Women's Mental Health*, 27, 537–545. <https://doi.org/10.1007/s00737-024-01437-1>
- [5] Csizér, K., & Albert, Á. (2024). Gender-related differences in the effects of motivation, self-efficacy, and emotions on autonomous use of technology in second language learning. *Asia-Pacific Education Researcher*, 33, 819–828. <https://doi.org/10.1007/s40299-023-00808->
- [6] Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles*, 66(3–4), 153–166. <https://doi.org/10.1007/s11199-011-9996-2>
- [7] INVALSI. (2021). *Rapporto nazionale prove INVALSI 2021*. Istituto Nazionale per la Valutazione del Sistema Educativo di Istruzione e di Formazione.
- [8] ISTAT. (2019). *Stereotipi di genere, ruoli e immagine della violenza*. Istituto Nazionale di Statistica.
- [9] ISTAT. (2023). *Stereotipi di genere e immagine sociale della violenza: Primi risultati*. *Statistiche Today*, 22 novembre. Istituto Nazionale di Statistica.
- [10] ISTAT. (2025). *Stereotipi sui ruoli di genere: Il punto di vista di ragazze e ragazzi*. *Statistiche Today*, 25 luglio. Istituto Nazionale di Statistica.
- [11] Leaper, C., & Friedman, C. K. (2007). The socialization of gender. In J. E. Grusec & P. D. Hastings (Eds.), *Handbook of socialization: Theory and research* (pp. 561–587). Guilford Press.
- [12] Liben, L. S., & Signorella, M. L. (1985). *Gender Stereotyped Attitude Scale for Children (GASC)*. Unpublished scale manual, Pennsylvania State University.
- [13] OECD. (2015). *The ABC of gender equality in education: Aptitude, behaviour, confidence*. OECD Publishing. <https://doi.org/10.1787/9789264229945-en>
- [14] OECD. (2019). *Assessment framework of the OECD study on social and emotional skills*. OECD Publishing.
- [15] OECD. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. <https://doi.org/10.1787/4c4e1d32-en>
- [16] Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*, 35(1), 4–28. <https://doi.org/10.1006/jesp.1998.1373>
- [17] Trautner, H. M., Ruble, D. N., Cyphers, L., Kirsten, B., Behrendt, R., & Hartmann, P. (2005). Rigidity and flexibility of gender stereotypes in childhood: Developmental or differential? *Infant and Child Development*, 14(4), 365–381. <https://doi.org/10.1002/icd.399>

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Students as Creators: Learning Mathematics with ASYMPOTOTE

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Abstract—Digital technologies have significantly influenced engineering education in recent years. Learning management systems, such as Moodle, have enabled the development of more flexible and interactive learning environments, allowing students greater control over their learning through personalised pathways, through immediate feedback and through interactive resources. However, despite the availability of these technologies, digital tools are often underused and their integration into traditional curricula remains fragmented. Consequently, there is an increasing need for digital platforms that combine content delivery with real-time assessment in ways that are engaging and adapted to students' learning needs. In higher education mathematics, adaptive digital platforms have been explored as a way to support students in introductory calculus courses, that are often challenging for engineering students. One such platform is ASYMPOTOTE, an adaptive digital learning environment that supports mathematics education through dynamic task generation, real-time feedback and the organization of activities through learning graphs representing relationships between mathematical concepts. Within this framework, the work presented focuses on the creation of student-generated mathematical tasks in a first-year Mathematical Analysis course. Working in small groups, students design tasks related to the topics addressed in the course. These tasks are subsequently reviewed and integrated into the ASYMPOTOTE platform, where they become part of the digital learning environment and are organized through learning graphs. By engaging students in the creation of learning materials that are later used by their peers, this approach promotes active participation, collaborative learning and deeper conceptual understanding of mathematical concepts.

Keywords—adaptive learning, digital learning platforms, mathematics education, student-generated tasks, learning graphs, ASYMPOTOTE, engineering education

REFERENCES

- [1] C. N. Watson, P. Duran, A. Castillo, E. Fuller, G. Potvin, and L. Kramer, "The supportive role of active learning in a calculus course on low precalculus proficiency students," *International Journal of Mathematical Education in Science and Technology*, vol. 56, no. 4, pp. 561–582, 2025.
- [2] M. Cirillo, D. Berk, R. LaRochelle, K. N. Bieda, and F. Arbaugh, "Undergraduate students' perceptions of features of active learning models for teaching and learning to teach mathematics," *International Journal of Research in Undergraduate Mathematics Education*, 2022.
- [3] E. Taranto, "Design and use of learning graphs through ASYMPOTOTE system," *Italian Journal of Pure and Applied Mathematics*, vol. 52, pp. 327–341, 2024.
- [4] D.-X. K. Oehler, L. Anhalt, S. Barlovits, M. Ludwig, and M. Kleine, "The ASYMPOTOTE project: Developing an adaptive and synchronous learning platform for mathematics education," in *Proc. International Conference on Mathematics Education*, pp. 287–296, 2023.
- [5] L. Johnson, S. Adams Becker, M. Cummins, V. Estrada, A. Freeman, and C. Hall, *NMC Horizon Report: 2016 Higher Education Edition*. Austin, TX, USA: The New Media Consortium, 2016.
- [6] S. Barlovits, A. Caldeira, G. Fesak, S. Jablonski, D. Koutsomanoli Filippaki, C. Lázaro, M. Ludwig, M. F. Mammana, A. Moura, D.-X. K. Oehler, T. Recio, E. Taranto, and S. Volika, "Adaptive, synchronous, and mobile online education: Developing the ASYMPOTOTE learning environment," *Mathematics*, vol. 10, no. 10, 2022.

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Thayer-inspired teaching routines as active learning in higher business education

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Abstract -This paper reports an embedded case study of a Thayer-inspired teaching routine (M1–M2–M3) implemented across four business curricular units (covering global competitiveness, strategic marketing, international marketing, and B2B marketing) during the 2025–2026 academic year. The routine operationalises (M1) a 10–20 minutes conceptual framing with explicit learning outcomes; (M2) small-group (≤ 3 students) applied problem work using permitted digital tools (including AI under disclosure and verification rules); and (M3) an unsupported oral defence (no slides, notes, or devices), with mandatory individual contribution and structured questioning. Drawing on evidence on active learning effectiveness and constructive alignment, the M1–M2–M3 routine is conceptualised as integrity-by-design: students may use tools to learn and build artefacts (M2), while their individual understanding and reasoning are authenticated through a technology-free defence (M3). Across the four embedded units of analysis, findings report a trajectory from initial student discomfort and insufficient preparation to progressively stronger conceptual accuracy and argumentation. The paper documents the positive learning outcomes achieved and the structural challenges encountered (including anxiety, overload, and unequal academic capital) and discusses their implications for assessment design in AI-normalised environments.

Keywords - Thayer method; active learning; constructive alignment; authentic assessment; oral defence; academic integrity; generative AI; assessment equity

REFERENCES

- [168] Shell, A. E. (2002). The Thayer method of instruction at the United States Military Academy: A modest history and a modern personal account. *PRIMUS*, 12(1), 27–38. <https://doi.org/10.1080/10511970208984015>
- [169] Connors, E. (2000). The Thayer method: Student active learning with positive results. *Journal of Mathematics and Science: Collaborative Explorations*, 4(1), 101–117. <https://doi.org/10.25891/P6SW-GR81>
- [170] O'Halloran, K. P., Tangirala, S., Sun, F., Anagho, L. E., Agbegha, G., Runck, C., Roth, D., & Erickson, A. H. (2020). An experiential report on the Thayer method of teaching across college-level chemistry, biology, math, and physics courses. *Georgia Journal of Science*, 78(2), Article 4.
- [171] Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410–8415. <https://doi.org/10.1073/pnas.1319030111>
- [172] Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, 93(3), 223–231. <https://doi.org/10.1002/j.2168-9830.2004.tb00809.x>
- [173] Bonwell, C. C., & Eison, J. A. (1991). Active learning: Creating excitement in the classroom (ERIC Digest; ED336049). ERIC.
- [174] Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education*, 32(3), 347–364. <https://doi.org/10.1007/BF00138871>
- [175] Black, P., & William, D. (1998). Assessment and classroom learning. *Assessment in Education: Principles, Policy & Practice*, 5(1), 7–74. <https://doi.org/10.1080/0969595980050102>
- [176] Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education*, 31(2), 199–218. <https://doi.org/10.1080/03075070600572090>
- [177] Wiggins, G. (1990). The case for authentic assessment. *Practical Assessment, Research, and Evaluation*, 2(1), Article 2. <https://doi.org/10.7275/ffb1-mm19>
- [178] Gulikers, J. T. M., Bastiaens, T. J., & Kirschner, P. A. (2004). A five-dimensional framework for authentic assessment. *Educational Technology Research and Development*, 52(3), 67–86. <https://doi.org/10.1007/BF02504676>
- [179] Nallaya, S., Gentili, S., Weeks, S., & Baldock, K. (2024). The validity, reliability, academic integrity and integration of oral assessments in higher education: A systematic review. *Issues in Educational Research*, 34(2), 629–646.
- [180] Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? In *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency* (pp. 610–623). ACM. <https://doi.org/10.1145/3442188.3445922>
- [181] Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 102274. <https://doi.org/10.1016/j.lindif.2023.102274>
- [182] Miao, F., & Holmes, W. (2023). Guidance for generative AI in education and research. UNESCO. <https://doi.org/10.54675/EWZM9535>
- [183] Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- [184] Krashen, S. D. (1982). *Principles and practice in second language acquisition*. Pergamon.
- [185] Bourdieu, P., & Passeron, J.-C. (1977). *Reproduction in education, society and culture*. SAGE.
- [186] Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE.
- [187] European Parliament and Council of the European Union. (2016). Regulation (EU) 2016/679 (General Data Protection Regulation). Official Journal of the European Union. <http://data.europa.eu/eli/reg/2016/679/oj>

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The “Advance Button” Model: Teaching Technological Paradigm Shifts in the Creative Industries

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Abstract— Understanding technological change is a central challenge in education for the creative industries. Students often encounter rapid transformations in media technologies but lack conceptual frameworks for analyzing how these shifts occur. This paper presents the “Advance Button” model as a pedagogical framework for teaching technological paradigm shifts in digital media and creative industries programs.

The model is based on the observation that major industry transformations frequently occur when a small technological affordance enables users to bypass existing constraints and adopt new practices at scale. The concept originates from the example of advertisement-skipping technology in digital video recorders, where the introduction of a simple thirty-second advance function allowed viewers to bypass television commercials easily, exposing the vulnerability of an advertising-dependent broadcast model. Similar dynamics can be observed in peer-to-peer music sharing, simplified online video platforms, digital reading devices, and innovations in music performance technologies.

In classroom settings, the Advance Button framework is used to analyze these cases through comparative discussion and project-based learning. Students identify four stages of technological transformation: technological accumulation, enabling affordance, behavioral cascade, and paradigm shift. Applying this framework allows students to explore how technological innovation reshapes creative production, distribution, and cultural markets.

The results from classroom implementation suggest that this model improves students’ ability to understand technological disruption, supports interdisciplinary learning between arts and technology, and provides a practical framework for analyzing innovation in the creative industries.

Keywords— Technological Paradigm Shifts; Digital Media Education; Creative Industries; Technological Disruption; Pedagogical Frameworks

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The flipped classroom in higher education: pedagogical innovation in a master's degree module

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Abstract— The introduction of the flipped classroom methodology stemmed from recurring difficulties identified by students, particularly in the theoretical component, where lessons were predominantly lecture-based, resulting in low student participation and a lack of motivation.

The proposal focused on the systematic adoption of the flipped classroom methodology, combined with peer-to-peer learning, to explore theoretical content and research practical case studies. In groups of three, students investigated topics guided by the teacher, produced summaries in digital formats (e.g., PowerPoint/Canva) and delivered oral presentations that took on the role of a 'lesson', complemented by learning assessment activities (e.g., quizzes) and a final discussion/reflection.

The observed results point to greater participation and motivation, evidence of knowledge acquisition and improved academic performance. Among the challenges, the following stand out: initial resistance from some students, the management of collaborative work in classes with international students, the need to redefine the teacher's role as a facilitator, and the misuse of AI (mitigated by requiring references). It is concluded that the flipped classroom, integrated with active strategies, contributes to more participatory, applied and meaningful learning in this course unit, justifying the continuation and refinement of the model.

Keywords— pedagogical innovation; flipped classroom; peer instruction; higher education

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The Impact of Environmental, Social and Governance (ESG) on Corporate Resilience in Uncertain Economic Contexts

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Abstract— The study aims to analyse the potential impact of sustainability performance, as measured by Environmental, Social and Governance (ESG) criteria, on business resilience in times of crisis. Recently, sustainability issues have taken on a pivotal role in organisational management, driven by growing pressure from stakeholders and the need to adapt to economic environments characterised by uncertainty. In this regard, the study seeks to highlight the possible relationship between companies that demonstrate best sustainable practices and greater resilience and recovery capacity during adverse periods.

The research adopts a quantitative approach, based on a sample of 588 listed European companies, covering the period between 2004 and 2023. Fixed-effects econometric models were used to analyse the relationship between Environmental, Social and Governance (ESG) performance, corporate investment and contextual variables, such as periods of crisis, with financial performance, measured alternately through ROA (Return on Assets) and market value.

The results show that the aggregate Environmental, Social and Governance (ESG) score has a positive and statistically significant impact on both accounting performance and market performance, suggesting that sustainability acts as a key strategic factor, helping to strengthen corporate resilience.

In the individual analysis of the three pillars of sustainability, the social factor stood out in terms of accounting performance, whilst all three pillars (environmental, social and governance) had a positive impact on market valuation. Investment was also found to contribute positively to companies' competitiveness and adaptability.

On the other hand, variables associated with periods of crisis revealed mostly negative effects, although with differences depending on the performance indicator analysed.

In conclusion, the study contributes to the literature by demonstrating that the integration of sustainable practices can strengthen business resilience, being relevant for the definition of organisational strategies and for future research on sustainability and financial performance.

Keywords— Sustainability, ESG, Business Resilience, Financial Performance, Fixed Effects

REFERENCES

- [1] Aydoğmuş, Mustafa, et al. "Impact of ESG Performance on Firm Value and Profitability." *Borsa Istanbul Review*, vol. 22, no. 2, 2022, pp. 119–127. <https://doi.org/10.1016/j.bir.2022.11.006>
- [2] Chen, Shanshan, et al. "Environmental, Social, and Governance (ESG) Performance and Financial Outcomes: Analyzing the Impact of ESG on Financial Performance." *Journal of Environmental Management*, vol. 345, 2023, article 118829. <https://doi.org/10.1016/j.jenvman.2023.118829>
- [3] Clément, Amélie, et al. "Improving ESG Scores with Sustainability Concepts." *Sustainability*, vol. 14, no. 20, 2022. <https://doi.org/10.3390/su142013154>
- [4] Ding, Lijun, et al. "Risk Management and Corporate ESG Performance: The Mediating Effect of Financial Performance." *Finance Research Letters*, vol. 69, 2024, article 106274. <https://doi.org/10.1016/j.frl.2024.106274>
- [5] Madden, Brian J. *Bet on Innovation, Not ESG Metrics, to Lead the Net Zero Transition*. 2022. <https://doi.org/10.2139/ssrn.4098194>
- [6] Maza, Francisco J. J., and María R. Cristóbal. "Impacto de la Calificación en Sostenibilidad sobre la Resiliencia Empresarial en el Contexto Pandémico." *Anales de Economía Aplicada*, 2022, pp. 221–242.
- [7] Walker, Thomas, et al. "Corporate Resilience during Crises and the Role of ESG Factors: Evidence from the COVID-19 Pandemic." *Finance Research Letters*, vol. 69, 2024, article 106168. <https://doi.org/10.1016/j.frl.2024.106168>
- [8] Wang, Hongrui, et al. "The Impact of ESG Responsibility Performance on Corporate Resilience." *International Review of Economics & Finance*, vol. 93, 2024, pp. 1115–1129. <https://doi.org/10.1016/j.iref.2024.05.033>
- [9] Xu, Ning, et al. "Corporate ESG and Resilience of Stock Prices in the Context of the COVID-19 Pandemic in China." *Pacific-Basin Finance Journal*, vol. 79, 2023, article 102040. <https://doi.org/10.1016/j.pacfin.2023.102040>
- [10] Zhang, Jian, et al. "Restart Economy in a Resilient Way: The Value of Corporate Social Responsibility to Firms in COVID-19." *Finance Research Letters*, vol. 47, 2022, article 102683. <https://doi.org/10.1016/j.frl.2022.102683>

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The Impact of Supplementary Mathematics Training and Digital Resources on Student Performance

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Abstract— This study presents the design, implementation, and impact of three complementary training courses: Matemática 4U, Matemática 4U2, and Financial Mathematics, developed to support students in strengthening their mathematical skills. The courses were delivered through face-to-face sessions and supported by a set of specially designed digital learning materials, including instructional videos, quizzes, interactive forms, and exercise worksheets. All supporting resources were made available through the online platform MatActiva, to extend learning beyond the classroom and promote autonomous study.

The pedagogical model combined in-person instruction with structured online resources, enabling students to review concepts, practice problem-solving, and assess their progress independently. To evaluate the effectiveness of the initiative, the academic performance of students who attended the courses was compared with that of students who did not participate.

The results indicate a significantly higher level of achievement among students enrolled in the training courses. Participants demonstrated improved understanding of mathematical concepts and achieved markedly better academic outcomes than their peers who did not attend the courses. These findings highlight the positive impact of combining targeted in-person training with well-designed digital learning resources.

Overall, the study suggests that structured support programs integrating classroom teaching and online platforms such as MatActiva can play a key role in enhancing students' mathematical competencies and academic success.

Keywords—Blended Learning Environments, Digital Educational Resources, Student Academic Performance, Higher Education, MatActiva Online Project.

REFERENCES

- [1] K. Asante, P. Novak, "When the push and pull factors in digital educational resources backfire: the role of digital leader in digital educational resources usage". *Education and Information Technologies*, 29(6), 2024. <https://doi.org/10.1007/s10639-023-12095-8>
- [2] X. Wang, M. Zalli, P. Tan, W. Lu, "Flipped classroom in mathematics education: A scoping review." *International Journal of Learning, Teaching and Educational Research*, 24(5), 1-24, 2024. <https://doi.org/10.26803/ijlter.24.5.3>
- [3] A. P. Lopes, F. Soares, "Perception and performance in a flipped Financial Mathematics classroom", *The International Journal of Management Education*, 16(1), 105-113. 2018. <https://doi.org/10.1016/j.ijme.2018.01.001>
- [4] M. De Bruijn-Smolanders, F.R. Prinsen, "Effective student engagement with blended learning: A systematic review". In *Heliyon* (Vol. 10, Number 23), 2024. <https://doi.org/10.1016/j.heliyon.2024.e39439>
- [5] Q. Huang, L. Lu, S. Tu, "Evaluating the Quality of AI-Generated Digital Educational Resources for University Teaching and Learning". *Systems*, 13(3), 2025. <https://doi.org/10.3390/systems13030174>

- [5] A.P. Lopes, F. Soares, C. Neto, M.N. Fernandes, M. Monteiro, "Didactic innovation in mathematics using technologies. In Proceedings of the 23rd European Conference on e-Learning (ECEL 2024) (Vol. 23, pp. 219-226). Academic Conferences and Publishing International Limited, 2024. <https://doi.org/10.34190/ecel.23.1.3110>
- [6] K. Khan, D. Gurbutt, R. Cragg, "The Importance of Key Pre-Requisite Mathematical Skills for Engineering Subjects With High Technical Content", *ICERI2025 Proceedings*, pp. 90-95, 2025. [10.21125/iceri.2025.0041](https://doi.org/10.21125/iceri.2025.0041)
- [7] S. Hrastinski, "What Do We Mean by Blended Learning?" *TechTrends*, 63(5), 2019. <https://doi.org/10.1007/s11528-019-00375-5>

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The importance of assessing digital skills in secondary schools

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Abstract— Digital competence is now an essential prerequisite for lifelong learning, social participation and active citizenship. This paper presents a national assessment model developed to evaluate the digital skills of second-year secondary school students. Based on the European Framework for Citizens' Digital Competences, the model focuses on four main areas: information and data literacy; online communication and collaboration; digital content creation; and safety and responsible use of digital environments.

The development of the assessment tool involved the creation of an item bank calibrated using established psychometric methodologies, as well as adopting a vertical scale that allows comparisons to be made over time between school cohorts. Proficiency levels were established through structured standard-setting procedures that distinguish three thresholds: basic, intermediate and advanced.

The results show that most students reach at least an intermediate level of proficiency across all domains. They demonstrate particular strength in information management and face greater challenges in digital safety, particularly regarding data protection and the management of online interactions. Furthermore, regional and socioeconomic disparities emerge, reflecting inequalities in learning opportunities and technological access.

Correlational analyses reveal positive and significant associations between digital skills and performance in standardized Italian and Mathematics tests. These correlations, ranging from approximately 0.35 to 0.58, suggest that higher levels of digital proficiency are associated with improved reading comprehension and more effective handling of numerical information. Level distribution confirms this trend: students with advanced digital skills are more frequently found in the advanced levels of subject tests, while those with basic digital skills tend to be concentrated in the lowest performance brackets.

Overall, the results suggest that digital competence is a cross-cutting dimension that supports fundamental learning. These findings provide useful insights for educational planning aimed at reducing regional and social disparities.

Keywords — digital competence; assessment; secondary education; information literacy; digital safety; learning outcomes; equity in education

REFERENCES

- [1] European Commission, Joint Research Centre. European Digital Competence Framework for Citizens - DigComp 2.2. Luxembourg: Publications Office of the European Union; 2021.
- [2] European Commission. Digital Competence Framework for Educators - DigCompEdu. Luxembourg: Publications Office of the European Union; 2017.
- [3] European Commission, Joint Research Centre. A Framework for Digitally Competent Educational Organizations - DigCompOrg. Luxembourg: Publications Office of the European Union; 2015.
- [4] Greenstein L. La valutazione formativa. Milano: UTET Università; 2017.

- [5] Griffin P, Care E. Assessment and Teaching of 21st Century Skills. Dordrecht: Springer; 2015.
- [6] Gui M, Assirelli G, Gerosa T. La competenza digitale degli studenti. Trento: Erickson; 2022.
- [7] Heckman JJ, Humphries JE, Kautz T, editors. The Myth of Achievement Tests. Chicago: The University of Chicago Press; 2015.
- [8] Istituto per la Ricerca e la Formazione Educativa (Iprase). Curriculum per lo sviluppo della competenza digitale. Trento: Iprase; 2022. Available from: <https://curriculum-digitale.iprase.tn/storage/107-Curriculum-per-lo-sviluppo-della-competenza-digitale.pdf>
- [9] Joint Research Centre. DigComp. A Framework for Developing and Understanding Digital Competence in Europe. Luxembourg: Publications Office of the European Union; 2013.
- [10] Lang C, Siemens G, Wise A, Gaevi A, editors. Handbook of Learning Analytics. Society for Learning Analytics Research; 2017.
- [11] Levin IP. Associative Effects of Information Framing. Bull Psychon Soc. 1987;25(3):202-204.
- [12] Nicolli S. Narrare la scuola. Insegnanti riflessivi e documentazione. Trieste: Asterios; 2018.
- [13] OECD. Students, Computers and Learning. Making the Connection. Paris: OECD Publishing; 2015.
- [14] OECD. Education at a Glance 2023: OECD Indicators. Paris: OECD Publishing; 2023.
- [15] Patrinos H, Vegas E, Carter-Rau R. An Analysis of Covid-19 Student Learning Loss. Washington DC: World Bank; 2022.
- [16] Punie Y, Brecko B, Ferrari A. DigComp: A Framework for Developing and Understanding Digital Competence in Europe. Luxembourg: Publications Office of the European Union; 2013.
- [17] Ranieri M. Le competenze digitali degli insegnanti. In: Biagi M, Oliviero S, editors. Il Tirocinio Diretto Digitale. Firenze: Firenze University Press; 2022. p. 49-60.
- [18] Ricci R. Gli apprendimenti ai tempi della pandemia. RicercAzione. 2021;13(2):1-21.
- [19] Ricci R. La dispersione scolastica e la povertà educativa. Nuova Secondaria. 2023;2:124-134.
- [20] Ricci R. Misurazione standardizzata e valutazione formativa una sinergia possibile. RicercAzione. 2023;15(2):31-44.
- [21] Schleicher A. Una scuola di prima classe. Bologna: Il Mulino; 2020.
- [22] UNICEF. Policy Guidance on AI for Children Version 2. New York: United Nations; 2021.
- [23] Van Dijk J. The Digital Divide. Cambridge: Polity; 2020.

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The student's role in self-empowerment

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Abstract — Education is a vast subject, ruled by specific and different studies, focused on society's evolution. In fact, repeating the same pedagogies, methodologies, strategies, and assessment methods for decades is not successful, because it promotes a great disconnection between students and learning desire, focus, engagement and resilience. In this sense, it is crucial to capture the student's attention, involve them in the learning process, and build a learning path with them so that they feel valued, confident, and resilient, imbued with a spirit of cooperation, sharing, articulation, and consolidation of knowledge, overcoming the easiest path: giving up. In 2019, Agrupamento de Escolas de Oliveira do Bairro (AEOB) faced the challenge of implementing an Innovation Plan (IP), over portuguese legislation and supervised by the Curriculum Autonomy and Flexibility team of the Ministry of Education, acting as mediator in the IP implementation process. In this program, AEOB adopted a cross-curriculum strategy with a methodology based on direct observation of students throughout the learning process and included representatives of parents/guardians in monitoring meetings, thus adopting a methodological shift. The IP implementation at AEOB constitutes a process of change, characterized by two completed periods of three academic years and the beginning of the third period in 2025. This is a path of inclusion, innovation, growth, new ideas, new considerations and new directions, consolidating the most positive achievements and, with a resilient attitude, questioning and implementing new pedagogies, methodologies and strategies.

Keywords—cross-curriculum, innovation, interdisciplinarity, project-based learning, guidelines, workshops, success

REFERENCES

- [1] Almeida, M.E.B., and Gerardini, A. F. S., "Metodologias ativas: das concepções às práticas em distintos níveis de Ensino", Educ. vol.17 nº.52, Curitiba abr./jun 2017, Epub 02-Mar-2020. Revista Disponível Diálogo.

- [2] Bender, Willian N., "Aprendizagem baseada em projetos: Educação diferenciada para o século XXI." Porto Alegre, BRASIL, 2014.
- [3] Ciclo de webinars Educação inclusiva: Um desafio permanente, organizado pelo CNE – Conselho Nacional de Educação.
- [4] Cintia-Regina-Bonalume–Mediação-Competências-e-o-lugar-da-aprendizagem-na-EaD| PDF | Educação à distância | Aprendizado.
- [5] Ferreira, D, Cosme, A.(2021). A importância de flexibilizar a prática pedagógica. Porto Editora, Portugal.
- [6] Frias, C. (2022). A Família, a Adolescência e a Escola. Atena Editora.
- [7] Leite, A., Ferreira, D. (2024). Pedagogia de Projeto: Um estudo de aplicabilidade. GT12: Formação de Professores. 32747-2294-26932-1-10-20250109.pdf
- [8] Lemos, G., Almeida, L., Guisande, M.A.& Primi, R. (2018). Inteligência e rendimento escolar: análise da sua relação ao longo da escolaridade. Revista Portuguesa de Educação 21(1), 83-99.vol.21.nº1 (2008). <https://doi.org/10-21814/rpe.13920>.
- [9] Nóvoa, A. (2005). Evidentemente: história da Educação. 1ed. Novas Oeiras.
- [10] Pereira, R., Gomes, A. (2014). A Metodologia Tradicional Expositiva. Modalidade_1datahora_11_07_2014_11_50_54_idinscrito_4259_d6633d4fe975ab2fa2bdddaf956c49b8.pdf
- [11] Sampaio, D. (2020, 17 de maio). Vamos conviver com familiares e amigos. É crucial mantermos as relações afetivas mais íntimas. Visão.
- [12] Vasconcellos, C., S. (1992). Metodologia Dialética em Sala de Aula. In: Revista de Educação AEC. Brasília: (n. 83). www.celsovasconcellos.com.br/Textos/Didática.
- [13] Vigotski, L. S. A. (2017) Educação em Vigotski: prática e caminho para a liberdade. Rio de Janeiro, RJ: E-papers Serviços Editoriais Lda.
- [14] <https://www.dge.mec.pt/noticias/decreto-lei.no-542018-educacao-inclusiva>.
- [15] <https://www.esfelgueiras.pt/docs/manual-de-apoio-a-praticeducativaDevreto-Lei>.

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Theoretical Foundations of Artificial Intelligence-enabled Project Management: A Systematic Literature Review

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Abstract — Artificial intelligence (AI) is recognised as an important technological driver of ongoing digital transformation in contemporary organisations. In the field of project management, recent literature increasingly highlights that AI is transforming project management practices and processes. However, despite the growing number of studies, the theoretical foundations of AI-enabled project management research remain fragmented and insufficiently synthesised. Without clear theoretical grounding, research on AI-enabled project management remains largely descriptive and theoretically underdeveloped, limiting its ability to explain project management phenomena, integrate empirical findings, and contribute to the existing body of knowledge.

The aim of this study is to identify, map, and explain the theoretical perspectives used in research on AI-enabled project management and to provide a structured synthesis of its theoretical foundations. To achieve this objective, the study applied a systematic literature review (SLR) designed in accordance with the PRISMA 2020 guidelines and the PRISMA-S extension. The literature search was conducted in two rounds using the Web of Science and Scopus databases and identified 712 records published between 2015 and 2025. Following screening and full-text eligibility assessment, 10 studies were retained as the core dataset for analysis.

The analysis shows recurring patterns in how the literature explains AI-enabled project management. The reviewed studies include both conceptual and empirical research and draw on several theoretical perspectives. Across the reviewed studies, AI is most often described as decision-support or as augmentation of managerial capabilities. Its impact on project management is mainly explained through several dominant perspectives, suggesting a focus on the functional role of AI. The findings also indicate that there is no single dominant theory explaining AI-enabled project management, instead, the literature relies on several parallel ways of interpreting the role and impact of AI.

This study contributes by mapping the theories and synthesising them to explain how the literature interprets the impact of AI on project management. The analysis identifies recurring patterns and highlights the limited use of explicit theoretical frameworks and the need for stronger theory-driven research, including the exploration and adaptation of alternative theoretical perspectives to better explain AI-driven changes and innovation in project management.

Keywords— artificial intelligence, project management, AI-enabled project management, theoretical foundations, systematic literature review, phenomena-driven research, AI adoption

REFERENCES

- [1] G. Vial, “Understanding digital transformation: A review and a research agenda,” *The Journal of Strategic Information Systems*, vol. 28, no. 2, pp. 118–144, Jun. 2019.
- [2] S. Kraus, S. Durst, J. J. Ferreira, P. Veiga, N. Kailer, and A. Weinmann, “Digital transformation in business and management research: An overview of the current status quo,” *International Journal of Information Management*, vol. 63, Art. no. 102466, Apr. 2022.
- [3] Y. K. Dwivedi et al., “Artificial intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy,” *International Journal of Information Management*, vol. 57, Art. no. 101994, Apr. 2021.
- [4] J. Geraldi and J. Söderlund, “Project studies: What it is, where it is going,” *International Journal of Project Management*, vol. 36, no. 1, pp. 55–70, Jan. 2018.
- [5] T. P. Kenworthy and K. Jugdev, “What do we really know? A 40-year scientific realist examination of theory testing in project management,” *International Journal of Project Management*, vol. 43, no. 8, Art. no. 102788, Nov. 2025.
- [6] R. Müller, G. Locatelli, V. Holzmann, M. Nilsson, and T. Sagay, “Artificial intelligence and project management: Empirical overview, state of the art, and guidelines for future research,” *Project Management Journal*, vol. 55, no. 1, pp. 9–15, Feb. 2024.
- [7] I. Taboada, A. Daneshpajouh, N. Toledo, and T. de Vass, “Artificial intelligence enabled project management: A systematic literature review,” *Applied Sciences*, vol. 13, no. 8, Art. no. 5014, Apr. 2023.
- [8] D. S. Adamantiadou and L. Tsironis, “Leveraging artificial intelligence in project management: A systematic review of applications, challenges, and future directions,” *Computers*, vol. 14, no. 2, Art. no. 66, Feb. 2025.
- [9] M. Khalil, A. Bravo, D. Vieira, and M. M. de Carvalho, “Mapping the AI landscape in project management context: A systematic literature review,” *Systems*, vol. 13, no. 10, Art. no. 913, Oct. 2025.
- [10] S. Salimimoghadam, A. N. Ghanbaripour, R. J. Tumpa, A. K. Rahimi, M. Golmoradi, S. Rashidian, and M. Skitmore, “The rise of artificial intelligence in project management: A systematic literature review of current opportunities, enablers, and barriers,” *Buildings*, vol. 15, no. 7, Art. no. 1130, Apr. 2025.

- [11] M. Chen, T. S. Martins, L. Zhang, and H. Dong, "Digital transformation in project management: A systematic review and research agenda," *Systems*, vol. 13, no. 8, Art. no. 625, Aug. 2025.
- [12] A. Kiani, "Artificial intelligence in entrepreneurial project management: A review, framework and research agenda," *International Journal of Managing Projects in Business*, vol. 18, no. 4–5, pp. 708–720, Nov. 2025.
- [13] V. Sobchenko, A. Bashynskiy, M. Piatkov, S. Shaforost, and V. Chmyr, "Artificial intelligence for enhancing engineering project management during emergencies: Perception-based analysis," *Quality Innovation Prosperity*, vol. 28, no. 3, pp. 46–62, 2024.
- [14] F. A. Ribeiro Serra, M. M. Sá, R. Penha, and C. A. R. Ferrari, "Artificial intelligence in project management: An analysis of patent trends and task-technology fit," *International Journal of Innovation*, vol. 13, no. 3, Art. no. e28348, Sep.–Dec. 2025.
- [15] G. J. Miller, "Stakeholder roles in artificial intelligence projects," *Project Leadership and Society*, vol. 3, Art. no. 100068, Nov. 2022.
- [16] A. M. Felicetti, A. Cimino, A. Mazzoleni, and S. Ammirato, "Artificial intelligence and project management: An empirical investigation on the appropriation of generative Chatbots by project managers," *Journal of Innovation & Knowledge*, vol. 9, no. 3, Art. no. 100545, Jul. 2024.
- [17] A. N. Khan and H. K. Kwan, "AI, agility, and environmental performance: A new framework for construction project managers," *Journal of Construction Engineering and Management*, vol. 151, no. 3, Mar. 2025.
- [18] S. C. Wijayasekera, S. A. Hussain, A. Paudel, B. Paudel, J. Steen, R. Sadiq, and K. Hewage, "Data analytics and artificial intelligence in the complex environment of megaprojects: Implications for practitioners and project organizing theory," *Project Management Journal*, vol. 53, no. 5, pp. 485–500, Oct. 2022.
- [19] D. Kögel, S. Meile, and L. Canos-Daros, "Who's steering whom and in what direction? An experiment on AI versus top management decision-making in projects," *Project Management Journal*, early access, Oct. 2025.
- [20] F. Xu and S.-P. Lin, "Theoretical framework of fuzzy-AI model in quantitative project management," *Journal of Intelligent & Fuzzy Systems*, vol. 30, no. 1, pp. 509–521, Jan. 2016.
- [21] L. Hughes et al., "Impact of artificial intelligence on project management (PM): Multi-expert perspectives on advancing knowledge and driving innovation toward PM2030," *Journal of Innovation & Knowledge*, vol. 10, no. 5, Art. no. 100772, Sept. 2025.

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Usability of a Computer-Based Serious Game to Foster Foundational Reading Skills

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Abstract — Despite the evidence that playful and interactive environments can strengthen foundational reading skills, serious games designed to support the early stages of reading acquisition remain scarce. This study presents the development and evaluation of a computer-based serious game designed to train phonemic awareness in children between kindergarten and first grade. The serious game was designed to promote auditory discrimination and phonemic awareness. A usability study was conducted with a sample of 16 first-grade children. A total of eight children were identified by their teachers as experiencing reading-related difficulties, while eight demonstrated typical reading development. Each child participated in three individual ten-minute sessions within the school environment. The materials comprised the serious game, a pseudoword reading assessment to confirm reading difficulties, and a structured observational scale developed to capture detailed indicators of usability and satisfaction. The usability of the serious game was examined through systematic observation across multiple dimensions, including tutorial comprehension, initiation of gameplay, auditory and visual perception of stimuli, ease of progression through tasks, interpretation of feedback, fine motor interaction, emotional responses, and behavioral evidence of engagement, confusion, frustration, or confidence. These observations were supplemented with post-session satisfaction ratings. With regard to satisfaction, children who did not exhibit reading difficulties consistently provided favorable responses. Conversely, children with reading difficulties demonstrated a more heterogeneous pattern of responses. Taken together, these findings suggest that the game is usable and engaging for early readers. The integration of a detailed observational usability instrument with implementation in school settings represents a significant contribution to ongoing discussions surrounding the development and evaluation of learning oriented serious games. The results of the study are particularly pertinent to educators and designers seeking to incorporate evidence-informed, developmentally responsive digital tools into early literacy instruction. In conclusion, this exploratory investigation emphasizes the potential of computer-based serious games as accessible tools for phonemic awareness development and underscores the necessity for iterative design improvements that reflect the diverse literacy profiles of young learners. Subsequent iterations will incorporate refinements informed by observational data to enhance both accessibility and pedagogical effectiveness.

Keywords—children, early reading, phonemic awareness, reading difficulties, satisfaction, serious games, usability.

REFERENCES

(Periodical style)

- [1] M. S. Alotaibi, "Game-based learning in early childhood education: a systematic review and meta-analysis," *Frontiers in Psychology*, vol. 15, 2024. doi: 10.3389/fpsyg.2024.1307881.

- [2] A. Asadzadeh, H. Shahrokhi, B. Shalchi, Z. Khamnian, and P. Rezaei-Hachesu, "Serious educational games for children: A comprehensive framework," *Heliyon*, vol. 10, no. 6, 2024. doi: 10.1016/j.heliyon.2024.e28108.
- [3] W. Barendregt and M. M. Bekker, "Developing a coding scheme for detecting usability and fun problems in computer games for young children," *Behavior Research Methods*, vol. 38, no. 3, pp. 382–389, 2006. doi: 10.3758/BF03192791.
- [4] I. Boada, A. Rodriguez, X. Garcia, V. Acuna, and L. Corominas, "H2O-EduK, A serious game for children to educate on the urban water cycle," *IEEE Access*, vol. 12, pp. 75262–75271, 2024. doi: 10.1109/ACCESS.2024.3405567.
- [5] M. Carrión-Toro et al., "Rethinking usability in serious games: Designing an instrument that evaluates what really matters in learning contexts," *Applied Sciences*, vol. 15, no. 18, 2025. doi: 10.3390/app151810084.
- [6] J. R. Lewis, "The System Usability Scale: Past, present, and future," *International Journal of Human-Computer Interaction*, pp. 1–14, 2018. doi: 10.1080/10447318.2018.1455307.
- [7] P. Markopoulos and M. Bekker, "On the assessment of usability testing methods for children," *Interacting with Computers*, vol. 15, no. 2, pp. 227–243, 2003. doi: 10.1016/S0953-5438(03)00009-2.
- [8] A. I. Martins, A. F. Rosa, A. Queirós, A. Silva, and N. P. Rocha, "European Portuguese validation of the System Usability Scale (SUS)," *Procedia Computer Science*, vol. 67, pp. 293–300, 2015. doi: 10.1016/j.procs.2015.09.273.
- [9] N. I. Othman, H. Mohamed, and N. A. M. Zin, "Testing the usability of serious game for low vision children," *International Journal of Advanced Computer Science and Applications*, vol. 14, no. 8, 2023. doi: 10.14569/IJACSA.2023.0140834.
- [10] S. Saeedi, M. Ghazisaedi, N. Ramezanghorbani, M.-S. Seifpanahi, and H. Bouraghi, "Design and evaluation of a serious video game to treat preschool children with speech sound disorders," *Scientific Reports*, vol. 14, no. 1, p. 17299, 2024. doi: 10.1038/s41598-024-68119-x.
- [11] A. Sánchez-Morales, J. A. Durand-Rivera, and C. L. Martínez-González, "Usability evaluation of a tangible user interface and serious game for identification of cognitive deficiencies in preschool children," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 6, 2020. doi: 10.14569/IJACSA.2020.0110661.
- [12] G. Tasiouli, M. Konstantakis, and G. Heliades, "Exploring the usability and interaction experience of the Artsteps virtual exhibition platform by preschool children," *Electronics*, vol. 14, no. 13, p. 2690, 2025. doi: 10.3390/electronics14132690.
- [13] P. Vlachogianni and N. Tselios, "Perceived usability evaluation of educational technology using the System Usability Scale (SUS): A systematic review," *Journal of Research on Technology in Education*, vol. 54, no. 3, pp. 392–409, 2022. doi: 10.1080/15391523.2020.1867938.
- [14] O. Yildirim and E. Surer, "Developing adaptive serious games for children with specific learning difficulties: A two-phase usability and technology acceptance study," *JMIR Serious Games*, vol. 9, no. 2, 2021. doi: 10.2196/25997.

(Book style with paper title and editor)

- [15] A. L. Brooks and E. Brooks (eds.), *Interactivity, Game Creation, Design, Learning, and Innovation*, vol. 196. Springer, 2017. doi: 10.1007/978-3-319-55834-9.

(Published Conference Proceedings style)

- [16] N. M. Diah, M. Ismail, S. Ahmad, and M. K. M. Dahari, "Usability testing for educational computer game using observation method," in Proc. Int. Conf. Information Retrieval & Knowledge

Management (CAMP), 2010, pp. 157–161. doi: 10.1109/INFRKM.2010.5466926.

- [17] A. Donker and P. Reitsma, “Usability testing with young children,” in *Proc. Conf. Interaction Design and Children*, 2004, pp. 43–48. doi: 10.1145/1017833.1017839.
- [18] M. Ismail, N. M. Diah, S. Ahmad, N. A. M. Kamal, and M. K. M. Dahari, “Measuring usability of educational computer games based on the user success rate,” in *Proc. Int. Symp. Humanities, Science and Engineering Research*, 2011, pp. 56–60. doi: 10.1109/SHUSER.2011.6008500. W. D. Doyle, “Magnetization reversal in films with biaxial anisotropy,” in *Proc. 1987 INTERMAG Conf.*, 1987, pp. 2.2-1–2.2-6.

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Virtual Reality and Augmented Reality in Teacher Training: Redefining Pedagogical Practices in Higher Education

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Abstract - This paper presents and analyses a training session, developed within the scope of the Erasmus+ project “The Power of AR & VR”, aimed at 26 Master’s students in Computer Science Teaching at the University of Minho, dedicated to exploring Virtual Reality (VR) and Augmented Reality (AR) in Higher Education contexts. The training was designed from a constructivist standpoint, integrating immersive tools — namely the ClassVR platform, the DelightEx application, and immersive web environments — with the aim of fostering more meaningful, interactive, and student-centred learning experiences. The session challenged participants to reflect not only on the available tools, but fundamentally on the pedagogical intentionality that should guide their use, the design of immersive experiences, and the transformative role of digital innovation in redefining teaching practices. The observed outcomes point to a positive impact on motivation, active engagement of trainees, and their predisposition towards the pedagogical integration of these technologies in their future professional practice. The study contributes to the emerging literature on immersive technologies in Higher Education, underlining the need for teacher training programmes that articulate technological literacy with critical pedagogical reflection.

Keywords - Virtual Reality; Augmented Reality; Teacher Training; Higher Education; Immersive Technologies; Pedagogical Innovation; Meaningful Learning

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REFERENCES

- [1] S. Freeman, S. L. Eddy, M. McDonough, M. K. Smith, N. Okoroafor, H. Jordt, and M. P. Wenderoth, “Active learning increases student performance in science, engineering, and mathematics,” *Proceedings of the National Academy of Sciences*, vol. 111, no. 23, pp. 8410-8415, 2014.
- [2] J. Radianti, T. A. Majchrzak, J. Fromm, and I. Wohlgenannt, “A systematic review of immersive virtual reality applications for higher education,” *Computers & Education*, vol. 147, art. 103778, 2020.
- [3] J. Tondeur, J. van Braak, P. A. Ertmer, and A. Ottenbreit-Leftwich, “Understanding the relationship between teachers’ pedagogical beliefs and technology use in education,” *Educational Technology Research and Development*, vol. 65, no. 3, pp. 555-575, 2017.
- [4] M. Bower, C. Howe, N. McCredie, A. Robinson, and D. Grover, “Augmented Reality in education - cases, places and potentials,” *Educational Media International*, vol. 51, no. 1, pp. 1-15, 2014.
- [5] D. A. Kolb, *Experiential learning: Experience as the source of learning and development*. FT press, 2014
- [6] D. P. Ausubel, *The Psychology of Meaningful Verbal Learning*. New York: Grune & Stratton, 1963.
- [7] Z. Merchant, E. T. Goetz, L. Cifuentes, W. Keeney-Kennicutt, and T. J. Davis, “Effectiveness of virtual reality-based instruction on students’ learning outcomes in K-12 and higher education: A meta-analysis,” *Computers & Education*, vol. 70, pp. 29-40, 2014.
- [8] L. Jensen and F. Konradsen, “A review of the use of virtual reality head-mounted displays in education and training,” *Education and Information Technologies*, vol. 23, no. 4, pp. 1515-1529, 2018.
- [9] R. T. Azuma, “A survey of augmented reality,” *Presence: Teleoperators and Virtual Environments*, vol. 6, no. 4, pp. 355-385, 1997.
- [10] H. K. Wu, S. W. Y. Lee, H. Y. Chang, and J. C. Liang, “Current status, opportunities and challenges of augmented reality in education,” *Computers & Education*, vol. 62, pp. 41-49, 2013.
- [11] P. Mishra and M. J. Koehler, “Technological pedagogical content knowledge: A framework for teacher knowledge,” *Teachers College Record*, vol. 108, no. 6, pp. 1017-1054, 2006.
- [12] J. Voogt, P. Fisser, N. Pareja Roblin, J. Tondeur, and J. van Braak, “Technological pedagogical content knowledge - a review of the literature,” *Journal of Computer Assisted Learning*, vol. 29, no. 2, pp. 109-121, 2013.
- [13] P. A. Ertmer and A. T. Ottenbreit-Leftwich, “Teacher technology change: How knowledge, confidence, beliefs, and culture intersect,” *Journal of Research on Technology in Education*, vol. 42, no. 3, pp. 255-284, 2010.
- [14] N. Pellas, P. Fotaris, I. Kazanidis, and D. Wells, “Augmenting the learning experience in primary and secondary school education: A systematic review of recent trends in augmented reality game-based learning,” *Virtual Reality*, vol. 23, no. 4, pp. 329-346, 2019.
- [15] L. Freina, & M. Ott, A literature review on immersive virtual reality in education: state of the art and perspectives. In *The international scientific conference elearning and software for education* (Vol. 1, No. 133, pp. 10-1007), 2015.
- [16] J. Pottle, “Virtual reality and the transformation of medical education,” *Future Healthcare Journal*, vol. 6, no. 3, pp. 181-185, 2019.
- [17] S. Mystakidis, “Metaverse,” *Encyclopedia*, vol. 2, no. 1, pp. 486-497, 2022.
- [18] S. Papert, *Mindstorms: Children, Computers, and Powerful Ideas*. New York: Basic Books, 1980.
- [19] C. Dede, “Immersive interfaces for engagement and learning,” *Science*, vol. 323, no. 5910, pp. 66-69, 2009.
- [20] R. K. Yin, *Case Study Research and Applications: Design and Methods*, 6th ed. Thousand Oaks, CA: SAGE Publications, 2018.

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Which is the First Portuguese School of Economics and Management?

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Abstract — The institutional history of Portuguese business and economics education is marked by competing claims regarding its origins. On the official websites of Instituto Superior de Contabilidade e Administração de Lisboa (ISCAL) and Instituto Superior de Economia e Gestão (ISEG), both institutions present themselves as the first Portuguese school of economics and management and claim to be the legitimate successors of the Instituto Superior de Comércio de Lisboa (ISC), founded in 1911. ISCAL goes even further by describing itself as the first economics and management school in Europe.

Given these apparently contradictory claims, this paper addresses three research questions: (1) which institution can legitimately be considered the successor of ISC; (2) which institution may claim the status of the first Portuguese economics and management school; and (3) whether the assertion that ISCAL is the first such school in Europe can be historically justified.

To answer these questions, the study analyses Portuguese official legislation from 1759, when the Aula de Comércio de Lisboa was established, often considered the earliest Portuguese institution in this field, until the moments when ISCAL (1976) and ISEG (1989) adopted their current designations.

The analysis suggests that ISC evolved institutionally into ISEG, making the claim that ISCAL replaced ISC historically inaccurately. It also shows that determining the first Portuguese school of economics and management depends on whether the Aula de Comércio de Lisboa is interpreted as a higher education institution or as secondary education. Finally, while ISCAL may plausibly claim primacy in Portugal under certain interpretations, the claim that it is the first such school in Europe appears historically unlikely.

Keywords — Business and Management Education, History of Economic Education, Portuguese Higher Education System, ISCAL, ISEG.

REFERENCES

- J. Almeida, and M.C. Marques, J. Almeida, and M.C. Marques, “A Contabilidade Pública em Portugal: da Monarquia (1761) à II República (2002)”, *Economia Global e Gestão*, Vol. VII (1), Abril, pp. 99-117, 2002.
- L. Rodrigues, R. Craig, and D. Gomes, “The Portuguese School of Commerce, 1759-1844: a reflection of the Enlightenment”, *Accounting History*, Vol. 9 (3), Novembro, pp. 53-71, 2004.
- L. Rodrigues, R. Craig, and D. Gomes, “State intervention in commercial education: the case of the Portuguese School of Commerce – 1759”, *Accounting History*, Vol. 12 (1), Fevereiro, pp. 55-85, 2007.
- M. Gonçalves e M.C. Marques, “Evolução do Ensino da contabilidade em Portugal na segunda metade do século XIX: uma análise histórica, 1844-1886”, *Pecunia Revista de la Facultad de Ciencias Económicas Y Empresariales*, Universidad de León, December 2011.
- M. Lira, “A importância da Aula do Comércio na história da Contabilidade portuguesa”, *Revista Universo Contábil*, vol. 7, n.º 2, pp. 97-113, abril/junho 2011.
- R. Carvalho, *História do Ensino em Portugal: desde a fundação da nacionalidade até o fim do regime de Salazar-Caetano*, 2.ª edição, Fundação Calouste Gulbenkian, 1996.
- J. Sousa, “Reformismo social e projecto educativo: António Sérgio, defensor do «ensino técnico-profissionais»”, presented at the II Jornadas de Contabilidade, Aveiro, 1985.
- M. Gonçalves, “E depois da aula de comércio? Digressão através do Ensino da contabilidade na Lisboa oitocentista”, *Encuentro de trabajo sobre Historia de la Contabilidad* (7.º. 2010. León), 2010, pp. 181-206.
- M. Gonçalves, “Institucionalização do Ensino da Contabilidade em Portugal nos Séculos XVIII e XIX” MSc dissertation, Departamento de Economia, Gestão e Engenharia Industrial, Universidade de Aveiro, 2009.
- M. Fernandes, “A Matemática Financeira no ensino commercial em Portugal durante a monarquia”, MSc Dissertation, Universidade Portucalense, 2020.
- H. Henriques, “O percurso da matemática no ensino técnico durante a monarquia”, Ph.D. thesis, Universidade Portucalense, Porto, 2004.

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