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STUDIES ON THE SUSTAINABLE IMPACT OF ARTIFICIAL INTELLIGENCE IN TECHNICAL AND AGRICULTURAL UNIVERSITY EDUCATION: BENEFITS CHALLENGE AND FUTURE DIRECTIONS,

Mădălina-Maria BREZULEANU[1], Elena UNGUREANU[2], Raluca Sînziana ZAHARIA[2], Carmen-Olguța BREZULEANU[2]

[1] Gheorghe Asachi Technical University, 53, D. Mangeron Boulevard, Iasi, Romania, Iasi, E-mail: madalina-maria.brezuleanu@academic.tuiasi.ro,
[2]"Ion Ionescu de la Brad" University of Life Sciences, 3, Mihail Sadoveanu Alley, Iaşi, Romania, E-mail: raluca.zaharia@iuls.ro, olguta.brezuleanu@iuls.ro

Corresponding author: olguta.brezuleanu@iuls.ro

Abstract

This undertaken study analyzes how students and professors perceive the use of artificial intelligence (AI) in education, in technical and agricultural higher education. At the same time, there were examined the perceived benefits, existing challenges, and future directions for implementation. The research is based on the analysis of a dataset collected through online questionnaires, which provides a detailed perspective on how AI influences technical and agricultural educational processes. The results indicate that perceived AI is predominantly positive, being appreciated for its usefulness in personalizing learning and optimizing evaluation processes, especially in technical fields. Nonetheless, it was noted that educators in technical and agricultural higher education encounter considerable obstacles in adopting this technology owing to insufficient resources, the necessity for further training, and issues associated with its effective incorporation into technical and agricultural educational practices.
In this regard, we have developed a series of recommendations to address these contemporary challenges, including the development of sustainable training programs for teachers in technical and agricultural higher education. We proposed to stimulate investments in the technological infrastructure appropriate to the field under study, and last but not least, it is necessary to clearly define the ethical framework for the use of artificial intelligence in student education.

Key words*: AI in education, technical and agricultural higher education, university professors, students from technical and agricultural education*

INTRODUCTION

Artificial intelligence (AI) has a large utilization in many field like: "expert system for decision making management [14], natural language processing, neural networks, robotics, machine learning, fuzzy logic, computer vision" and has recently become increasingly present in the field of education, especially in technical and agricultural higher education, which offers significant opportunities for improving the learning process as well as academic efficiency [10].
However, there are also a number of obstacles in the implementation of AI that can pose major challenges for teachers and institutions, most of which are particularly related to access to resources, which is quite difficult and sometimes precarious, adaptation to new technologies, and the ethics of AI usage [4, 6, 7, 9].
In recent years, artificial intelligence (AI) has emerged as a prevalent sustainable instrument in education, particularly in technical higher education, as it provides innovative solutions that enhance learning personalization, automate administrative processes, and refine evaluation methods. The incorporation of this technology into the technical education system yields numerous advantages, yet also presents considerable challenges for educators and institutions, particularly regarding resource accessibility, adaptation to new technologies, and the ethical implications associated with AI utilization [3,10,17].

Review of the specialized literature

The introduction of artificial intelligence (AI) in higher education has become increasingly common, reflecting the growing concern of

researchers about the subject. AI can be said to offer significant opportunities for personalizing learning, optimizing administrative processes, and improving academic performance.

In this section, there are analyzed the main studies regarding the use of AI in higher education, those research efforts that also include online applications, ethical considerations, and the impact of using this tool in the educational process.

Thus, following the review of the specialized literature, we observed that authors such as Schön, E.-M. et al. (2023) have addressed and analyzed artificial intelligence (AI) and stated that it has the potential to support creativity, generate new ideas, and contribute to the automation of various tasks that were often performed manually and required a high level of execution, fundamentally changing the way people work. This transformation can have a beneficial influence on both students and teachers, impacting the processes of teaching, learning, and assessment [16].

In the context of technological evolution, significant implications for higher education can be identified. On the one hand, as is to be expected, new challenges may arise, such as the unethical use of these tools by students, which can create increased difficulties for teachers in the evaluation process and uncertainties regarding the long-term impact of AI on education [12]. On the other hand, it is considered that AI offers valuable opportunities, such as the development of intelligent tutoring systems (ITS) and the stimulation of creativity in the educational process [12].

One of the major challenges of using ChatGPT in the academic environment [2] is represented by the inability of current control mechanisms, namely specialized plagiarism detection software, to accurately identify whether texts are written by humans or generated by AI (Gao et al., 2022). In this context, the need for a reevaluation of how teachers design and administer exams and other forms of academic assessment can be identified [5].

Thus, the need is felt to create a legislative framework as well as some ethical norms aimed at the responsible use of AI-based tools, both by students and by professors [2]. At the same time, technical changes are also targeted, which not only involve technical aspects but also require a cultural transformation through the adoption of a student-centered approach, focusing on the teacher, and promoting value-based learning [4, 16].

Considering the significant impact of these emerging technologies on higher education, there is a felt need for a broad debate as well as clear guidance on their effective and ethical integration into the educational process, so that teachers and students can utilize these tools [4, 5, 12, 16].

Ouyang et al. (2022) [13] conducted a systematic review of empirical research on the application of AI in online higher education between 2011 and 2020. The main conclusions of the study highlight the future importance through the increase of academic performance as well as the optimization of the educational process. It is recommended to personalize learning resources and to automate assessment and real-time feedback collection.

The authors assert that AI is a crucial instrument in digital learning environments, enhancing active and immediate student engagement for educational assistance, while also addressing challenges such as scalability, insufficient digital training for educators, and the ethical ramifications of algorithmic usage [13].

Sharma et al. (2024) performed a quantitative investigation of the implementation of AI in higher education institutions in India. Their research underscores the necessity for AI to perpetually grow in order to accommodate technology advancements and educational needs. The authors emphasize that national education policies are progressively endorsing the incorporation of AI into the curriculum to enhance student learning results and educators' instructional techniques. Simultaneously, it is emphasized that there exists uncertainty concerning the long-term effects of AI in education, indicating that examining prior advancements may offer insight into its revolutionary potential [18].

Khan et al. (2025) examine the function of AI in sustainable higher education, assessing its ethical ramifications and operational efficacy. Their research underscores various methods by which AI improves educational experiences, including the development of learning platforms that may be readily tailored to accommodate the requirements of the instructional process [8].

Despite the various apparent advantages, researchers express certain concerns, mainly pertaining to the ethics of AI use and the secrecy of the data employed or produced. The findings indicate that AI should serve as an enhancement or supplement to educational practices, rather than a total substitute .

Maphosa and Maphosa (2023) performed a bibliometric analysis that underpins a literature evaluation in the domain and a topic modeling study to investigate research on AI in higher education. This results reveal a significant surge in AI papers, with China, the United States, Russia, and the United Kingdom leading in research within this domain [11].

This study conducted by the authors illustrates the concern and growing significance of AI as a transformative instrument, perceived as a means to enrich students' learning experiences, optimize teachers' responsibilities, and expedite institutional operations [11].

In the framework of the global economy, artificial intelligence (AI) is crucial for fostering development and is progressively included into the national plans of major economies, including the USA, China, South Korea, and Japan [1]. Consequently, it may be asserted that poor nations encounter obstacles in the adoption of AI due to insufficient infrastructure, restricted access to technology, the absence of suitable policies, and a deficiency in data science expertise. The reviewed specialized literature indicates that the use of artificial intelligence for youth education has been identified as a generator of ethical challenges, with a special focus on the data collection and storage segment [19].

On the other hand, AI can contribute to the improvement of personalized learning by analyzing and anticipating the optimal study moments, thus adapting to the pace and needs of each student in technical and agricultural education. In this sense, artificial intelligence can contribute to optimizing the university educational process, facilitating a superior assimilation of specific concepts which can lead to academic performance [15].

Research on the influence of AI in higher education has predominantly occurred in industrialized nations, where the incorporation of this technology is regarded as a crucial element for socio-economic advancement, directly affecting enterprises and organizations.

Based on the reviewed literature, we can assert that artificial intelligence is crucial in revolutionizing higher education, impacting both students' learning experiences and educators' teaching methodologies.

Although a number of considerable benefits have been identified, the literature also highlights a series of challenges such as digital equity, teacher training, and the responsible integration of AI. Future research should focus on evaluating the long-term impact of AI, developing clear ethical frameworks, and strategies for improving digital literacy among teachers and students.

MATERIALS AND METHODS

This study investigates the opinions of students and instructors concerning the application of artificial intelligence (AI) in technical higher education, focusing on its advantages, problems, and future prospects. We choose the suitable research methodology to analyze the responses and to maintain a consistent study trajectory on the subject matter.

The survey was done online during the period 1 and June 30, 2024.

To examine the correlation between the application of AI in technical university education, we utilized a mixed research methodology, incorporating both qualitative and quantitative approaches.

The data collection for this study was conducted using an online questionnaire designed to ascertain the perceived advantages for both students and faculty in

higher education, along with the problems they face in utilizing this tool. The questionnaire had open-ended questions aimed at examining the benefits and shortcomings of AI integration in education.

The questionnaire comprised open-ended questions:

1. In what ways might the incorporation of AI technology affect conventional pedagogical approaches over the long term? This inquiry seeks to examine the influence of artificial intelligence on conventional educational practices and the potential modifications in teaching methodologies.
2. What are the possible advantages of employing AI in educational environments? The advantages of AI in education are examined, including enhanced access to materials, personalized learning, and streamlined instructional processes.
3. Could you furnish examples of AI applications presently applicable in educational settings? This inquiry identifies AI tools now utilized in education, including virtual assistants, voice recognition software, and adaptive platforms.
4. In what ways might AI facilitate individualized learning experiences for students? They are examining how AI can customize instructional content to meet the specific needs of students.
5. What are the essential guidelines for ethical considerations regarding the use of artificial intelligence in education? (This question analyzes aspects such as data privacy protection, ensuring equitable access to educational resources, and the implementation of clear ethical principles in the use of AI in the educational process.)
6. How can AI contribute to improving assessment and grading methodologies? (The study explores how AI can optimize academic evaluation processes by reducing subjectivity, providing personalized feedback, and ensuring an objective and precise analysis of student performance.)
7. What obstacles may instructors encounter when integrating AI technology into their instructional methodologies? This inquiry identifies obstacles to AI adoption, including inadequate training and insufficient funding.
8. In what ways may AI-driven tools assist educators in lesson planning and curriculum design? The application of AI for the automation of administrative activities and the enhancement of the educational process is under investigation.
9. How might AI enhance accessibility and inclusivity in education? Examining the role of AI in enhancing educational access for children with special needs or from underprivileged backgrounds.
10. What is the students' perception of AI utilization in their educational experiences?

This research explores how students in technical and agronomic higher education understand the use of AI and how it influences their educational journey.

By using open-ended questions, the respondents to the questionnaire had the opportunity to express their opinions in detail and present various views on the subject under study. These responses play an important role in identifying evolving trends and how they view the future integration of AI in higher education.

At the same time, nuanced responses can be obtained to complement the quantitative analysis of the study. The diversity of opinions is explored based on professional experience and level of familiarity with AI.

Sample size:

The sample consists of 100 participants, of which: the majority of respondents, 60%, are students enrolled in undergraduate and postgraduate programs in technical higher education, while 40% are professors teaching in higher education institutions.

The study group was randomly selected and grouped in such a way as to be balanced and representative of the respondent cohorts.

RESULTS AND DISCUSSIONS

The paper focused on examining the perceptions of students and university professors regarding the use of artificial intelligence (AI) in education. The focus was on technical and agronomic higher education. The study analyzed both the identified advantages and the obstacles encountered in adopting this technology. Additionally,

possible directions for the efficient integration of AI into the educational process were explored. The influence of AI on teaching methods was highlighted, including the adaptation of teaching strategies and the use of these innovative technological tools, and the way it affects communication, interaction, and the dynamics of the educational process between students and university professors was analyzed.

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Next, the literature review section explores current trends in research regarding the use of AI in technical higher education, its impact on the teaching process, and the ethical considerations associated with this technology.

In this regard, we conducted a bibliometric analysis of the specialized literature.

Introduction to the context

Artificial intelligence (AI) plays an increasingly important role in education, influencing both teaching methods and the learning process. The analysis of the relationships between the concepts associated with this field allows for the identification of the main research directions and how it can be effectively integrated into education. Thus, the bibliometric network of relationships between the analyzed terms in the field of AI applied in education helps highlight the main areas of interest. This offers a clear perspective on the connections between concepts and highlights the complexity of the field. Through this approach, one can better understand the impact of AI on education and identify current and future research trends.

Thus, the purpose of the analysis is to understand the structures and clusters in the bibliometric map, which is essential for identifying the main research directions and the challenges associated with the use of AI in education.

The visual representation of the relationships between terms in education and AI reveals three major thematic groups, each reflecting distinct perspectives and priorities. By analyzing the overall structure of the network and the clusters, we can discover new opportunities for the efficient integration of AI in education. Research on AI in education focuses on the relationships between educators' perceptions, integration in universities, and ethical aspects, themes that are reflected in the structure of the bibliometric network.

Thus, an advanced search of the Web of Science database was conducted to create the co-occurrence matrix of the keywords education, higher education, and AI in education. By using the specialized software VOSViewer, the following were generated.

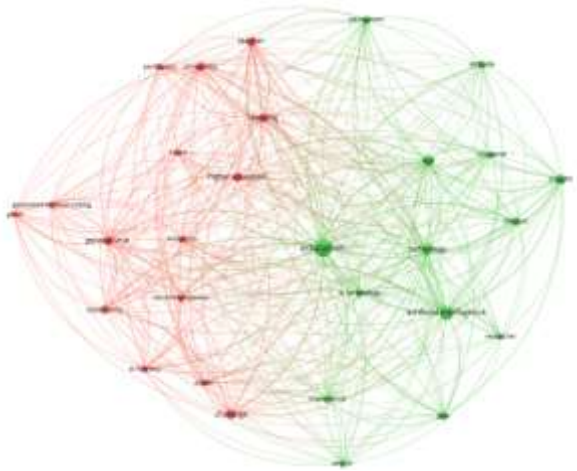

Fig.1. Co-occurrence matrix for key words
Source: author's processing using VOSViewer [20].

In the first phase, the minimum threshold for the occurrence of a term was selected. In this case, we set that threshold to 10, which means that only the terms that appear at least 10 times in the analyzed database will be taken into consideration. Thus, out of a total of 2,525 terms, only 69 met this criterion. This method is used to eliminate terms that appear rarely, focusing on the most significant ones.

In the next stage, specialized software was used to calculate a relevance score for each of the remaining 69 terms. This score allowed for the identification of the most significant terms for analysis, facilitating an objective selection based on statistical criteria. The selection process was based on a default value of 60% of the terms with the highest relevance scores. Thus. Out of a total of 69 terms, 41 were selected, considered the most representative for further analysis. This

method ensured a structured approach and contributed to optimizing the process of extracting relevant information.

Thus, it was generated the co-occurrence matrix on clusters of interest.

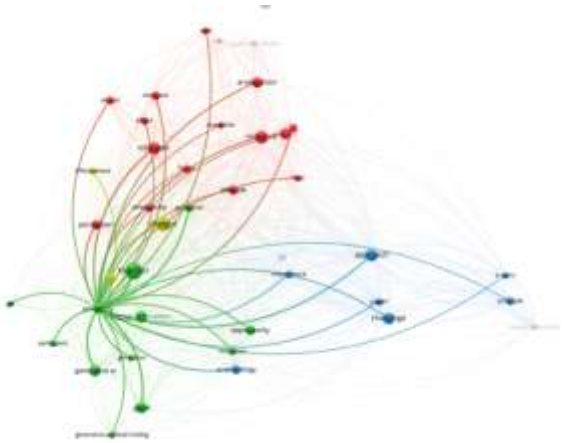

Fig. 2. Co-occurrence matrix of the cluster of interest
Source: author's processing using VOSViewer [20].

The bibliometric map is a visual representation of the relationships between concepts and research areas associated with AI in education. Three main groups of terms are observed, each represented by a distinct color:

• Red: Concepts related to research and educators.

• Green: Concepts related to higher education, teachers, and generative AI.

• Blue: Concepts related to challenges, ethics, and principles.

This segmentation indicates three major research directions on AI in education.

Cluster analysis

(A)The red cluster: Research and educators

Key terms: "research" (cercetare), "educator" (educator), "attitude" (atitudine), "perception" (percepție), "ai education" (educație AI), "effect" (efect), "factor" (factor)

This group focuses on how educators perceive and use AI in education. Teachers' attitudes, the effects of AI on teaching, and factors influencing AI adoption are analyzed. AI is viewed as a teaching tool, and researchers are investigating how it affects the effectiveness of learning.

We can observe that the term Research is connected with ChatGPT, indicating researchers' interest in using ChatGPT in education. The relationship between perception and educator suggests that there are studies investigating how teachers perceive AI and its impact on teaching.

(B) The green cluster: Higher education, generative AI, and teachers

Key terms: "teacher" (professor), "higher education" (educație superioară), "university" (universitate), "generative AI" (AI generativă), "GPT", "participant", "guideline" (ghid).

In this cluster, the emphasis is placed on the role of AI in universities and teacher education. Generative AI, including ChatGPT and GPT, is analyzed from the perspective of its benefits for higher education. Guidelines and recommendations are mentioned, suggesting the need for regulation of AI use in the academic environment.

Keywords Teacher and higher education are connected with generative AI, indicating that generative AI is a topic of interest in higher education. On the other hand, University and participant suggest that the studies include empirical research with professors and students.

(C)The Blue Cluster: Challenges, Principles, and Ethics

Key terms: "challenge" (provocare), "approach" (abordare), "principle" (principii), "ai ethic" (etică AI), "risk" (risc), "importance" (importanță), "paper" (lucrare).

It can be said differently that the interest of researchers analyzing the ethical challenges of using AI in education has increased.

Artificial intelligence (AI) in education has seen significant growth, generating debates regarding the principles of responsible use, advantages, and associated risks. Researchers are analyzing appropriate methods for the efficient integration of AI into the educational system. The relationship between principles and AI ethics reflects the concern for developing clear ethical guidelines regarding the use of artificial intelligence. At the same time, the challenges related to AI are closely connected with the proposed approaches, which suggests the efforts of the academic community to find effective solutions for the difficulties encountered in implementation. AI in education remains an active research

field, structured around three main directions: teachers' perceptions, the integration of artificial intelligence in universities, and the ethical aspects associated with the use of this technology.

Generative AI, especially ChatGPT, is an important topic, indicating that these technologies are being analyzed for their impact on teaching and learning. Research highlights both the opportunities of AI in education and the associated challenges and risks.

The questionnaire was administered to students and professors at Iasi University of Life Sciences (IULS), participants in the DPPD, and consists of 10 questions, distributed in such a way as to provide information both about their opinions and about the concrete actions they undertake regarding the proposed theme. Specifically, 10 open-ended questions were formulated, which offered respondents—students and professors—the opportunity to freely express their opinions.

Next, 10 pie charts are presented, each illustrating the distribution of responses for a specific question, thus highlighting the trends and perspectives of the participants.

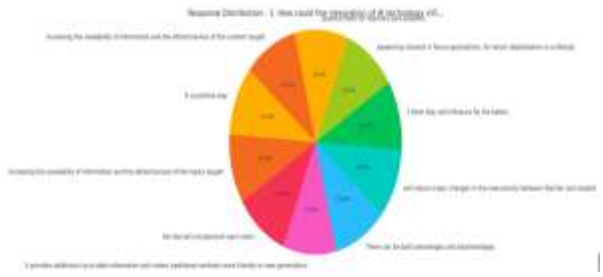

Fig. 3. Distribution of responses to question 1
Source: author's processing.

In question no. 1, the majority of the responses suggest that AI has a positive impact on education. Phrases such as "Adaptive learning" and "Improving the quality of teaching," which are frequently mentioned, indicate that AI is perceived as a tool for personalizing learning to the needs of the student/teacher. Some responses indicate the initial implementation difficulties, which in the long term generate benefits.

AI can become an essential tool in modernizing education, helping to personalize teaching materials and streamline the teaching process. However, teachers need training to use AI effectively, and the technological infrastructure must be adapted to the requirements of the new teaching methods.

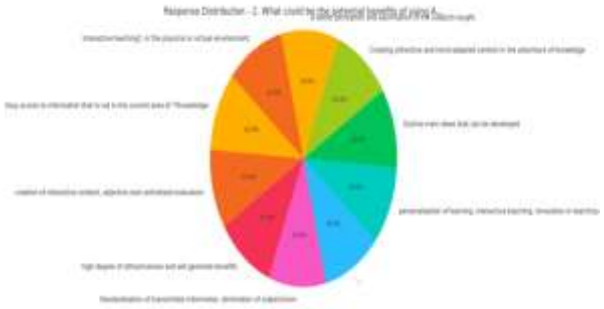

Fig. 4. Distribution of responses to question 2
Source: author's processing.

In question no. 2 from the responses given by students/professors, it can be observed that the most frequently mentioned advantages were: quick access to information, data processing, and increased accuracy in the teaching-learning process. In this case, AI is seen as a tool that can improve access to and distribution of educational materials, and it is also viewed as an additional aid for teachers.

The implementation of AI can significantly improve the educational process in technical education, providing access to diverse resources and facilitating data-driven learning. However, effective integration depends on the ability of teachers and higher education institutions to adapt these technologies to the real needs of students.

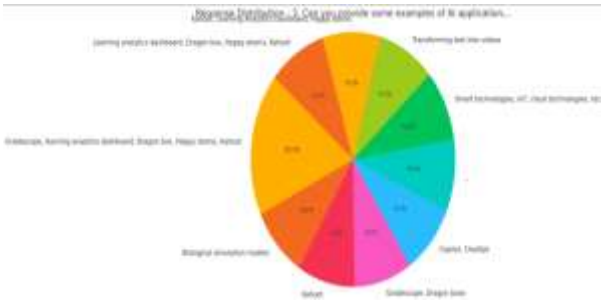

Fig. 5. Distribution of responses to question 3
Source: author's processing.

In question no. 3, the answers given by students/professors most frequently mentioned Grammarly, ChatGPT, Duolingo, and Kahoot. These applications are used for interactive learning, automatic correction, and

language assistance. Machine translation and text analysis are also important aspects of using AI in education in general and in ethnic higher education in particular.

The development of AI tools specific to different technical academic disciplines is necessary to increase the impact of technology on the entire educational process.

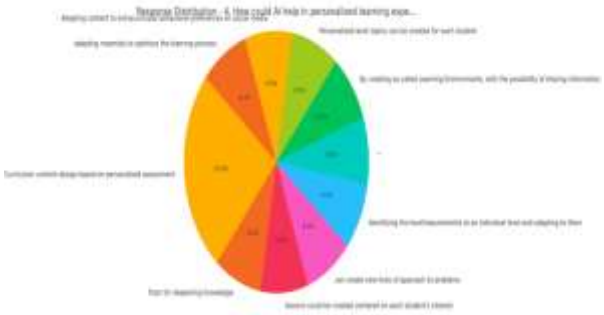

Fig. 6. Distribution of responses to question 4
Source: author's processing.

In question no. 4, "AI Tutors" and "Virtual Assistants" are frequently mentioned as tools used, suggesting that AI can provide instant feedback and personalized support for teaching/learning. Some responses indicate that AI could help in quickly selecting relevant information, which would streamline the learning process in technical higher education. Personalized learning is one of the greatest benefits of AI in education.

However, the use of AI must be parallel to traditional methods to avoid excessive dependence on technology and to maintain the student-teacher interaction in the educational process.

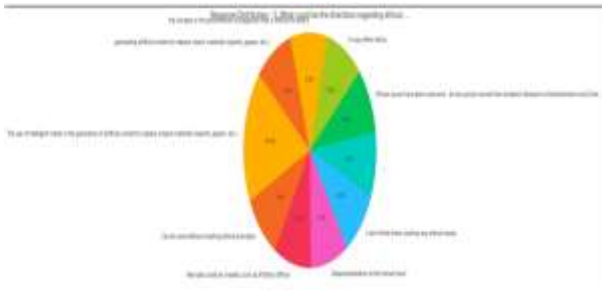

Fig. 7. Distribution of responses to question 5
Source: author's processing.

We can observe that in question no. 5, for the majority of respondents, the greatest concern is related to plagiarism and the unethical use of AI, but we can also see that some participants believe that AI can be used without violating ethical principles, as long as it is used appropriately.

At the same time, there are respondents who emphasize the necessity of having a clear ethical framework for the use of AI in education and that it should be integrated into a well-defined ethical framework, which would prevent inappropriate use and promote the responsible use of technology in education in general and in ethnic education in particular.

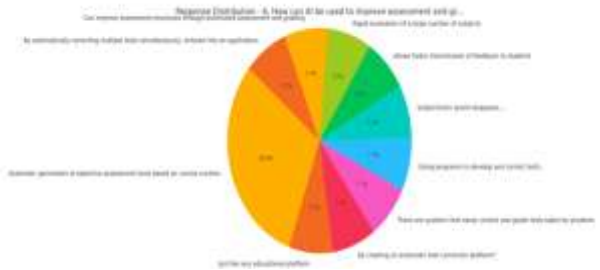

Fig. 8. Distribution of responses to question 6
Source: author's processing.

From analyzing the responses given by respondents to question no. 6, we can observe that the most frequent answers mention the automation of grading papers, thus eliminating subjectivity in grading.

Some even consider that AI can be used similarly to an educational platform, providing quick and objective assessments for the teaching-learning process. Thus, AI can be considered a valuable tool for automating assessment tasks, but final decisions regarding grades must be reviewed by teachers to ensure the accuracy and transparency of the evaluation.

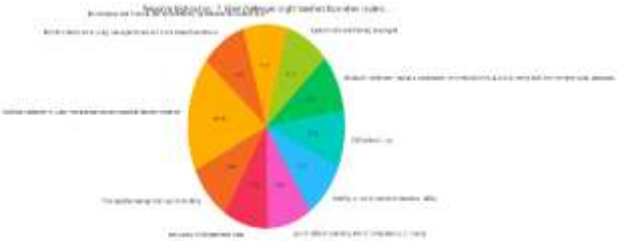

Fig. 9. Distribution of responses to question 7
Source: author's processing.

From the analysis of the responses received to question no. 7, it is observed that the most frequently mentioned difficulties are: lack of training for teachers, adoption of new

technologies, and issues related to unreliable information sources. There are also responses suggesting that AI could diminish charisma and human interaction in the teaching/learning process in technical higher education. Therefore, the adoption of AI in education must be accompanied by training programs for teachers and a clear strategy for integrating new technologies into teaching.

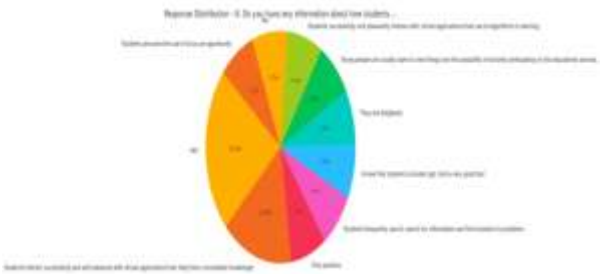

Fig.10. Distribution of responses to question 8
Source: author's processing.

In the graph above, we can observe that the majority of responses are positive, indicating that students consider AI a useful tool for quickly searching and organizing information. Some participants mentioned that students use AI very frequently for various academic activities specific to technical education. Among the respondents, students are more open to using AI compared to professors, which suggests that education needs to evolve to meet the new technological realities of today's society.

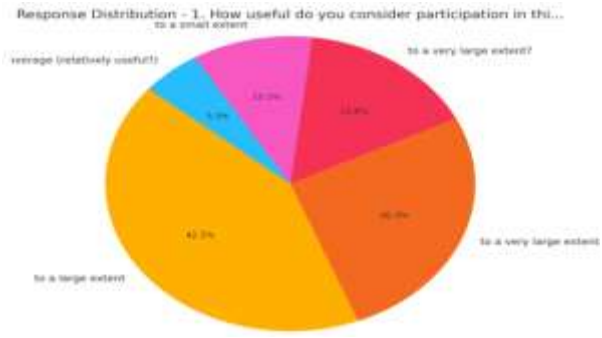

Fig. 11. Distribution of responses to question 9
Source: author's processing.

The majority of the responses to question no. 9 are very positive, indicating a high level of satisfaction. Participants: students and teachers consider that the workshop was extremely informative and relevant for educational practice in technical vocational education, being well received, but with the recommendation that future sessions should be more interactive and include more examples of applied AI usage.

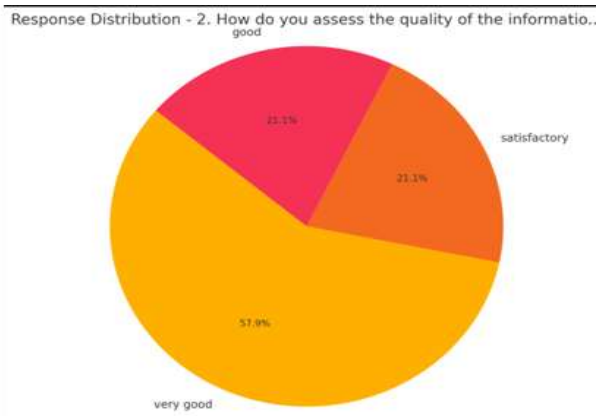

Fig. 12. Distribution of responses to question 10
Source: author's processing.

Most of the responses to question 10 indicate that the information received was very good or satisfactory. Some participants suggest that it would be useful to delve deeper into certain topics related to AI in education and for technical education.

AI is perceived as an extremely valuable tool for education in general and for technical higher education in particular, with the potential to personalize teaching and learning experiences and to automate assessment processes.

There are ethical concerns and challenges related to the implementation and training of teaching staff in technical education, but participants believe that the benefits outweigh the obstacles.

The workshop was highly appreciated, with recommendations for more frequent and applied sessions.

The limitations of the study

Since the sample size was relatively small, the representativeness and reliability of the results can be influenced by limiting the possibility of drawing generalizable conclusions about the target group studied: teachers and students.

Additionally, the interpretation of participants' open-ended responses may be subject to possible errors, either due to the ambiguity of the formulations or the subjectivity of their analysis. The limitation also arises from

differences in expression and the use of vague terms or the multiple meanings of certain words, which can lead to difficulties in classifying and correctly understanding the responses.

CONCLUSIONS

The results of this study conducted during a workshop at Iasi University of Life Sciences (IULS) highlight the important role of artificial intelligence (AI) in transforming instructional-educational processes in technical higher education. Based on the data collected from students and professors and the analyzed literature, we can identify the main benefits, challenges, and future directions for integrating AI into the instructional-educational process.

In this regard, to maximize the benefits of using AI in education and to overcome the identified challenges, a clear and well-defined national strategy is necessary for the implementation of this technology in technical higher education.

We can recommend, following the conducted study, training sessions for teaching staff through the development of training programs on the effective use of AI in teaching, learning, and assessment. It is also important to invest in technological infrastructure for the modernization of university laboratories and the implementation of AI platforms dedicated to technical and agricultural education.

At the national and institutional level, it is essential to develop a clear ethical framework for the use of AI in education. This process requires the development of specific educational and regulatory policies aimed at ensuring transparency in the implementation of AI, ensuring equity in access to educational technologies, and protecting users' personal data. The creation of well-structured norms can help avoid unethical uses and increase trust in AI as a supportive tool in education. In this context, a gradual integration of artificial intelligence into the technical and agronomic university curriculum is recommended, with the objective of developing the digital competencies of students and professors, as well as the concrete application of AI technologies in the teaching-learning process. Such an approach would facilitate not only the theoretical understanding of this technology but also the development of the practical skills necessary for its efficient use in the future professional careers of students.

Artificial intelligence has a significantly positive impact on technical and agricultural university education, facilitating personalized learning, automating educational processes, and providing quick access to information. But care must be taken regarding how we adopt AI, namely to do so in a balanced and ethical manner, considering the need for teacher training, data privacy, and maintaining human interaction in education.

Therefore, by implementing appropriate strategies, AI can become an essential element in modernizing technical higher education, contributing to the preparation of students and teachers for the demands of the job market and the development of relevant digital skills for the future.

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