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Transforming higher education through AI-enriched tools: an open innovation approach

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Introduction: The integration of AI-enriched tools is increasingly transforming the study process in higher education and reshaping teaching and learning practices. The aim of the study is to analyze the perceptiveness and evaluation of students and academic staff regarding the transformation of the study process, considering the integration of AI-enriched tools in higher education within the framework of the open innovation approach.

Methods: A sequential mixed methods design was employed. Quantitative data were collected through a survey of students and academic staff, followed by qualitative focus group discussions with separate participant groups to contextualize and deepen the interpretation of overall quantitative trends. Quantitative data were analyzed using descriptive and non-parametric statistical methods, while qualitative data were examined through thematic analysis. The integrated findings were subsequently structured using a SWOT analysis framework to identify strengths, weaknesses, opportunities, and threats related to the integration of AI-enriched tools in higher education.

Results: The findings indicate that both students and academic staff recognize the potential of AI-enriched tools to enhance the study process, although academic staff consistently report more positive evaluations. Both groups demonstrate moderate self-assessed confidence in AI-related skills, pointing to a shared competence gap. The SWOT analysis highlights strengths and opportunities related to pedagogical innovation and collaboration, alongside challenges associated with ethical concerns, institutional readiness, and the need for targeted competency development.

Discussion: The results suggest that the sustainable integration of AI-enriched tools in higher education requires a systematic and collaborative approach that combines competency development, professional and pedagogical support, and ethical governance. Framed within an open innovation approach, the study underscores the importance of collaboration among students, academic staff, institutions, and external stakeholders in supporting pedagogical transformation and the responsible use of AI technologies.

KEYWORDS

artificial intelligence, competency development, higher education, open innovation, study process transformation

1 Introduction

The swift advancement of technology and the growing accessibility of artificial intelligence (AI) enriched tools have profoundly reshaped the landscape of higher education. The adoption of AI-enriched tools is driving a rapid transformation of study practices, presenting not only novel opportunities but also intricate challenges. These developments underscore the necessity

for innovative pedagogical approaches and well-considered strategies for effective technology integration. UNESCO *Guidance for generative AI in education and research* (2023) emphasizes that AI has the potential to significantly change education systems, but its implementation must be ethically justified, fair and appropriately regulated. The literature highlights the potential of generative artificial intelligence tools (e.g., ChatGPT, Gemini) to personalize learning, improve student engagement and streamline administrative processes, while raising concerns about academic integrity, ethical use and the digital divide (Cai et al., 2024; Kurtz et al., 2024; Ali et al., 2024). Research by UNESCO highlights that Generative Artificial Intelligence tools have significant potential to promote learning and research, but their use must be based on a human-centred approach that respects ethics, inclusion, gender equality and cultural diversity (Miao and Holmes, 2023). In turn, the OECD research project “AI and the Future of Skills”, implemented at the Centre for Educational Research and Innovation, confirms that AI is fundamentally changing the work and education environment, requiring a thoughtful approach to assessing AI capabilities and comparing them with human skills (OECD, 2023). The impact of AI on education and employment is directly related to how the requirements for competencies – especially digital, problem-solving and collaborative skills – are changing, and how education systems are able to adapt to these changes. The OECD emphasizes that a multidimensional approach is needed, simultaneously encompassing both expert assessments and direct AI indicators, to understand the development of AI technologies and its interaction with human competencies in the context of education (OECD, 2023).

Strategic integration of AI-enhanced tools in higher education opens up opportunities for the transformation of the study process. Such technologies can enhance the learning experience by providing adaptive feedback, supporting self-directed learning and facilitating collaboration. Of particular importance are the possibilities for personalization, targeted feedback and structuring of study processes based on the development of student autonomy, critical thinking and reflection skills (Cai et al., 2024; Chang et al., 2023; Vorobyeva et al., 2025; Kakhkharova and Tuychieva, 2024). At the same time, integrating AI into education brings notable challenges. Key concerns include data privacy risks, algorithmic biases, and the widening digital divide all of which may impact both the accessibility and the quality of educational experiences (Alotaibi, 2024; Eden et al., 2024; Vorobyeva et al., 2025). The professional development of academic staff is also a significant issue – the effective use of AI tools requires not only digital literacy, but also the ability to integrate them into the study process in a pedagogically sound manner. Therefore, comprehensive professional development is needed to strengthen both technical and didactic competence. To address these challenges, well-thought-out educational policies and ethical regulations that set the boundaries of the use of AI and promote transparency are essential. At the same time, it is important to provide long-term support mechanisms for academic staff, especially those who are less confident in using AI (Chen et al., 2025; Sidorkin, 2025). A well-considered and strategic approach that aligns innovation potential with a commitment to academic integrity and equity can enable higher education institutions to leverage AI’s transformative capabilities for fostering inclusive and impactful learning experiences (Alotaibi, 2024; Alqahtani and Wafula, 2024; Cai et al., 2024; Eden et al., 2024).

These changes are occurring at a time when the education system must be able to adapt not only to technological challenges, but also to societal and labor market demands. The open innovation approach

offers an effective way to integrate AI-enriched tools into the study process, promoting collaboration between educational institutions, technology developers, and students as active co-creators. This perspective aligns with broader frameworks: the Sustainable Development Goals, particularly Goal 4 on quality education, which emphasizes inclusive and equitable learning opportunities (United Nations, 2015), and technology acceptance models such as the Unified Theory of Acceptance and Use of Technology, which provides guidance on factors influencing the adoption of new digital tools in educational settings, including performance expectancy, effort expectancy, social influence, and facilitating conditions (Taiwo and Downe, 2013). In this context, it is essential to understand how the integration of AI-enriched tools affects the transformation of the study process, how this change is perceived by students and academic staff, as well as what competencies are needed to ensure the meaningful and sustainable use of AI in higher education.

The aim of the study is to analyze the perceptiveness and evaluation of students and academic staff regarding the transformation of the study process, considering the integration of AI-enriched tools in higher education within the framework of the open innovation approach. In line with the study’s aim, the following research questions have been formulated:

- 1) What opportunities and challenges are seen by students and academic staff while integrating AI tools into the study process?
- 2) What competencies and prerequisites are considered essential for the effective use of AI-enriched tools in the study process?

In order to respond to the research questions and reach the study’s goal, the authors have defined the following research tasks:

- 1 To analyze scientific literature on the possibilities of integrating AI-enriched tools and their role on the transformation of the study process in higher education.
- 2 To conduct an empirical study to examine the experiences and perspectives of students and academic staff regarding the integration of AI-enriched tools in higher education, building upon insights gained from the literature review.
- 3 To summarize and structure the results obtained using SWOT analysis to identify the strengths and weaknesses, opportunities and threats of the integration of AI-enriched tools in higher education.
- 4 To promote discussion and further research on the necessary prerequisites and competencies to successfully implement AI-enriched tools in the study process.

2 Literature review

2.1 Integrating AI-enriched tools into higher education

The integration of AI-enriched tools in higher education is considered one of the most important factors in the transformation of the study process. The growing potential of AI opens up new opportunities for personalized, adaptive and student-centered learning environments. Several effective strategies for integrating AI tools in higher education have been identified in the literature. These include raising

awareness of disruptive changes, training faculty, reviewing teaching and assessment practices, collaborating with students, and transferring AI skills (Kurtz et al., 2024; Chang et al., 2023; Celik, 2022; Cordero et al., 2024; Chiu, 2024).

The use of AI-enriched tools in the study process allows for dynamic feedback, adaptive assessments, and personalized learning paths that improve student engagement and academic performance. Such tools can also facilitate self-regulated and reflective learning, where AI acts as a structured support for students' goal setting and progress monitoring (Chang et al., 2023; Sidorkin, 2025). At the same time, they foster a collaborative environment where students develop cross-curricular skills, such as critical thinking and problem solving, by working in teams and engaging in project-based learning experiences (Cai et al., 2024).

However, alongside the opportunities, there are also significant challenges—ethical and social issues such as data privacy, bias and risks to academic integrity, which create the need for clear ethical regulations and transparent practices (Alqahtani and Wafula, 2024; Eden et al., 2024). Research highlights that the readiness of academic staff to work with AI-enriched tools is uneven, and there is a risk of increasing the pedagogical gap if adequate support is not offered to academic staff who feel insecure in a technology environment (Chen et al., 2025). In addition, the adoption of AI can be hindered by technical barriers, such as lack of resources, unavailability of software or overly high expectations about the capabilities of AI (Vorobyeva et al., 2025).

Another important aspect is the digital divide – access to AI technologies and related training can deepen social and regional inequalities. This challenge is particularly significant in developing countries or remote regions where the relevant infrastructure or staff capacity is lacking (Alotaibi, 2024; Iskandarova et al., 2024). Mitigating these risks requires targeted professional development that promotes academic staff's AI literacy, ethical awareness and ability to adapt teaching to changing technological demands (Cai et al., 2024; Chang et al., 2023).

Research shows that training programs that include practical examples, support measures, and opportunities to collaborate with colleagues significantly improve faculty confidence and effectiveness in using AI (Cordero et al., 2024). In addition to professional development, institutional engagement is important – higher education institutions should develop flexible and value-based policies that support innovation while ensuring academic integrity, transparency, and accountability (Alqahtani and Wafula, 2024; Symeou et al., 2025).

Effective AI integration is possible when all stakeholders – students, academic staff, technology developers and policymakers – are involved and regular evaluation is ensured, adapted to the rapidly changing needs of technology and education (Mohebi, 2024; Kurtz et al., 2024). Achieving sustainable impact requires a unified strategic approach, where AI is used not as a technological addition to existing practices, but as a transformative tool in creating higher quality and more inclusive education.

The literature analyzed shows that the integration of AI has a significant transformative potential, but this opportunity is fully realized only if structural and pedagogical foundations are addressed. Firstly, AI should be considered not only as a technological tool, but rather as a catalyst for changes in the educational culture, requiring new competencies for both academic staff and students. Secondly, without targeted professional development, digital competence development and institutional leadership involvement, there is a risk that the

implementation of technologies will remain superficial or even increase existing inequalities. It is also essential to create regular evaluation mechanisms and flexible guidelines that would allow responding to changing challenges – both technological and ethical. Finally, special attention should also be paid to ensuring a balance between the capabilities of AI and the importance of the human factor in education, where empathy, critical thinking and pedagogical flexibility of academic staff still retain a central role.

2.2 The role and competencies of academic staff in the AI era

The integration of AI-enriched tools in higher education is changing the role of academic staff, while setting new challenges and requirements for the necessary competencies. Traditional functions, knowledge transfer and teaching management, are now being supplemented by new roles, such as the integration of digital technologies, data interpretation, the creation of collaborative environments and the strategy of AI application (Kumar et al., 2024; Cai et al., 2024). This process requires the development of competencies, especially in terms of transversal competencies and work with AI technologies. Faculty are expected to integrate AI-enriched tools into teaching, research, and administrative tasks, which can improve academic performance and efficiency, but also pose challenges such as increased stress and concerns about academic integrity and plagiarism (Sadallah et al., 2024; Titko et al., 2023; Ahmad et al., 2022; Abulibdeh et al., 2025).

Transversal competencies such as digital, research and innovation are becoming essential prerequisites for the transformation of the study process in the AI era. There is a high demand for professional development and institutional support among academic staff to develop skills, as well as clear ethical guidelines and strong policy frameworks to address issues such as data privacy and bias (Mah et al., 2025; Titko et al., 2023; Mazhar et al., 2025; Abulibdeh et al., 2025). While AI can facilitate knowledge sharing and reduce administrative burdens, its benefits are limited without adequate training and support structures (Ahmad et al., 2022; Kautonen and Gasparini, 2024; Mazhar et al., 2025). Transversal competencies are essential skills that go beyond specific knowledge in a specific field and are important for success in the labour market. These skills encompass effective communication, critical thinking, collaboration, adaptability, emotional intelligence, and the ability to solve problems. Rubene et al. (2021, 2023) identify a broad set of transversal competencies essential for navigating the challenges of modern higher education, including digital competence, innovation competence, research competence, global awareness, civic engagement, and entrepreneurship. In this article, particular attention is given to three of these competences – digital, innovation, and research – due to their close relevance to the integration of AI-enriched tools in the study process. These competencies are valuable because they are transferable across different contexts and professions, supporting lifelong learning and adaptability (Mezinska et al., 2024).

Digital competence not only improves the ability to use technology effectively, but also promotes innovative thinking and research productivity in both organizational and academic contexts (Espina-Romero et al., 2024; Shin and Choi, 2022; Huu, 2023; Brodny and Tutak, 2024). Research highlights that digital competence enables the ability to engage in creative problem solving, knowledge sharing, and innovative work, which are essential for adapting to rapid technological change (Huu, 2023; Mancha and Shankaranarayanan, 2020). The

integration of digital competence with innovation is associated with improved research outcomes, especially when supported by a supportive institutional environment and continuous professional development (Shin and Choi, 2022; Nasiri et al., 2020). In higher education, developing digital innovation capabilities among students and academic staff requires a combination of technical skills, motivation and a supportive environment that encourages experimentation and collaboration (Mancha and Shankaranarayanan, 2020; Huang et al., 2024). The synergy between digitalization and innovation is a key driver of competitiveness and sustainable development (Espina-Romero et al., 2024; Brodny and Tutak, 2024). Therefore, organizations and educational institutions are encouraged to prioritize training, access to digital tools and a culture that values creativity and research excellence in order to fully exploit these transversal competencies (Huu, 2023; Ramdani et al., 2021; Nasiri et al., 2020).

Academic staff can only successfully adapt to the AI era if they are provided with appropriate support mechanisms. Research highlights the need for regular professional development that includes practical examples, reflection, collaboration and the opportunity to adapt AI tools to the specific study process (Magrill and Magrill, 2024). Effective professional development is best achieved through collaborative learning communities, networking and institutional support that foster a culture of continuous improvement and shared responsibility for educational quality (Karu and Aava, 2023; Giridharan, 2022; Barry, 2022). Continuous Professional Development programs, including seminars, workshops and online resources, help academic staff keep up with pedagogical innovations and digital tools, ultimately improving both teaching quality and student outcomes (Yurynets et al., 2023; Giridharan, 2022; Sheridan et al., 2023). Methodological support further enriches professional growth and promotes the implementation of innovative teaching methods (Labzina, 2023). The Erasmus+ project “DialogEduShift: Transforming Higher Education Teaching and Evaluation Approaches in the Era of AI Chat Tools” no. 2023-1-PL01-KA220-HED-000167212 is directly aimed at the development of academic staff competencies in the era of artificial intelligence (Vindaca et al., 2024). The results developed within the project provide a significant contribution to the professional development of academic teaching staff, offering specific, practically applicable resources:

- Handbook on Usage of AI Language Models in Higher Education, which offers teachers structured recommendations and examples of good practices for integrating AI into the study process;
- Guidelines on the Use of AI Chat Tools in Higher Education which helps educational institutions make informed decisions in implementing AI;
- Online course for academic staff aiming to provide knowledge and skills on the effective use of language models such as ChatGPT in higher education (DialogEduShift, 2025).

The importance of such initiatives is also confirmed by recent studies, which show that regular engagement in professional development activities is associated with higher digital competence and greater motivation for lifelong learning (Yurynets et al., 2023; Efimova, 2024; Nychkalo et al., 2022). Such an approach strengthens the ability of educators to adapt to the challenges of the technological age, while maintaining academic quality and ethical standards.

The introduction of AI in education often faces initial resistance, which may be related to fear of change, lack of knowledge or lack of

trust in technology. To overcome this resistance, it is necessary to create a supportive culture of innovation, where AI is not perceived as a threat, but as a means to enrich the study process. A successful strategy is a gradual introduction, emphasizing pedagogical benefits and allowing academic staff to maintain autonomy (George and Wooden, 2023). The development of academic staff competencies is not a secondary aspect, but a prerequisite for the integration of AI in higher education to be sustainable, student-centered and responsive to the challenges of the 21st century.

2.3 Open innovation approach for integrating AI-enriched tools into higher education

Open innovation approach refers to a shift from a closed, institutionally constrained innovation process to a collaborative, knowledge-sharing model that also involves external stakeholders – industry, technology developers, society and policy makers (Chesbrough, 2003). Open innovation is particularly relevant when it comes to the integration of AI-enriched tools, as the development and use of these tools often require interdisciplinary collaboration. This model holds particular significance for the integration of AI-enriched tools, as it fosters cross-sectoral collaboration and highlights not only technological, but also pedagogical and ethical considerations in the educational context. In higher education, the open innovation approach is expressed in the co-creation of study content, where academic staff, students, researchers and external partners are involved. Such collaboration allows the inclusion of real-life problems, AI solutions and industry news in the educational process, creating a flexible and future-skills-oriented study environment (Bogers et al., 2018).

The integration of AI-enriched tools in higher education requires not only a technological approach, but also an understanding of how these tools can be meaningfully adapted to study goals. Open innovation here serves as a framework that allows higher education institutions not only to use existing technologies, but also to participate in their development in collaboration with industry and society, becoming active participants in the innovation ecosystem (Magrill and Magrill, 2024; Southworth et al., 2023; George and Wooden, 2023). Several important aspects are highlighted in the implementation of this approach:

- Interdisciplinary collaboration is a prerequisite for integrating AI into all fields of study, not just computer science. It helps students develop a broad AI literacy and prepare for diverse careers. Collaboration with industry and policymakers helps align study programs with labor market demands (Magrill and Magrill, 2024; Southworth et al., 2023).
- Involving academic staff, students and external partners in the development of AI solutions, ensuring that the technology is practically applicable, ethically justified and tailored to specific study needs (Kumar et al., 2024; George and Wooden, 2023).
- Ethical and social aspects of using AI require attention to risks related to algorithmic bias, data security and academic integrity, and must be addressed through clear ethical principles and transparent institutional policies (Francis et al., 2025; Msambwa et al., 2025).

An important aspect is the development of academic staff competencies, which include technological literacy, pedagogical

understanding and the ability to adapt to changing AI technologies (Fayziyeva, 2025; Cai et al., 2024). Open innovation also promotes a cultural change in higher education – creating innovations becomes a process of collaboration and co-creation, rather than just an internal institutional activity. AI tools here serve not only as teaching support tools, but also as objects of collaboration and research, combining the technological and pedagogical dimensions. This approach allows higher education institutions to use the potential of AI in a balanced way, creating an inclusive, collaborative and future-skills-based study environment.

The practical implementation of the open innovation approach also requires appropriate governance that is able to balance technological development with the principles of educational quality and ethics. Higher education institutions should develop policy documents that define the conditions for the use of AI, as this promotes trust and a sense of security for transformation (Francis et al., 2025; OECD, 2023). Yun et al. (2024) argue that the dynamics of open innovation in the context of digital transformation require regulatory transformation to stimulate the growth of transformed new industries. Similarly, in higher education, supportive and flexible regulatory architectures are essential to ensure that innovation does not threaten educational quality, equity, or trust. At the same time, governance mechanisms should not hinder flexibility and innovation, therefore balanced policies are a prerequisite for responsible integration of AI.

From a pedagogical perspective, this approach also promotes a shift from traditional, passive learning to active, problem-based learning, where AI-enriched tools are not perceived as an end goal, but as a tool that supports the development of thinking, reflection, and collaboration (Lan and Zhou, 2025; Msambwa et al., 2025). In such an environment, the role of the teacher changes from a transmitter of knowledge to a curator or designer of the learning environment.

The development of transversal competencies, in particular digital literacy, investigative thinking and innovation skills, is one of the most important prerequisites for the meaningful integration of AI-enriched tools in higher education. These competencies are considered essential requirements of the 21st century, as they not only ensure the ability of students to operate in an AI-enriched environment, but also allow them to actively participate in the creation of new solutions, problem analysis and the development of sustainable innovations. Scientific literature confirms that the systematic development of these competencies promotes deeper engagement in the study process, improves the quality of learning and prepares students for work in complex and technologically advanced contexts (Mezinska et al., 2024; Benvenuti et al., 2023; Huang, 2021). Thus, the systematic inclusion of transversal competencies in the study process, including in cooperation with external partners and using AI-enriched tools, is one of the most important prerequisites for ensuring high-quality and future-oriented education.

Given the potential of the open innovation approach and the challenges associated with the integration of AI, it becomes essential to

understand how this transformation is perceived in higher education practice. Although the literature emphasizes the importance of AI-enriched tools in personalizing learning, developing competencies and promoting collaboration, practical implementation still depends on the ability of universities to involve all stakeholders, create clear regulations and develop academic staff competencies. Therefore, it is necessary to study in depth how these changes are evaluated by students and academic staff – how they see the role of AI-enriched tools on the quality of studies, what benefits and obstacles they experience in practice and what competencies they consider essential in the context of these technological changes. Such an understanding is essential for developing evidence-based pedagogical strategies and creating an inclusive, responsible and effective process of AI-enriched tools integration in higher education.

3 Methodology

3.1 Design

This research adopts an sequential mixed methods approach, in which qualitative data are used to contextualize and deepen the interpretation of findings obtained through quantitative analysis (Toyon, 2021). The study was conducted in several stages (see Figure 1), including a literature review, a survey and focus group discussion, as well as data collection in a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis (Helms and Nixon, 2010). First, a scientific literature review was conducted to identify pedagogical strategies, challenges and competence needs related to the integration of AI-enriched tools in higher education. Special attention was paid to transversal competencies, digital, research and innovation, as essential components of the transformation of the study process. In the second stage, an empirical survey was conducted with the participation of academic staff and students. Quantitative data were analyzed to assess respondents' attitudes towards the integration of AI-enriched tools in higher education, as well as to identify potential differences between students and academic staff. In the third stage, 2 focus group discussions were conducted, one of which was attended by academic staff, while the other was attended by student representatives. The discussion was organized to understand in depth the results obtained in the quantitative survey and to analyze practical experiences related to the use of AI tools. The focus group data were analyzed using a SWOT analysis approach.

The empirical study used both quantitative and qualitative research methods. As part of the quantitative part, a survey of academic staff and students was conducted, the aim of which was to find out their opinions on the role of AI-enriched tools on the quality of the study process, the development of transversal competencies and the perceived need for professional development. The

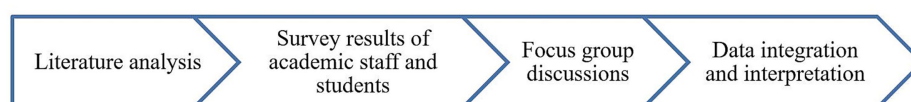


FIGURE 1
Research design.

obtained data were analyzed using statistical data processing methods to assess the differences in the perceptions of academic staff and students about the opportunities, challenges and their role in the development of competencies. In turn, to understand in depth the experiences, attitudes and contextual nuances of the participants regarding the integration of AI-enriched tools into the study process, a qualitative method was used, which included focus group discussions and content analysis. The focus group discussions explored and organized aspects previously identified in the literature review and quantitative survey, with particular emphasis on transformation conditions such as digital literacy and research and innovation competence. The participants' opinions were collected and analyzed using a SWOT analysis to identify the strengths, weaknesses, opportunities, and threats of AI integration. This analysis provided a complementary perspective on the institutional and pedagogical challenges, as well as strategic opportunities for improving the quality of education, based on the principles of open innovation.

The data obtained from all stages of the study were integrated using the principle of triangulation – comparing and complementing the findings of scientific literature, survey results and conclusions of focus group discussions. Such an approach allowed to ensure the reliability of data interpretation and to gain a deeper understanding of the role of AI-enriched tools on the quality of the study process and the development of competencies. The analysis of the results was carried out using interpretive analysis, the aim of which was to identify thematic connections between AI integration and the transformation of higher education, with a special emphasis on the perspective of students and academic staff. The conceptual model developed by the authors, grounded in triangulated findings, illustrates the potential and necessary conditions for the integration of AI-enriched tools in higher education, with a focus on transversal competencies and cross-sectoral collaboration.

3.2 Participants

A total of 97 individuals participated in the quantitative part of the study, including 45 students and 52 academic staff. The student group included 35 women and 10 men, whereas the academic staff group was composed of 38 women and 14 men. Student participants represented different levels of higher education, including first-cycle professional higher education, bachelor's, master's, and doctoral studies. The respondents represented Latvia, Bulgaria, Cyprus, France, Greece, Mexico, Norway, Italy, Lithuania, Romania, Spain, and Ukraine. The choice of countries was determined by the participants' involvement in joint international educational and research projects, as well as the goal of obtaining comparative insight into the integration practices and perceptions of AI-enriched tools in different cultural and educational contexts. While this international composition provided valuable diversity of experiences, the distribution of respondents across countries and study levels was uneven. Therefore, the data were analyzed at an aggregated level, focusing on overall trends in students' and academic staff perceptions rather than on country-, discipline-, or institution-specific comparisons.

In addition to the survey participants, a separate and non-overlapping group of 12 experts took part in two focus group discussions: in the first group – 7 academic staff representatives, in the second group – 5 engineering students (see Table 1). Participants for the focus group discussions were selected using the convenience sampling

TABLE 1 Profile of focus groups participants.

No of participant	Academic position	Gender
1	PhD in education science, lead researcher	Female
2	PhD candidate in education science, researcher, lecturer	Female
3	PhD in engineering and technology, professor, AI specialist	Male
4	PhD candidate in engineering and technology, researcher, AI specialist	Male
5	PhD candidate in engineering and technology, researcher, lecturer	Male
6	PhD in education science, lecturer	Female
7	PhD in economics and business, professor, lead researcher	Female
8	Bachelor's student in engineering sciences	Female
9	Bachelor's student in engineering sciences	Female
10	Bachelor's student in engineering sciences	Male
11	Bachelor's student in engineering sciences	Male
12	Bachelor's student in engineering sciences	Male

method, taking into account their availability and relevance to the thematic focus of the study (Battaglia, 2008).

3.3 Procedure

Quantitative data were obtained using an assessment survey, data collection was carried out using the *QuestionPro* platform. The survey provides an opportunity to assess respondents' attitudes towards the use of AI-enriched tools in the study process, their potential benefits, risks and role on the development of transversal competencies. Participants were recruited through partner institutions involved in the joint international educational, and research projects and professional academic networks. Invitations to participate were distributed via institutional mailing lists and direct email communication. Participation was voluntary, and no incentives were provided. As the survey link was disseminated through multiple channels, a precise response rate could not be calculated. This limits the ability to assess potential self-selection bias and is therefore acknowledged as a limitation of the study. Several aspects were considered to ensure validity – face validity was assessed by reviewing the questions with experts in the field and ensuring their conceptual relevance, content validity (the survey was developed based on previously identified theoretical models and an analysis of scientific literature) (Geske and Grinfelds, 2020). The questionnaire defined 7 statements, which were measured on a 7-point Likert scale (where 1 = strongly disagree and 7 = strongly agree). To evaluate the reliability of the questionnaire, Cronbach's alpha coefficient was calculated and yielded a result of 0.808. This value corresponds to good internal consistency, which indicates that the questions included in the questionnaire consistently measure a single construct under study. According to

methodological guidelines (Tavakol and Dennick, 2011), alpha values in the range of 0.8 to 0.9 indicate good reliability of the measuring instrument. Thus, the obtained data are considered suitable for further quantitative analysis. The survey was conducted from May 13 to June 17, 2024. The survey was offered in two language versions, Latvian and English, with identical content, ensuring that all participants had access to the same questions and instructions regardless of their language preference. The obtained data were analyzed using the statistical software JASP.

On June 27, 2025, two focus group discussions were organized in person with the aim of gaining a deeper understanding of the role of the AI-enriched tools in the higher education study process, as well as to clarify which competencies are considered essential in the AI era. The discussions were led by one of the study authors, ensuring an open-ended conversation in which participants were encouraged to freely express their opinions and respond to what others said. At the beginning of the discussions, the leader provided a brief overview of the strategies for integrating artificial intelligence in higher education and introduced the participants to the results of the previously obtained quantitative survey data, which served as the basis for structuring the discussion. The discussions were conducted in person in Latvian and lasted 90 min for academic staff and 60 min for students. The focus group data were transcribed and analyzed using thematic analysis following Braun and Clarke (2006). Initial coding and theme development were conducted by one of the study authors, after which the emerging themes were discussed within the research team to ensure conceptual consistency and alignment with the study aims. The identified themes were subsequently synthesized and organized using a SWOT framework, enabling a structured interpretation of participants' perspectives by categorizing them into strengths, weaknesses, opportunities, and threats related to the integration of AI-enriched tools. Thematic saturation was considered achieved when no substantially new themes emerged across the two focus group discussions and when similar patterns were observed in both participant groups. As the focus group discussions were conducted in Latvian, the transcripts were translated into English by the researchers involved in the analysis. Particular attention was paid to preserving the original meaning and context of participants' statements. The study was conducted in accordance with ethical research standards, adhering to the requirements of the General Data Protection Regulation. All survey and focus group participants were informed about the purpose of the study and provided their consent to participate. The collected data were processed anonymously, stored securely, and made accessible only to the research team.

4 Results

The study analyzed both quantitative and qualitative data to understand the perspectives of academic staff and students on the integration of AI-enriched tools in higher education. Data triangulation allowed the identification of both common and different aspects regarding perceptions, risks, benefits, and competence development needs.

Quantitative data were collected from 97 respondents to 45 students (mean age 30.93) and 52 academic staff (mean age 48.19). Among students, 14 were enrolled in first-cycle professional higher education programs, 23 in bachelor's programs, 4 in master's programs, and 4 in doctoral studies. This distribution helps explain the

relatively high mean age of the student group, as it includes adult learners and students at advanced levels of study. The student group included 35 women and 10 men, whereas the academic staff group was composed of 38 women and 14 men. This distribution shows that the sample represents a relatively balanced gender structure, with slightly higher female participation, and reflects the diversity of international backgrounds in higher education. To assess the opinion on the integration of AI-enriched tools in higher education, the respondents' (academic staff and students) ratings of the role of AI-enriched tools in the study process were analyzed. Since the data did not meet the assumptions of parametric statistics ($p < 0.05$), group differences were tested using the Mann–Whitney U test. Mean ranks are reported as recommended for non-parametric group comparisons, while mean values are provided for descriptive purposes only (see Table 2).

The analysis revealed several statistically significant differences between students and academic staff. Overall, academic staff consistently rated the role of AI-enriched tools in the study process higher than students. For example, academic staff rated the role of AI in the study process higher (mean = 5.12) compared to students (mean = 4.53), and this difference was statistically significant ($p = 0.037$). A similar trend was observed with regard to the development of transversal competencies: academic staff were much more confident in stating that AI improves both their own (mean = 5.37, $p < 0.001$) and students' (mean = 4.92) competencies than students.

A significant difference was also found in the question of the need to supplement knowledge in the use of AI – the average rating of academic staff (mean = 5.60) was higher than that of students (mean = 4.73, $p = 0.012$), indicating their increased self-reflection and readiness to improve. Similarly, the opportunities created by AI for improving the study process were rated significantly higher in the academic staff group (mean = 5.69 vs. mean = 4.53, $p < 0.001$). In turn, a statistically significant difference ($p = 0.005$) was found regarding the threats posed by AI in the study process, where academic staff (mean = 5.33) perceive risks more strongly than students (mean = 4.38), which could indicate a deeper understanding of aspects of ethics, academic integrity, or privacy.

Overall, the results indicate differences in perceptions between academic staff and students, especially regarding the opportunities and challenges of AI in improving the quality of education. This indicates the need for coordinated awareness-raising and support mechanisms that would promote more active engagement of both students and academic staff in the integration of AI-enhanced tools into the study process.

Two focus group discussions were organized as part of the study. The discussions were structured according to the research questions. Thematic analysis (Braun and Clarke, 2006) was used for data analysis, which allowed for the identification and systematization of main themes and subthemes. The results were structured within the framework of SWOT analysis, dividing the responses into four thematic blocks: strengths, weaknesses, opportunities and threats. Each of these categories revealed distinctive patterns and insights, beginning with the strengths identified by both academic staff and students.

Strengths: In focus group discussions, participants from both groups acknowledged that AI provides significant advantages in the study process. The ability of AI-enhanced tools to quickly summarize and structure information, as well as to provide conceptual overviews that help to better understand complex topics, was emphasized. Several participants mentioned that AI can act as an “idea generator”

TABLE 2 Student and academic staff evaluations of the role of AI-enriched tools.

Statement	Mean		Mean rank		p/sig.
	Students	Academic staff	Students	Academic staff	
AI-enriched tools improve the study process	4.53	5.12	42.79	54.38	0.037
The integration of AI-enriched tools in higher education supports the development of transversal competencies among academic staff	4.44	5.37	38.47	58.12	< 0.001
The implementation of AI-enriched tools in higher education supports the development of transversal competencies among students	4.36	4.92	43.42	53.83	0.060
I have sufficient knowledge and skills to use AI-enriched tools in my work/study activities	3.89	4.38	45.07	52.40	0.195
I feel the need to improve my knowledge and skills in using AI-enriched tools in the study process	4.73	5.60	41.49	55.50	0.012
AI creates opportunities to improve the study process	4.53	5.69	36.67	59.67	< 0.001
AI presents challenges for the study process	4.38	5.33	40.59	56.28	0.005

or “first draft assistant,” especially when working on creative tasks, project ideas or preparing lecture content.

Academic staff members pointed to the usefulness of AI in saving time and facilitating routine tasks, such as checking grammar, creating references or selecting thematic information. The role of AI in supporting students’ self-directed learning was also positively assessed. Some participants compared AI to an “additional intellectual resource” that can help ask better questions and expand thinking.

While the strengths reveal considerable optimism and perceived benefits, the discussions also brought attention to a number of challenges and limitations associated with AI integration. These are reflected in the following weaknesses. Weaknesses: Both students and academic staff acknowledged that in practice there is still a lack of full knowledge and confidence in how to effectively and ethically integrate AI-enhanced tools into the study process. In particular, limited AI skills and a lack of critical thinking regarding the information generated by AI were highlighted. Students indicated that they often do not know how to evaluate the content offered by AI or how to interpret it, while academic staff highlighted the lack of methodological guidelines from institutions.

Several students in the discussion admitted that they do not use AI-enhanced tools themselves in the study process or do so very minimally. There was a certain caution and distrust of the information provided by AI, especially in relation to the correctness of the language or the quality of the information. At the same time, it was mentioned that academic staff lacks support, both technical and pedagogical, to ensure that the integration of AI is consistent and useful.

Despite the identified gaps and challenges, focus group participants also saw significant development directions and opportunities that the use of AI-enriched tools could open up in the transformation of the study process. Opportunities: Participants mentioned personalized learning opportunities, adaptive feedback, and individual progress monitoring as areas where AI can significantly improve the student study experience. Academic staff members expressed greater optimism about the possibilities of AI in the development of study materials. It was mentioned that AI can serve as a tool that supports interdisciplinary collaboration, helps prepare for labor market challenges, and promotes student autonomy. Several participants emphasized that the results provided by AI should be interpreted with critical

thinking, and users should be able to assess the reliability of the information themselves.

However, alongside the opportunities, concerns were also expressed about the risks and potential negative consequences that could arise if AI-enriched tools are not used thoughtfully and responsibly. Threats: The tendency for students to use AI to avoid active engagement and reflection, thus undermining academic integrity, was highlighted. Concerns were expressed that AI-enriched tools are used for automated task completion rather than as a support for thinking and analysis. Unequal access to AI-enriched tools was also mentioned, which may exacerbate the digital divide between different user segments. Both students and lecturers pointed out the need to strengthen ethical guidelines and responsible use to prevent risks to information quality and AI-generated erroneous or unverified content.

The focus group findings provided qualitative support for several patterns identified in the survey data. For example, the quantitative results showed that academic staff consistently rated the role of AI-enriched tools higher than students, particularly with regard to opportunities for improving the study process and supporting competency development. This trend was reflected in the focus group discussions, where academic staff expressed greater optimism and confidence in the pedagogical potential of AI, while students more frequently emphasized uncertainty, limited experience, and the need for guidance. Similarly, the survey results indicating moderate confidence in AI-related skills among both groups were echoed in the focus group themes related to insufficient digital competence, the need for professional development, and concerns about ethical and responsible use. These qualitative insights helped to contextualize the quantitative findings and deepen the understanding of underlying perceptions and concerns.

The conceptual model presented in Figure 2 was developed through the integration of quantitative survey results, qualitative focus group insights, and the structured synthesis provided by the SWOT analysis. The survey findings revealed statistically significant differences between students and academic staff regarding the perceived role of AI-enriched tools in improving the study process, supporting the development of transversal competencies, and addressing challenges related to AI integration. These findings informed the model components related to stakeholder roles, competency development, and perceived opportunities and risks.

The focus group discussions further contextualized and expanded these results by highlighting concrete experiences related to institutional support mechanisms, leadership, ethical considerations, and professional development needs. These themes are reflected in the model as enabling and contextual conditions for meaningful AI integration. In turn, the SWOT analysis provided a systematic synthesis of strengths, weaknesses, opportunities, and threats associated with AI-enriched tools, directly informing the model's dimensions related to institutional readiness, sustainability, and collaboration. Through this triangulation of data sources, the conceptual model represents an integrative framework that links empirical evidence with theoretical insights to illustrate the key conditions, stakeholders, and support mechanisms involved in the sustainable transformation of the study process through AI-enriched tools.

As illustrated in Figure 2, the proposed conceptual model identifies three interrelated support mechanisms that underpin the meaningful and sustainable integration of AI-enriched tools in higher education within an open innovation approach. The first mechanism, competence-based support, refers to the development of digital, research, and innovative competencies among both students and academic staff. The empirical findings indicate that moderate self-assessed confidence in using AI tools highlights the need to strengthen these competencies as a foundation for effective AI adoption. The second mechanism,

professional and pedagogical development support, emphasizes continuous professional learning, methodological guidance, and capacity building for academic staff. This mechanism reflects the study's findings that academic staff play a key role in driving AI integration, yet require ongoing support to align technological possibilities with pedagogical goals. The third mechanism, ethical and regulatory governance support, encompasses institutional policies, ethical guidelines, and regulatory frameworks that ensure responsible, transparent, and equitable use of AI. Both survey and focus group data underscored the importance of clear ethical boundaries and institutional leadership in mitigating risks related to academic integrity, data privacy, and bias. Together, these support mechanisms operate within a collaborative ecosystem involving students, academic staff, institutions, and industry, reinforcing the open innovation approach and enabling the pedagogical strategies necessary for sustainable educational transformation.

The results of the study allow us to draw conclusions about the views of students and academic staff on the integration of AI-enriched tools in higher education. The effective integration of AI-enriched tools in higher education requires a systematic approach that includes both professional development and institutional support for academic staff, as well as strengthening students' digital competence and building ethical awareness. The results also highlight the importance of

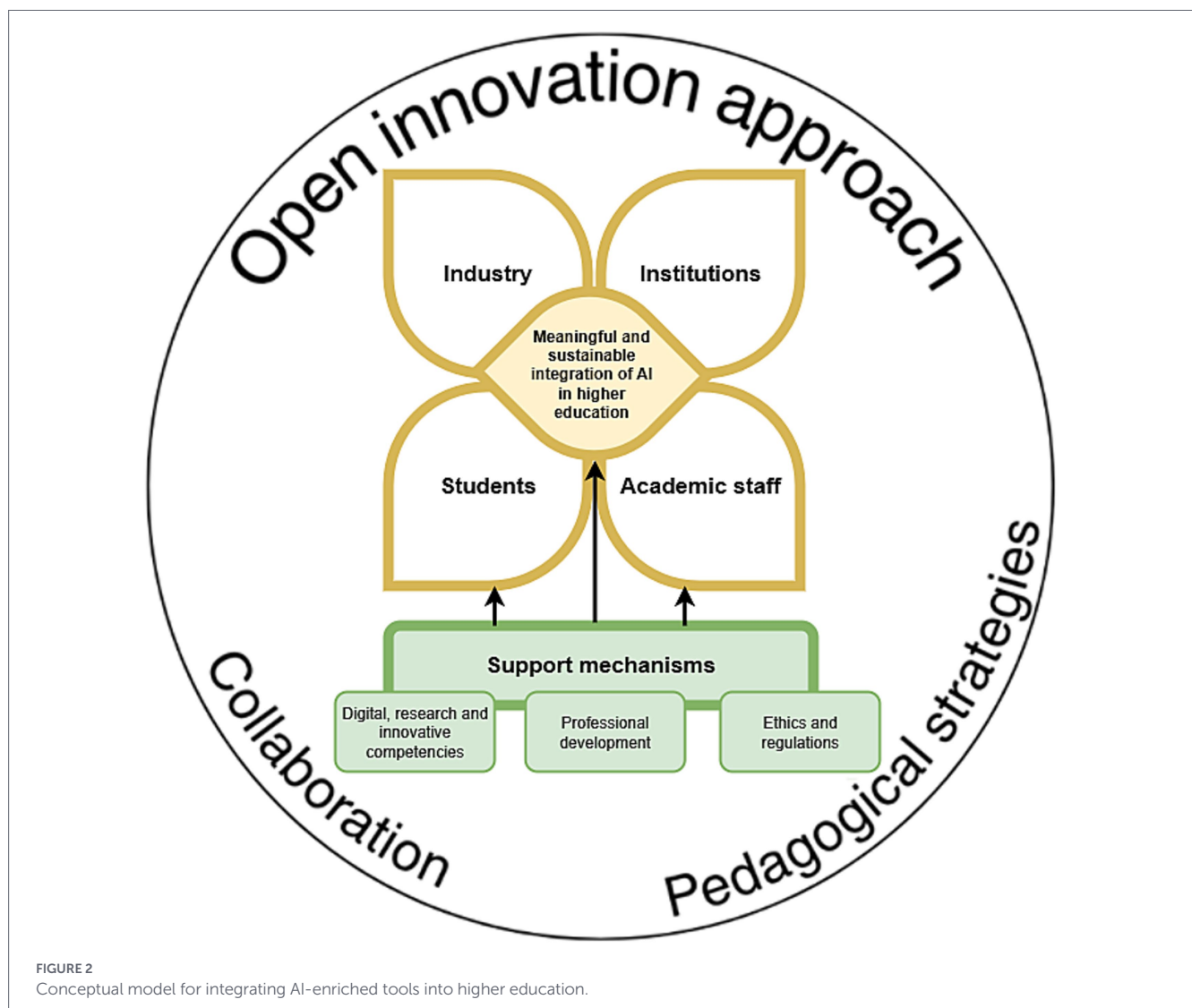


FIGURE 2
Conceptual model for integrating AI-enriched tools into higher education.

interdisciplinary collaboration and active learning as important aspects to achieve a modern and future-oriented learning environment. Integration is not a one-time process, but a continuous collaboration between stakeholders, policymakers, academic staff, students and industry representatives. It is precisely such an open, ethically based and collaborative approach that can ensure that the potential of AI is used to its full potential, responsibly and sustainably.

5 Discussion

The literature reviewed in the study shows that integrating AI-enhanced tools into higher education can significantly improve teaching and learning outcomes if institutions adopt comprehensive strategies that address pedagogical, ethical, and technical aspects (Kurtz et al., 2024; Chang et al., 2023; Celik, 2022; Cordero et al., 2024; Chan, 2023; Chiu, 2024; Walter, 2024; Eden et al., 2024). The literature confirms the need for training academic staff, curriculum redesign, and AI literacy development among both educators and students (Kurtz et al., 2024; Chang et al., 2023; Celik, 2022; Ng et al., 2023; Iskandarova et al., 2024). However, the authors also highlight potential challenges, including the digital divide, ethical concerns, and resistance to change, that hinder the equitable and sustainable implementation of AI-enriched tools in educational settings (Ali et al., 2024; Alotaibi, 2024; Iskandarova et al., 2024; Eden et al., 2024).

The results of the study confirm the trends identified in the literature and reveal that both students and academic staff recognize the potential of AI in improving the study process. While both groups acknowledge AI's value in education, academic staff consistently provided more positive evaluations. This discrepancy may be attributed to their deeper disciplinary knowledge, more extensive exposure to institutional initiatives, or a stronger sense of ownership in shaping educational innovation. This is consistent with previous findings that highlight the importance of faculty digital competence and proactive attitudes in the adoption of educational technologies (Mah et al., 2025; Titko et al., 2023). It is also noteworthy that several differences between students and academic staff were not statistically significant, particularly regarding self-reported confidence in using AI-enriched tools. The moderate mean scores reported by both groups suggest a shared perception of insufficient AI-related skills, indicating a broader competence gap that affects both learners and educators. This finding highlights that AI integration challenges are not limited to one stakeholder group but require institution-wide capacity-building initiatives.

Although the study involved participants from multiple countries, the findings are interpreted at an aggregated level. Differences in national education systems, institutional strategies, disciplinary cultures, and levels of digital maturity may influence how AI-enriched tools are perceived and integrated in practice. While these contextual factors could not be examined systematically due to sample size and distribution constraints, the observed patterns suggest that institutional roles, access to innovation processes, and professional responsibilities may play a more significant role in shaping perceptions than national context alone. Future research could build on these findings by adopting comparative or multi-level designs that explicitly examine how contextual and cultural factors mediate AI integration in higher education.

This study also explores the integration of AI-enriched tools through the lens of the open innovation approach, emphasizing the importance of stakeholder engagement and cross-sectoral

collaboration. Theoretically, the findings reinforce the importance of open innovation as a framework for analyzing AI integration in higher education. These principles suggest that higher education institutions should not operate in isolation but instead create innovation ecosystems involving students, academic staff, administrators, industry, and policy makers. The focus group data support this view by revealing that academic staff are more actively involved in the implementation of AI-enriched tools and perceive themselves as contributors to institutional innovation. This aligns with prior research emphasizing the critical role of faculty in driving technological change (Titko et al., 2023). In contrast, students appear less engaged in these processes, which may signal a missed opportunity for participatory design and co-creation. This discrepancy points to the need for a more intentional inclusion of students as co-creators in AI-related educational reforms. Bridging this gap requires deliberate strategies to strengthen both technological and social collaboration across institutional roles. An inclusive culture of AI integration should be fostered through shared responsibility, open dialogue, and mechanisms that build trust, capacity, and a common vision.

AI-enriched tools hold considerable promise for reshaping educational practices and enhancing the learning experience. However, the realization of these benefits depends on how well the challenges related to technology, academic staff competence and ethics are addressed. Sustainable and meaningful integration demands not only access to tools, but also a clear ethical and pedagogical framework that guides their use. Strategic planning, professional development support and responsible leadership are critical factors for achieving effective and equitable integration of AI-enriched tools in higher education. From a practical and policy perspective, these insights underline the need for institutional strategies that balance innovation with equity and ethics.

In light of these findings, we recommend developing structured professional development initiatives that extend beyond technical training to encompass ethical reasoning, pedagogical innovation, and critical reflection. These efforts should be grounded in inter-institutional collaboration and aligned with the principles of open innovation, ensuring that AI integration contributes to both academic excellence and institutional transformation.

6 Limitations and future work

The authors acknowledge certain limitations of the study; the selection of model components was informed by triangulated data, yet their validation calls for further investigation. One limitation is the use of convenience sampling for the focus group discussions, which may limit the transferability of the qualitative findings, as participants were selected based on their availability and willingness to participate. While this approach allowed for valuable qualitative insights from respondents with direct experience using AI tools, it limits the generalizability of the results to a broader population of academic staff and students. In addition, due to the distribution of the assessment survey through multiple institutional and professional channels, a precise response rate could not be calculated. The use of voluntary participation and the absence of a documented response rate may have introduced self-selection bias, as individuals with a stronger interest in AI-related topics may have been more likely to participate. Although the study involved respondents from multiple countries and study levels, the uneven distribution across these categories limited the feasibility of subgroup analyses. Therefore, the findings should be interpreted as indicative of general trends rather

than context-specific differences. Although the qualitative phase followed the quantitative phase, the focus group participants were separate and non-overlapping from the survey respondents. As a result, the qualitative data were used to contextualize and deepen the interpretation of overall quantitative trends rather than to explain individual survey responses, which limits the explanatory strength of the mixed methods design at the individual level. Another limitation is that the focus group discussions were conducted in Latvian, which may have influenced nuances of meaning during translation into English for analysis and reporting. Future studies would be recommended to use a more representative sample or expand the range of participants to strengthen the comparability of data across institutional and cultural contexts.

7 Conclusion

By conducting this study, the authors explored student and academic staff perspectives on how the integration of AI-enriched tools, within the framework of the open innovation approach, contributes to the transformation of the study process in higher education. Quantitative and qualitative methods complemented each other, providing a multidimensional perspective on the potential, challenges, and required competencies of integrating AI-enriched tools.

Regarding the first research question (What opportunities and challenges are seen by students and academic staff while integrating AI tools into the study process?), the authors concluded that the integration of AI-enriched tools is perceived as a potential driver for the transformation of the study process, offering benefits such as information structuring, personalized learning experiences, and time savings. The focus groups emphasized the support of AI in generating ideas, strengthening self-directed learning, and interdisciplinary thinking. However, several challenges exist, including insufficient user skills, lack of critical thinking, risks to academic integrity, and insufficient institutional guidelines that limit the meaningful and ethical use of AI.

Regarding the second research question (What competencies and prerequisites are considered essential for the effective use of AI-enriched tools in the study process?), the authors concluded that the effective integration of AI-enriched tools requires not only specific skills, but also a broader set of competencies. Among the most essential competencies, digital competence, ethical awareness, critical thinking and the ability to formulate questions precisely were identified. Innovation competence, the ability to generate new ideas, adapt technologies to pedagogical needs and create creative solutions, and research competence, which includes the ability to analyze AI-generated content, assess its reliability, as well as use AI as a tool for data acquisition, interpretation and formulation of conclusions, also play an important role. Both students and academic staff recognized that the use of AI is effective only if the user is able to evaluate the quality of information and adapt AI-generated content to the specific situation. The development of these competencies requires systematic institutional support and targeted professional development programs.

The results of the study show that the integration of AI-enriched tools offers significant transformational potential for both the study process and for institutional operations as a whole. However, this transformation cannot happen without a strategic approach that combines pedagogical, ethical, technological and organizational aspects. In summary, the study emphasizes that the transformation of the study process with AI-enriched tools requires a multi-level, systemically organized approach, in which the development of competencies,

support mechanisms (methodological, technical, administrative), ethical regulation and an open innovation approach play a significant role—in cooperation between students, academic staff, management and industry representatives.

For sustainable and inclusive integration, it is also necessary to strengthen students participation, which is currently limited. Further research is recommended to investigate in depth the long-term impact, to develop strategies and competencies frameworks, and to evaluate the practical implementation of AI-enriched tools in higher education.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethics Commission of the Rezekne Academy of Technologies. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because all questionnaire participants were informed and agreed that the collected data would be used in a summarized and anonymized form for research purposes. Participants in the focus group discussions also agreed to the public recording of the sessions and were informed that the discussion content would be used for research in an anonymized format.

Author contributions

AA: Formal analysis, Visualization, Writing – original draft, Data curation, Writing – review & editing, Conceptualization, Methodology. AZ: Data curation, Writing – review & editing, Conceptualization, Writing – original draft. OV: Conceptualization, Supervision, Writing – review & editing, Validation, Data curation, Writing – original draft. SU: Writing – review & editing, Validation, Writing – original draft, Visualization, Methodology, Data curation, Conceptualization. YP: Conceptualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was not used in the creation of this manuscript.

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