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Integrating ESG and AI in higher education: a conceptual framework for curriculum innovation

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Abstract: This paper examines the challenges and opportunities of integrating Environmental, Social and Governance (ESG) principles with artificial intelligence (AI) tools in higher education (HE), particularly in finance and business-related study programmes. Drawing on a structured review of recent academic literature and informed by insights from the Erasmus+ GenESG project, it identifies four key systemic gaps that hinder effective implementation: lack of standardised ESG frameworks, weak interdisciplinary integration, ethical uncertainties surrounding AI use, and low student engagement with sustainability topics.

Keywords: ESG education, higher education, sustainable finance, artificial intelligence in education, interdisciplinary learning

JEL classification: I23, Q56, O33

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Integracija ESG in umetne inteligence v visokošolskem izobraževanju: konceptualni okvir za inovativne učne načrte

Povzetek: Članek obravnava izzive in priložnosti vključevanja okoljskih, družbenih in upravljaljskih (ESG) vsebin ter orodij umetne inteligence (UI) v visokošolsko izobraževanje, zlasti na področju financ in poslovnih ved. Temelji na strukturiranem pregledu aktualne znanstvene literature ter na spoznanjih iz projekta Erasmus+ GenESG. Avtorji izpostavljajo štiri ključne sistemske vrzeli, ki ovirajo učinkovito vključevanje teh vsebin: pomanjkanje standardiziranih okvirov ESG, šibko interdisciplinarno sodelovanje, etične nejasnosti glede uporabe UI in nizko motivacija študentov za vključevanje v trajnostne teme.

Ključne besede: ESG izobraževanje, visokošolsko izobraževanje, trajnostne finance, umetna inteligenca v izobraževanju, interdisciplinarno učenje

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1 INTRODUCTION

Contemporary HE is undergoing profound transformation driven by global, national, and local forces, resulting in increasingly uneven patterns of institutional development (Marginson, 2004). Globalization and neoliberal market logics are exacerbating the stratification of universities, where elite institutions dominate access to research funding and visibility, while transnational education markets are increasingly detached from public good objectives such as equity, accessibility, and inclusion (Chankseliani et al., 2021).

In this shifting landscape, universities act both as competitive agents in a globalized economy and as key contributors to the achievement of the Sustainable Development Goals (SDGs). This dual responsibility compels them to design curricula that prepare students to navigate the complexities of environmental, social, and governance (ESG) challenges, while also mastering advanced digital technologies—particularly artificial intelligence (AI)—as part of a broader digital transformation (Mohiuddin et al., 2022).

The restructuring of HE is therefore being shaped by two interlinked paradigm shifts. The first is the transition towards sustainable finance, which merges economic, environmental, and social perspectives and reflects the growing importance of responsible investment, climate risk management, and long-term value creation. The second is the integration of AI as a transformative pedagogical and analytical tool, capable of personalizing learning, automating assessment, and enhancing student engagement through adaptive and data-driven methods (Truong and Papagiannidis, 2022; Jiang et al., 2022).

These developments require HE institutions to move beyond traditional teaching frameworks and adopt holistic, interdisciplinary, and ethically grounded approaches that align with the complexity of ESG-related issues and the disruptive potential of AI. As such, the transformation of curricula is not merely a technical update, but a strategic reorientation of the purpose and values of universities in the 21st century.

The aim of the article is to investigate how well AI tools and ESG content are incorporated into finance-related curricula at universities in Austria, Bulgaria, Poland, Slovenia, and the Netherlands. The key research question was twofold: (1) how are ESG content and AI tools being incorporated into financial education programs at higher education institutions?; and (2) what are the obstacles to incorporating these technologies into financial education programs at higher education institutions? The study was founded on a triangulation of research methods, which included a critical review of the literature on teaching ESG and AI tools, desk research analysis of educational programs in the five countries examined, focus group interviews with professors, and a quantitative student surveys.

The article contributes to the literature in several ways. First, it explains how finance curricula in Austria, Bulgaria, Poland, Slovenia, and the Netherlands incorporate AI tools and ESG content. Second, it offers a global viewpoint on the pedagogical and systemic shortcomings in the teaching of sustainable finance and ESG. Third, it showcases creative approaches and best practices for using AI tools to teach sustainable finance and ESG. It also contributes to the conversation about the ethical implications of AI in education.

The article is structured as follows: A review of the literature on ESG and AI tools in higher education teaching is done in the following section. Subsequently, the research methodology, data collection and analysis techniques, and selected sampling were introduced. The study's empirical findings, which were derived from curriculum analysis, focus group interviews with professors, and quantitative student surveys, are presented in the article's next section. The article's final section offers important findings and recommendations for further research.

2 LITERATURE REVIEW

2.1 ESG as a transformative framework in HE

The role of ESG principles as a critical framework for contemporary business strategy and regulation is rapidly expanding, with direct implications for the reconfiguration of HE curricula (Turcan and

Reilly, 2020; Smith and Fox, 2019). Concurrently, the digital transformation—where AI plays a central role in data analysis, decision-making, and automation—is accelerating the adoption of technological tools in educational contexts (Holmes and Porayska-Pomsta, 2023; Jiang et al., 2022).

Despite widespread acknowledgement of the relevance of both ESG and AI, their integration into HE remains highly uneven across Europe (Mohiuddin et al., 2022). In many academic environments, sustainability-related topics appear only as elective modules or peripheral content within existing programmes. Interdisciplinary linkages remain weak, and curricular reforms are often fragmented and incremental (Glastra et al., 2004). One of the most pressing challenges lies in bridging the divide between the technical comprehension of AI and the value-driven, ethical dimensions of ESG, which are frequently treated as distinct and disconnected educational domains (Olssen et al., 2004).

As Chankseliani et al. (2021) and Marginson (2004) argue, HE institutions operate within a tension between neoliberal market imperatives and their foundational mission as custodians of the public good. In this context, ESG education is not merely a content innovation but calls for a paradigm shift in pedagogical models—ones that foster critical thinking, ethical reflection, systems thinking, and digital fluency. These competencies are essential for preparing students to navigate the complexities of a world facing interconnected sustainability challenges and rapidly evolving technologies.

The integration of ESG into HE requires a reimagining of traditional disciplinary boundaries, particularly within economics and finance. It calls for the merging of economic reasoning with insights from environmental science, law, ethics, and technology. In this sense, ESG is not just a set of topics, but a transformation in how we conceive the role of business and finance professionals in society. Effective ESG education must therefore cultivate the ability to evaluate multifaceted data, apply ethical reasoning, and critically assess the societal impact of financial and managerial decisions.

2.2 AI as a pedagogical driver in ESG education

AI is becoming an increasingly prominent tool in HE, with the potential to enhance personalization, simulate complex decision-making, automate feedback processes, and dynamically adjust learning content in response to individual student progress (Holmes and Porayska-Pomsta, 2023). The capacity of AI systems to foster interactive and reflective learning environments is particularly valuable in the context of complex and multidimensional subjects such as ESG.

Among the most promising AI-enabled pedagogical strategies are the use of chatbots to support the analysis of ESG reports, simulations of decision-making scenarios that incorporate environmental and social risks, and structured monitoring of skill development through adaptive quizzes and automated feedback mechanisms. These innovations offer opportunities to shift away from traditional, lecture-centric teaching models toward more inquiry-based, problem-oriented, and student-centered learning experiences (Truong and Papagiannidis, 2022).

However, the integration of AI into education is not without its challenges. Issues such as unequal access to digital infrastructure, varying levels of digital literacy, and ethical concerns related to data privacy, algorithmic bias, and the opacity of automated assessment systems must be carefully addressed (Olssen et al., 2004). As Edwards and Usher (2001) argue, technology in education should not only be understood as a neutral tool, but also as an object of critical pedagogical inquiry—raising questions about power, surveillance, and the epistemological assumptions embedded in digital learning environments.

Consequently, AI must assume a dual role in HE. On one hand, it should function as an enabler of pedagogical innovation and curricular transformation. On the other, it should become a subject of critical reflection, with students learning to understand its capabilities, limitations, and societal impacts. In this light, the development of digital literacy, data ethics, and critical thinking emerges as a core component of ESG education in the digital age—equipping learners not only to use AI, but also to interrogate and shape its role in future socio-economic systems (Jiang et al., 2022).

2.3 Interdisciplinarity in ESG-oriented learning

Effectively addressing ESG challenges requires transcending traditional disciplinary boundaries. Issues such as climate change, environmental degradation, social inequality, weak corporate governance, and the societal impacts of technology are inherently complex, systemic, and interdependent. Responding to these challenges demands the integration of diverse fields of knowledge, including economics, environmental science, law, technology, ethics, and the social sciences (Glastra et al., 2004; Schlegel and Kraus, 2023).

These challenges are not only substantive but also pedagogical. Contemporary educational approaches—such as project-based learning, problem-oriented instruction, team collaboration, and cooperation with industry—are becoming essential components of learning environments that aim to foster interdisciplinary thinking and real-world application. Students must engage in settings where they are exposed to authentic ESG-related problems and collaborate across disciplines to co-create viable solutions (Mohiuddin et al., 2022).

Importantly, interdisciplinarity is not simply a matter of combining content from various fields. It involves cultivating transversal competences: the ability to collaborate effectively, communicate across disciplinary divides, translate conceptual frameworks between domains, and engage in co-design of sustainable responses. Achieving this shift requires institutional adaptations, including more flexible curricula, the development of shared modules, and the implementation of co-teaching models that draw on expertise from multiple disciplines (Schlegel and Kraus, 2023; Marginson, 2004).

Despite its strategic relevance, the implementation of interdisciplinarity is often hindered by structural limitations. HE institutions are frequently organized into disciplinary silos, with rigid curricular frameworks, bureaucratic obstacles, and limited incentives for interdepartmental collaboration. Nevertheless, successful examples—such as joint ESG projects involving students from multiple academic backgrounds, or the integration of real-world industry challenges into coursework—demonstrate that meaningful interdisciplinary education is not only feasible, but essential for the future of ESG learning.

2.4 Pedagogical and ethical implications of AI

The integration of AI into HE presents not only significant pedagogical opportunities but also raises complex ethical, methodological, and epistemological concerns. The growing use of generative AI models—such as ChatGPT—is transforming how students access information, produce academic texts, and participate in learning processes. These developments pose serious challenges for academic integrity, transparency, accountability, and the reliability of knowledge sources (Holmes and Porayska-Pomsta, 2023).

A recurring issue is that students frequently use AI tools without fully understanding the methodological assumptions behind generated content or critically evaluating its credibility. This can result in superficial analysis, uncritical replication of information, and a decline in research literacy. Ultimately, such practices risk undermining the development of essential academic competencies, including critical thinking, independent inquiry, and authentic engagement with learning tasks (Olssen et al., 2004; Edwards and Usher, 2001).

One of the most pressing ethical concerns is the invisibility of AI-generated input in final student submissions. Students often fail to disclose the use of AI tools, creating grey zones in terms of authorship, originality, and intellectual contribution. At the same time, educators are often left without institutional guidance regarding the permissibility, monitoring, or assessment of AI-supported work—leading to inconsistencies and uncertainties in academic practice.

Beyond the classroom, there is also a broader question of institutional responsibility. Universities are called upon to lead by example in developing ethical frameworks and technological solutions that uphold principles of fairness, transparency, data protection, and resistance to algorithmic bias (Jiang et al., 2022; Holmes and Porayska-Pomsta, 2023). Without a systemic and values-driven approach, there is a risk that AI will not serve as a catalyst for deeper learning but instead become a tool for perpetuating existing educational inequalities and epistemological flaws.

To ensure that AI supports—not compromises—the integrity of HE, institutions must adopt comprehensive strategies. These should include clear policies on AI usage, pedagogical support for critical AI literacy, and mechanisms to foster ethical reflection. Only through such an integrated approach can AI become a responsible and transformative element of academic life.

The GenESG project, as documented by Pawlik, Tomala, and Urbaniec (2025), conducted a comprehensive empirical study across five European countries—Austria, Bulgaria, Poland, Slovenia, and the Netherlands—using focus groups, student surveys, and desk research. The findings confirm many of the theoretical concerns discussed earlier, while also revealing nuanced, country-specific insights into the integration of ESG and AI in HE.

3 RESEARCH METHODOLOGY

This article aims to investigate the degree to which banks in Austria, Bulgaria, Poland, Slovenia, and the Netherlands are incorporating AI tools and ESG content into their finance-related curricula. As part of the GenESG project, Austrian, Bulgarian, Dutch, Polish, and Slovenian universities' ESG, sustainable finance, and AI tools curricula and literature were analyzed. Additionally, professors with experience teaching finance subjects from universities in Austria, Bulgaria, the Netherlands, Poland, and Slovenia participated in focus group interviews. They were able to determine particular training needs and competency gaps in ESG subjects and the application of AI in the classroom as a result (Pawlik et al., 2025). An online survey administered to students at DOBA Faculty of Applied Business and Social Sciences (Slovenia), FH Joanneum (Austria), Krakow University of Economics (Poland), The Hague University of Applied Sciences (the Netherlands) and University of National and World Economy (Bulgaria) served as the last step. This led to the formulation of the following research questions: (1) how are ESG content and AI tools being incorporated into financial education programs at higher education institutions?; and (2) what are the obstacles to incorporating these technologies into financial education programs at higher education institutions?

Three steps were taken to conduct the research analysis (Figure 1).

Figure 1. The three-step research process

Desk research

- The goal was to determine the potential of using AI, including chatbots, to teach sustainable finance and ESG while also identifying knowledge, skill, and resource gaps.
- An analysis of 28 universities in Austria, Bulgaria, Poland, Slovenia, and the Netherlands was conducted.

Focus group interviews

- Finding specific competency gaps and training requirements in the areas of ESG and AI in education was the goal.
- 32 professors in all took part in the focus group interviews.

Online survey

- Online survey aimed to bridge the ESG skills gap in higher education by integrating sustainable finance and AI-driven learning.
- A total of 385 responses were obtained.

Source: own elaborations.

Based on secondary data, such as literature reviews and university websites, the first step involved examining the ESG, sustainable finance, and AI tools curricula of a few chosen Austrian, Bulgarian, Dutch, Polish, and Slovenian universities. Six Austrian universities, six Bulgarian universities, five Dutch universities, six Polish universities, and five Slovenian universities were included in the research sample. All of the examined universities offer business and/or economics majors. The inclusion of ESG, sustainable finance, or AI tools courses in the curriculum was the first area of study. Analyzing the learning outcomes for the selected subjects was the next step. The third step involved examining the learning materials for the subjects under analysis. The methods and instructional resources utilized in the syllabuses of the examined subjects were the focus of the fourth area. During the desk research phase, several sustainable development best practices from the universities surveyed were also noted, with a focus on AI tools, ESG, and sustainable finance.

Through focus group interviews with professors who teach finance, the second phase of the study enabled us to examine the Content and Methodology of Teaching ESG and Sustainable Finance, Integration of Artificial Intelligence in Teaching ESG and Sustainable Finance, and Competencies and Development of AI-Based Tools in Education. Five professors from Austria, twelve from Bulgaria, five from the Netherlands, five from Poland, and five from Slovenia took part in the focus group interviews.

Through the integration of AI-based learning and sustainable finance, the third phase of the study sought to close the ESG skills gap in higher education. An online student survey was carried out for this purpose. Students at the DOBA Faculty of Applied Business and Social Studies (50 respondents), FH Joanneum (69 respondents), Krakow University of Economics (144 respondents), The Hague University of Applied Sciences (50 respondents), and University of National and World Economy (72 respondents) provided the research material. 385 responses in all were received.

The study's research methods included quantitative student surveys, focus group interviews with professors, desk research on educational programs in the five countries under investigation, and a critical review of the literature on teaching ESG and AI tools. The article's selection of research techniques was based on its ability to satisfy two research requirements: reliability and validity. Publicly accessible secondary data, focus group interview qualitative data, and online survey quantitative data were used to provide these criteria.

4 RESULTS

The following section presents key findings from the GenESG study, which explored how higher education institutions across five European countries (Austria, Bulgaria, Poland, Slovenia, and the Netherlands) are integrating ESG content and AI tools into finance-related programmes. Based on a qualitative analysis of focus group discussions with university educators, the results highlight major structural and pedagogical challenges, as well as emerging good practices. The sub-sections below are organized thematically, reflecting six core areas identified during the research process.

4.1 Fragmentation and uneven integration

ESG education is frequently fragmented and inconsistent across institutions and programmes. In most countries, ESG-related content is limited to elective or postgraduate courses, leaving undergraduate students with minimal exposure. While the Netherlands demonstrates more advanced integration—particularly through initiatives like the Sustainable Finance Lab and AI4FinTech—the overall picture shows sporadic efforts without systemic embedding in curricula.

4.2 Competence gaps among educators

Focus group interviews with academic staff revealed widespread gaps in ESG knowledge, particularly regarding international regulations, sustainability reporting, and interdisciplinary frameworks. Many lecturers also lack the training and confidence to integrate AI into their teaching, especially for ESG-related applications. There is limited access to AI tools and few institutional guidelines regarding ethical use, assessment practices, or curriculum design involving AI. This limits not only pedagogical innovation but also the standardization of quality instruction.

4.3 Structural and institutional barriers

The study identifies several institutional challenges: rigid disciplinary structures, insufficient collaboration between departments, and weak engagement with industry partners. These factors hinder the creation of interdisciplinary modules, limit access to real-world data, and slow down curriculum innovation.

4.4 Best practices and emerging solutions

Despite these challenges, the report identifies promising examples of innovation: the ESG Lab at Sofia University, simulation-based learning approaches in Slovenia, and AI chatbot projects in the

Netherlands serve as templates for wider adoption. These practices illustrate the potential for combining digital tools with real-world ESG problem-solving in meaningful ways.

4.5 Strategic recommendations

The findings underscore the need for a systemic, multi-level approach:

- *Curriculum Development*: Move beyond isolated ESG topics to integrated, cross-disciplinary modules.
- *Faculty Training*: Provide educators with the knowledge and tools to ethically and effectively use AI.
- *Student-Centred Pedagogy*: Expand the use of case studies, simulations, and industry collaboration.
- *Policy Support*: Establish institutional guidelines for AI in education and incentivise interdisciplinary collaboration.
- *Resource Access*: Improve availability of ESG databases, AI platforms, and multilingual educational materials.

In summary, the GenESG empirical research confirms that meaningful integration of ESG and AI in HE demands more than content additions—it requires structural reform, strategic investment, and pedagogical innovation. The identified gaps should serve as focal points for future curriculum design, training initiatives, and policy development to enable a truly transformative educational ecosystem.

5 CONCLUSION

The effective integration of ESG principles and AI into HE demands more than the mere revision of course content. It calls for a comprehensive transformation of pedagogical approaches, institutional frameworks, and the underlying value systems that shape how knowledge is produced, disseminated, and applied. In this evolving educational landscape, ESG must no longer be treated as a peripheral or optional component; instead, it must serve as a foundational axis around which curriculum design, teaching practices, and institutional strategies are organized. Only then can it fulfil its potential as a catalyst for connecting economic reasoning with ecological responsibility, social justice, ethical reflection, and digital innovation.

AI, in this context, is not just an instructional tool but also a subject of critical engagement. Its growing role in education presents both challenges and opportunities—demanding new didactic models grounded in personalization, student participation, interdisciplinary inquiry, and critical reflection (Holmes and Porayska-Pomsta, 2023). Educators and students alike must develop the capacity not only to use AI tools but to critically interrogate their implications for knowledge production, academic integrity, and social impact.

Achieving these objectives requires robust institutional support. Systemic incentives for interdisciplinary collaboration, sustained investment in faculty development, and access to up-to-date digital infrastructure are essential. Equally important is the establishment of clear ethical frameworks to ensure the responsible and transparent use of technology, protection of personal data, and maintenance of academic standards. Without such structures, there is a risk that the integration of ESG and AI will remain superficial or inconsistent.

The ESG framework, along with its associated competencies—systems thinking, ethical literacy, digital fluency, and sustainability awareness—provides a powerful foundation for preparing students to engage with the complexities of a rapidly changing world. From climate risk and ecological degradation to algorithmic inequality and misinformation, today's global challenges demand professionals who are not only knowledgeable, but also critically engaged and socially responsible.

In this context, HE institutions must move beyond reactive adaptation and assume a proactive role in shaping the contours of a more inclusive, ethical, and sustainable future. ESG and AI are not simply emerging trends—they are constitutive elements of a new academic paradigm. As such, they must be embraced not only as content areas but as structural pillars of a future-oriented university: responsible, collaborative, and aligned with the common good.

Moving forward, the findings of this study will feed into the next stages of the GenESG project, which aims to develop targeted microlearning tools and AI-assisted pedagogical models. As central agents of change, higher education institutions have a unique opportunity—and responsibility—to lead systemic innovation at the intersection of sustainability, technology, and education.

There are limitations to this article, just like with any scientific work. The critical literature review and several recommendations are not unique to this context, but the desk research analysis in each of the five countries was based on particular higher education institutions. Another drawback that can be mentioned is the convenience sampling used to gather information from both students and professors. Convenient access to participate in the focus group interviews and the quantitative student survey was a prerequisite for sample selection. The research sample was underrepresented, so it is not possible to extrapolate the findings to all students and professors in the countries under study.

It is worthwhile to conduct additional research that compares institutions with high and low levels of AI and ESG integration. Longitudinal studies on how student education affects AI-supported ESG courses could also be crucial. The ethical framework and the teaching staff's preparedness to use AI in the classroom are additional factors that merit more investigation.

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