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Factors Enhancing Students' Views on Artificial Intelligence

Abstract

Artificial Intelligence (AI) is now one of the most important and contemporary directions of development of science in an interdisciplinary context. The EU's approach to artificial intelligence centres on excellence and trust, aiming to boost research and industrial capacity while ensuring safety and fundamental rights (A European approach to artificial intelligence). Strengthening the fostering excellence in AI will strengthen Europe's potential to compete globally. Simultaneously not yet solved are a lot of challenges and issues. The problem raised in the article is to explore and analyse computer science and education students' attitude to educational, social, and ethical aspects of AI implementation. The purpose is to discover and analyse computer science students and pedagogical attitude towards education, social-, and ethical aspects of AI implementation. Students of two faculties of the University of Silesia in Katowice, Poland, were asked to respond to a survey. They were mainly students of two specializations – Computer Science and Pedagogy. As many as 103 students have been surveyed. The Kruskal-Wallis tests were used for verification. The main issues studied were the students' level of competence in AI, their awareness of AI applications in

various areas of life and economy, and the importance of the AI field. The study also included the level of confidence towards AI and the level of anxiety towards AI. Various types of dependencies and connections between these aspects were investigated. The hypotheses were mostly confirmed. Finally, the article presents the discussion and main conclusions.

K e y w o r d s: Artificial Intelligence (AI), educational, social and ethical aspects, students of computer science and education, opinion, Kruskal-Wallis tests

We live in a modern technological society driven by intelligent human systems and machines. This is due to advances in artificial intelligence (AI) (Yu and Nazir, 2021).

The artificial intelligence is widely present in our daily lives: facial recognition systems in smartphones, digital voice assistants, smart home devices, mobile banking, Google predictive search, Netflix recommendations, Google Maps, carpooling applications, banking mobile devices and more (Oprea, 2021). We agree with Oprea (2021) that the field of artificial intelligence is developing continuously and rapidly.

Background research

According to previous research, "artificial intelligence" and "smart tutoring system" are among the most common keywords in related bibliographic analyzes of AI in education (Baek and Doleck, 2020).

Other researchers have developed and provided a systematic overview of AI technologies in STEM education (Xu and Fan (2022). They have identified and detailed types of AI applications, teaching content, etc. practices, as well as teacher involvement, pedagogical strategies, teaching methods, contexts, and the impact of AI for STEM and STEAM education (Xu and Fan, 2022).

Some experts provided an overview of publications on the use of AI in higher education by keywords and topics such as author, institution, country and citation (Hinojo-Lucena et al., 2019).

The purpose of another study is to determine the trend of interaction of artificial intelligence (weak, hybrid, superintelligence) with humans in the areas of: forecasting, decision-making, development of artificial intelligence tools and development strategies, relations with society, valuation, evaluation, selection of new business models and artificial intelligence risk management. The methodology

includes benchmarking, comparative analysis of trends in the generation of artificial intelligence and its interactions (Richardson and Clesham, 2021).

Based on a large-scale technology adoption scenario, artificial intelligence (AI) is expected to have a disruptive impact on economies and societies. In recent years, there has been a breakthrough in basic research into the technologies underlying artificial intelligence. Artificial intelligence shows greater potential to become a general-purpose technology (Huang and Peissl, 2023).

Artificial intelligence (AI) is now being developed by large corporations and governments around the world are working hard on it. Artificial intelligence is not a futuristic concept; it is already here and being implemented in many industries (Mhlanga, 2022). The study of Yu and Nazir (2021) provides a detailed overview of the role of 5G and AI in the research and transformation of situational English teaching in higher education (Yu & Nazir, 2021).

The research of Ahmed & Ganapathy (2021) aims to focus on methods for creating intellectual content that improve learning management and enable the use of embedded artificial intelligence. Artificial intelligence is probably one of the most outstanding fields, and it can be used effectively. Azevedo & Almeida (2021) present the design and practice of this training specifically aimed at decision makers in medium-sized enterprises (SMEs). The proposed program with a multidisciplinary scope includes various thematic chapters (autonomy), as well as cross-cutting topics, towards the paradigm of Industry 4.0 and digital transformation (Azevedo and Almeida, 2021).

The aim of the work of Fedotova et al. (2020) is to assess the current changes in the structure of national economic systems resulting from the transition to Industry 4.0. (Fedotova et al., 2020).

The article presents the impact of artificial intelligence on the quality of diagnostic criteria of the pedagogical supervision system (Khaperskaya, & Minin, 2020). The authors have developed methods for providing automated educational supervision, describing the principle of operation of the developed methods from the technical and educational point of view and giving examples of their implementation. The article confirms that artificial intelligence can expand the field of pedagogical supervision in the digitization process, while maintaining the principles of traditional pedagogy (Khaperskaya & Minin, 2020).

The aim of the study of Karnouskos (2022) is to explore many potential problems of law and society by examining the interaction of law, robotics and society from different angles such as legal, social, economic, gender and ethical opinion (Karnouskos, 2022).

The moral hazard of employing algorithms that use international human rights law as a common standard for determining algorithmic accountability has been highlighted by Yam & Skorburg (2021).

Four types of algorithmic impact analysis with five human rights of candidates participating in the recruitment algorithm are effectively evaluated (Yam and Skorburg, 2021).

Interesting research results were presented by Kozlova et al. (2021). Business models of the economy of the future with the use of artificial intelligence of human resources have been proposed. A new model of working with analytics, a platform business model, has been developed (Kozlova et al., 2021).

As indicated by Pikkarainen and Tihinen (2023), the manufacturing industry is currently moving towards smart manufacturing systems through digitization. There are many technologies and professional skills that are recognized as crucial for embracing changes in the manufacturing industry, such as digital platforms and solutions, artificial intelligence (AI), diagnostics and data analytics (Pikkarainen and Tihinen, 2023).

Therefore, research by Pikkarainen & Tihinen (2023) focuses on educational solutions that drive digital transformation in the manufacturing industry.

The study of Ramírez (2021) provides an analysis of the areas, resources, and management options required to respond to the new environment of public higher education institutions in Mexico. These processes integrate the necessary elements, such as artificial intelligence, machine learning, digitization of processes or comprehensive leadership implementation (Ramirez, 2021).

Research shows that managing the Covid-19 crisis is difficult for startup training due to the need for specific and practical examples (Ratten, 2020). This means that augmented reality and artificial intelligence are needed to simulate the real environment. This will enable a more community-based approach to entrepreneurship research and practice (Ratten, 2020).

Smart digital aids for analog learning experiences and dynamic, transport-adaptive object-based learning textbooks for quantum cryptography are discussed in Sosnovsky et. al. (2020).

Researchers have developed an introductory course to teach basic ML concepts such as the basics of neural networks as well as the limitations and ethical issues of K-guideline 12 on artificial intelligence (Martins et al. 2023).

An analysis of AI music and its possible benefits in non-drug therapy is presented in Mata-Rivera et al. (2022).

In fact, AI is at the center of attention of many researchers and this trend is dynamically developing. Simultaneously a lot of questions are still without answers, in particular, the opinions of young people, and students of different specializations on the ethical and social aspects of AI and its impact and future perspective of using it in different areas of society, environment, economy, etc. Some research results were presented in Smyrnova-Trybulska, Przybyła-Kasperek, & Kommers (2023) and in Skalka, & Drlik (2022).

This article presents the extended results of research conducted by the authors.

Methodology

Research questions were defined based on literature review and the authors' own experience. Questions formulated in the present study are the following:

RQ1: What level of AI competence do computer science and education students have?

RQ2: What level of AI competence do students who have completed engineering technical studies (Bachelor's degree) have as well as those who are just after high school?

RQ3: What level of AI competence do students in their fifth year of study have as well as students in earlier years of study?

RQ4: What level of awareness of AI do education and computer science students have?

RQ5: What level of awareness of AI possibilities and applications do fifth year students have as well as students in their earlier years of study?

RQ6: Are there any dependencies between the level of students' AI competence, and the level of their appreciation of AI possibilities?

RQ7: Is there a difference between the level of fear of AI development among computer science students and education students?

RQ8: Is there a difference between the level of fear of AI development among computer science students and education students, because the increase in AI competence influences a calm attitude towards AI and a decrease in fear of AI development?

RQ9: Is there a difference between increased AI competence and the level of fear of AI development?

A model was created to present what relations are to be analysed and studied in this paper. Figure 1 shows the six conceptualized categories and the relations between them that will be verified.

Adequate hypotheses are posed. The hypotheses are verified based on the questionnaire responses using statistical inference specifically the Mann-Whitney and the Kruskal-Wallis tests. Of course, a comparison of statistical measures and graphs was also performed to confirm the differences in results and the following hypotheses.

H1: Computer science students have a higher level of AI competence than education students.

H2: Students who have completed engineering technical studies (Bachelor's degree) have a higher level of AI competence than students who are just after high school.

H3: Students in their fifth year of study have higher AI competence than students in earlier years of study.

H4: Computer science students are more aware of the possibilities and applications that AI brings than education students.
H5: Fifth-year students have a higher awareness of AI possibilities and applications than students in earlier years of study.
H6: Awareness of AI possibilities and applications increases proportionally to the level of AI competence. The higher the student's AI competence, the more they appreciate the possibilities of AI.
H7: Computer science students are more concerned and afraid of the development of AI than education students.
H8: Fifth year students have a lower level of concern and fear about AI development than students in their earlier years of study. This is due to greater experience and knowledge of these students.
H9: The increase in AI competence influences a calm attitude towards AI and a decrease in fear of AI development.

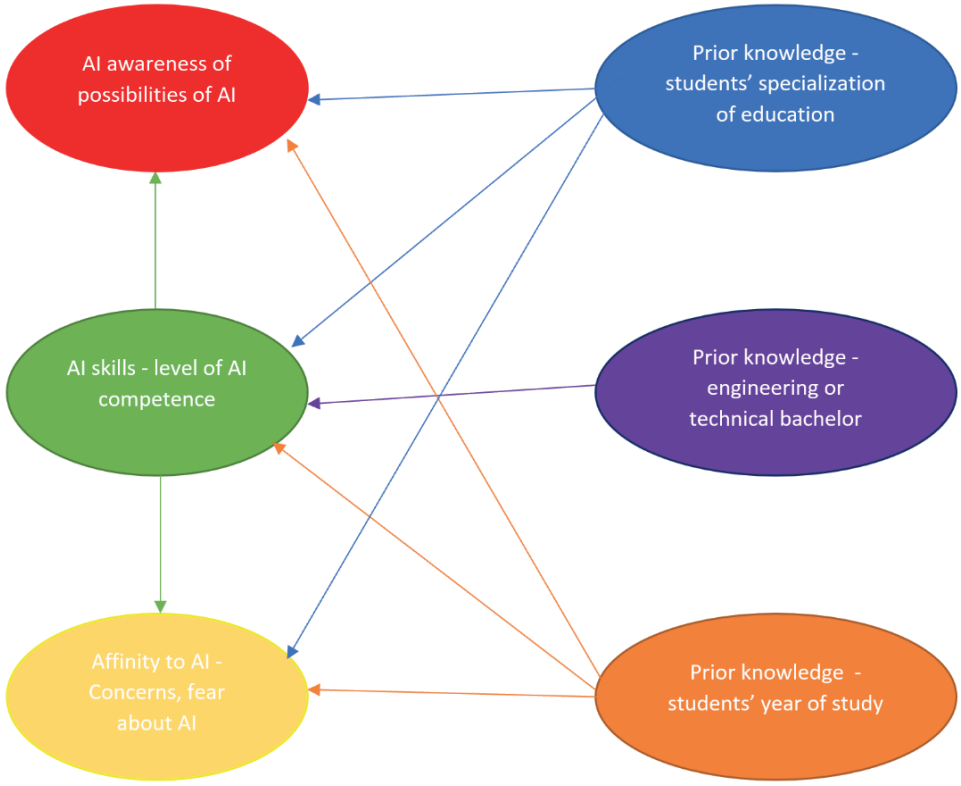

Figure 1. Six factors model and investigated relations

S o u r c e: Own work based on Asghar, Minichiello, & Iqbal, 2022.

This paper is a continuation of the conference paper (Smyrnova-Trybulska, et al., 2023) and provides a significant extension of it. It presents further analysis of risk perceptions regarding AI as well as analysis of the correlation between students' level of competence and answers to questions on various aspects, i.e. AI applications or AI risks.

The structure of the work is as follows. In Section 2, we present the assumptions of the questionnaire conducted as well as the sociological background of students. Section 3 presents the main results and analysis. This section is divided into sections on the various aspects studied: AI competence, AI possibilities and applications, AI possibilities and applications and self-assessment of AI literacy, potential risks of AI, correlation between feelings of anxiety toward AI and self-assessment of AI literacy. Section 4 contains discussions of the obtained results, the most important hypotheses that were successfully demonstrated are summarized here. The paper ends with conclusions.

Questionnaire, purpose and research questions

Our focus was on exploring students' attitudes toward AI issues, the degree of knowledge they have and their awareness of the potential use of AI issues in various aspects of life and the economy as well as their fears and anxieties about AI. Students from two different faculties, five different years of study and differing in age and gender, were asked to answer questions about their AI competences, perceptions of opportunities to use AI issues, and fears they have about AI development. The survey was conducted in December 2022 and January 2023. The students of two faculties – Faculty of Science and Technology, and Faculty of Arts and Educational Science of the University of Silesia - were asked to participate in the study. They were mainly students of two specializations – Computer Science and Education. A total of 103 responses were received. Respondents were randomly selected. Emails were sent to students at different years of studies and faculty asking them to fill out the survey. Taking part in the survey was voluntary.

Sociological background

In order to study the relationship between student characteristics and knowledge of AI or attitudes toward AI, the questionnaire included sociological questions. The sociological characteristics of questions and possible responses in the questionnaire are presented below:

- age – <19–21>, <22–25>, <25–30>, >30

- name of previous school, university – open question, (optional question)
- name of current school, university – open question
- gender – male, female
- course of the study – 1st, 2nd, 3rd, 4th, 5th
- study specialization – education, social, computer science, humanities, economics, technical but not AI

Descriptive statistics on the responses obtained related to the sociological background are presented in Table 1.

Table 1.
Descriptive statistics on responses to sociological questions

Age	Quantity/ Percentage	Name of previous school, university	Quantity/ Percentage	Name of current school, university	Quantity/ Percentage
<19–21>	33/32.04	Technical secondary school	31/30.10	University	103/100
<22–25>	55/53.40	General secondary school	33/32.04		
<26–30>	10/9.71	University	17/16.50		
>30	5/4.85	Technical University	12/11.65		
Gender	Quantity/ Percentage	Year of study	Quantity/ Percentage	Study specialisation	Quantity/ Percentage
Male	54/52.43	1st	18/17.48	Education	42/40.78
Female	49/47.57	2nd	19/18.45	Social	0/0
		3rd	35/33.98	Computer science	61/59.22
		4th	23/22.33	Humanities	0/0
		5th	8/7.77	Economics	0/0
				Technical but not AI	0/0

Based on the results obtained, it can be concluded that the majority of respondents are between 22 and 25 years old. They are mainly secondary school graduates – the vast majority of them received not technical but general education. All students are currently studying at the University of Silesia in Katowice. In terms of gender, it can be said that the sample is balanced – almost equal numbers of men and women were interviewed, only 5 more men than women were surveyed. The most numerous group of respondents is currently in their third year of study. Also, a large group of fourth-year students are present. Together, they account for more than half of the sample. First-year and second-year students make up about

36% of the total sample. The fifth-year students are the least represented. Students from the two specialties – education and computer science were interviewed, with computer science students accounting for 59.22% of the total sample.

Research questions

In our study, we had several research questions. First, we wanted to answer the question of what the level of AI competence among students is and whether social aspects influence this level. Further critical questions include the following: What is the awareness of the applicability of AI issues in different areas of life? Is there a significant correlation between this awareness and students' level of AI competence? What concerns do students have about AI development and about the future related to AI? Are these concerns significantly different in groups related to, for example, specialization, year of study, gender, age? Is there a significant correlation between the level of AI competence and concerns about AI?

All of the above questions are addressed and discussed in the next section.

Results and statistical tests

In this section, we will present statistical tests, analyses and their results on the perceptions of AI issues, opportunities that AI brings and concerns about AI expressed by the students who participated in the questionnaire. Each aspect is discussed separately in one of the following sections.

AI Competence

After the sociological background, the next coherent part of the questionnaire concerned students' self-assessment of their competence on various aspects of AI. The main purpose of this part was to find out whether respondents had encountered AI issues at university or in their personal lives, and at what do they rate their knowledge of specific AI issues. The questions in this part and possible responses included in the questionnaire are listed below:

1. Did you encounter AI – Yes, No
2. What do you think Artificial intelligence is? – robots, intelligent machines, machine learning, learning based on experience, learning based on data, other

3. How do you rate your level of AI competence? – seven-point qualitative scale, 1 the lowest level, 7 the highest level
4. How do you rate your level of competence in the area of AI supporting in programming languages (e.g. Python)?
5. How do you rate your level of competence in the area of ethical and social aspects of AI?
6. How do you rate your level of competence in the area of Data Preprocessing Techniques?
7. How do you rate your level of competence in the area of Knowledge Discovery?
8. How do you rate your level of competence in the area of Machine Learning?
9. How do you rate your level of competence in the area of Deep Learning?
10. How do you rate your level of competence in the area of Natural Language Processing?
11. How do you rate your level of competence in the area of Learning Analytics?
12. How do you rate your level of competence in the area of AI in cyber security?
13. How do you rate your level of competence in the area of Recommender systems?

As many as 98 respondents answered that they encountered AI issues, representing 95.15% of the sample. Five respondents answered that they had not encountered AI, which means that they are not aware of using AI issues on a daily basis through their smartphones or search engines. To the question "What do you think Artificial Intelligence is?", the largest number of respondents answered intelligent machines (31 responses), followed by learning based on experience (23 responses), machine learning (22 responses), robots (12 responses), all other possibilities were indicated by individual respondents. Bar charts of the responses obtained related to the assessment of AI competences are shown in Figure 2.

As can be seen from the results, students do not rate their knowledge and competences related to AI highly. For all questions presented in Figure 1, the most frequent answers are 1–3 which means low. It can be concluded that students rated their knowledge and competences in the following areas: Knowledge discovery and ethical and social aspects of AI. On the other hand, they rated their competences lowest in the areas of AI supporting programming languages, AI in cyber security and Learning analytics.

Statistical tests were performed in order to test the AI competence level obtained for groups defined by: study specialization, age, gender, year of study and previous school (each issue was considered separately). All results examined are for the ordinal variable. The Mann-Whitney test was used to detect differences in the two independent samples defined by field of study and gender. The results obtained are presented in Table 2: sum of ranks across groups and p-value. Significant results are shown in bold. If we take into account the groups defined by different specializations of studies, then we have a significant difference in results concerns competence in the area of AI supporting in programming languages (e.g. Python).

This confirms hypothesis H1. It is rather natural for computer science students to be more competent in this field than education students. What is surprising, however, is the lack of significant differences in other technical subjects such as machine learning or deep learning. This may indicate unsatisfactory competence of computer science students in this area. If we take into account the groups defined by gender there are statistically significant differences in the results obtained for two aspects studied: level of competence in area Deep Learning and level of competence in the area of AI in cyber security. Women indicated a higher degree of competence than men in both areas. But the third quartile of scores is rather low – below 4.

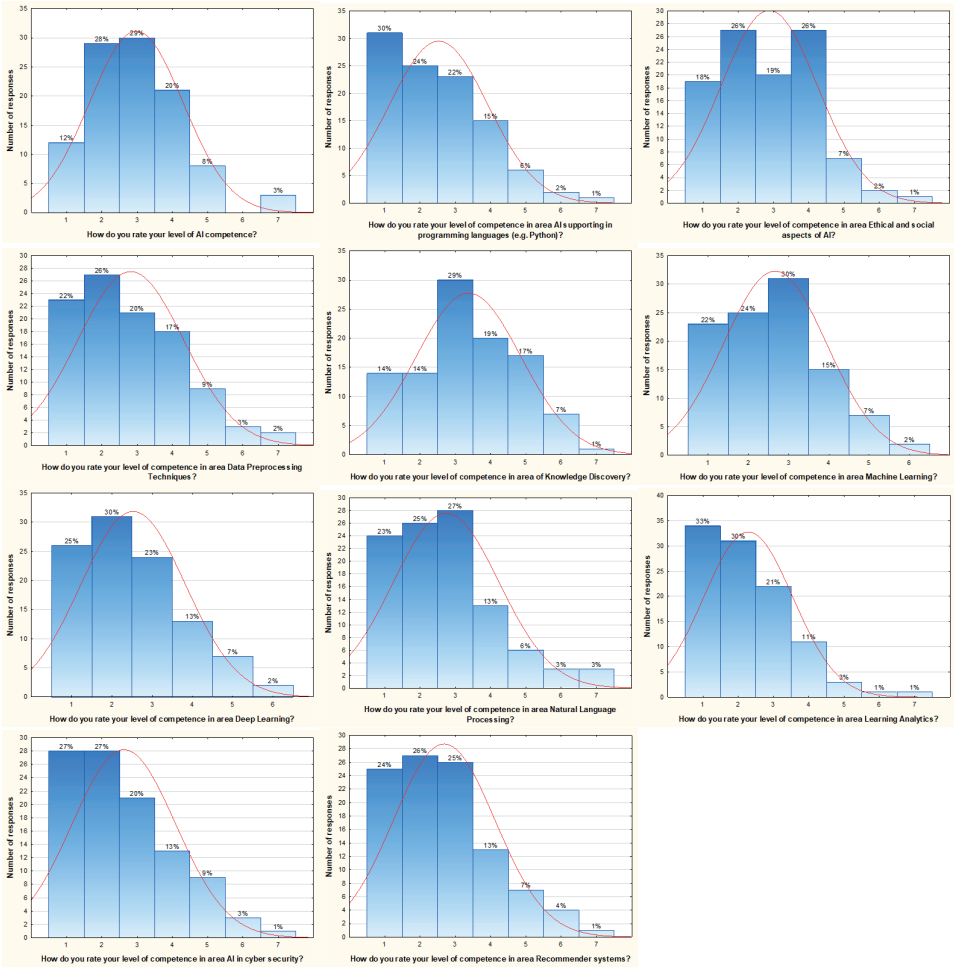

Figure 2. Bar charts of the responses obtained related to the assessment of AI competences

The Kruskal-Wallis tests were performed for groups defined by age, year of study and previous school (in each case the number of groups was greater than 2). The results obtained group size, group rank mean, p-value and test statistic value are presented in Table 3. Significant results are shown in bold. As can be seen, age, type of previous school and year of study have little influence on the evaluation of the AI competence in different fields. Significant differences were confirmed in the level of Knowledge Discovery competence by groups defined by the type of previous school. Based on the box-whiskers chart (Figure 3), it can be concluded that students who graduated from the technical universities have higher competence in this area than other students. This confirms hypothesis H2. Significant differences for groups defined by year of study were confirmed for competencies concerning: AI supporting in programming languages (e.g. Python), Data Preprocessing Techniques, Machine Learning and Recommender systems. Based on the box-whiskers charts (Figure 3), it can be concluded that students in the fifth year of study are distinguished by higher competences in this area compared to students in other years of study. This confirms hypothesis H3. This means that at the University of Silesia these issues are taught and students of the last year of study are familiar with them.

Table 2.
The Mann-Whitney test results of AI competence level for groups defined by study specialization and gender

Question	Groups defined by the study specialization: education and computer science			Groups defined by gender: male and female		
	Sum of the ranks for computer science	Sum of the ranks for education	p-value	Sum of the ranks for male	Sum of the ranks for female	p-value
3	3161	2195	0.944	2724	2632	0.581
4	3504.5	1851.5	**0.026**	2985	2371	0.244
5	3420	1936	0.097	2984	2372	0.246
6	3399	1957	0.129	2906.5	2449.5	0.518
7	3105.5	2250.5	0.658	2735.5	2620.5	0.634
8	3360	1996	0.208	2855.5	2500.5	0.756
9	2896	2460	0.064	2496.5	2859.5	**0.040**
10	2961	2395	0.158	2527.5	2828.5	0.064
11	3030.5	2325.5	0.344	2607	2749	0.185
12	2900.5	2455.5	0.069	2508	2848	**0.048**
13	3230.5	2125.5	0.697	2767.5	2588.5	0.792

Table 3.
The Kruskal-Wallis test results for AI competence and groups defined by age, year of study and previous school

Groups defined by age				
	<19–21>	<22–25>	<26–30>	>30
n	33	55	10	5
Question	Rank avg and results			
3	47	56	51	44
	H(4,103)=2.739; p-value=0.434			
4	45	56	56	44
	H(4,103)=3.491; p-value=0.322			
5	51	53	49	61
	H(4,103)=0.676; p-value=0.879			
6	49	57	37	54
	H(4,103)=4.511; p-value=0.211			
7	46	57	44	53
	H(4,103)=3.562; p-value=0.313			
8	50	55	43	47
	H(4,103)=2.024; p-value=0.568			
9	53	53	45	40
	H(4,103)=1.674; p-value=0.643			
10	52	54	40	52
	H(4,103)=1.967; p-value=0.579			
11	50	55	48	39
	H(4,103)=1.877; p-value=0.598			
12	54	54	40	45
	H(4,103)=2.253; p-value=0.522			
13	51	53	44	61
	H(4,103)=1.467; p-value=0.690			

Groups defined by previous school				
	Technical secondary school	General secondary school	University	Polytechnic
n	31	33	17	12
Question	Rank avg and results			
3	47	47	45	50
	H(3,93)=0.248; p-value=0.970			

4	44	43	51	60
		H(3,93)=4.460; p-value=0.216		
5	45	45	47	58
		H(3,93)=2.594; p-value=0.459		
6	47	43	46	61
		H(3,93)=3.986; p-value=0.263		
7	46	45	37	70
		H(3,93)=12.100; p-value=0.007		
8	46	44	43	61
		H(3,93)=4.293; p-value=0.232		
9	46	51	39	51
		H(3,93)=2.470; p-value=0.481		
10	48	50	44	40
		H(3,93)=1.512; p-value=0.679		
11	50	47	42	45
		H(3,93)=0.942; p-value=0.815		
12	48	53	37	42
		H(3,93)=4.847; p-value=0.183		
13	51	46	40	51
		H(3,93)=2.076; p-value=0.557		

	Groups defined by year of study				
	1st	2nd	3rd	4th	5th
n	18	19	35	23	8
Question			Rank avg and results		
3	51	58	47	47	74
		H(4,103)=7.154; p-value=0.128			
4	51	48	51	46	87
		H(4,103)=12.937; p-value=0.012			
5	65	46	50	47	58
		H(4,103)=5.644; p-value=0.227			
6	52	52	49	46	82
		H(4,103)=9.728; p-value=0.045			
7	43	54	52	52	65
		H(4,103)=3.434; p-value=0488			
8	59	51	49	42	78
		H(4,103)=10.266; p-value=0.036			

9	48	62	51	43	67
		H(4,103)=7.455; p-value=0.114			
10	45	60	51	48	64
		H(4,103)=4.723; p-value=0.317			
11	54	57	52	44	60
		H(4,103)=3.305; p-value=0.508			
12	54	64	52	41	52
		H(4,103)=6.686; p-value=0.153			
13	60	55	50	38	75
		H(4,103)=11.804; p-value=0.019			

Evaluation of perception of AI possibilities and applications in relation to study specializations, age, gender, year of study and previous schools

A subsequent section of the questionnaire included questions on perceptions of the applicability of AI issues in various areas of life and economy as well as the social and educational aspects of AI. The aim of this study was to analyse the attitudes and concerns about AI among students of different study specializations, age, gender, year of study and previous schools. The questions in this part and possible responses included in the questionnaire were defined using Likert scales to the 7-point scale listed below e.g.:

1. Can and should AI be more actively used, for example, in education to personalize teaching-learning?
2. Can social robots be helpful in the development of children including those with special needs?
3. Where can it be most useful and effective to use AI?
   a) For people
   b) For Education
   c) For Medicine
   d) For Transport
   e) For Business, Finance and Banking
   f) For Space and NASA
   g) For Economy and Management
   h) For IT (Information Technology)
   i) For public services
   j) Cybersecurity and safety

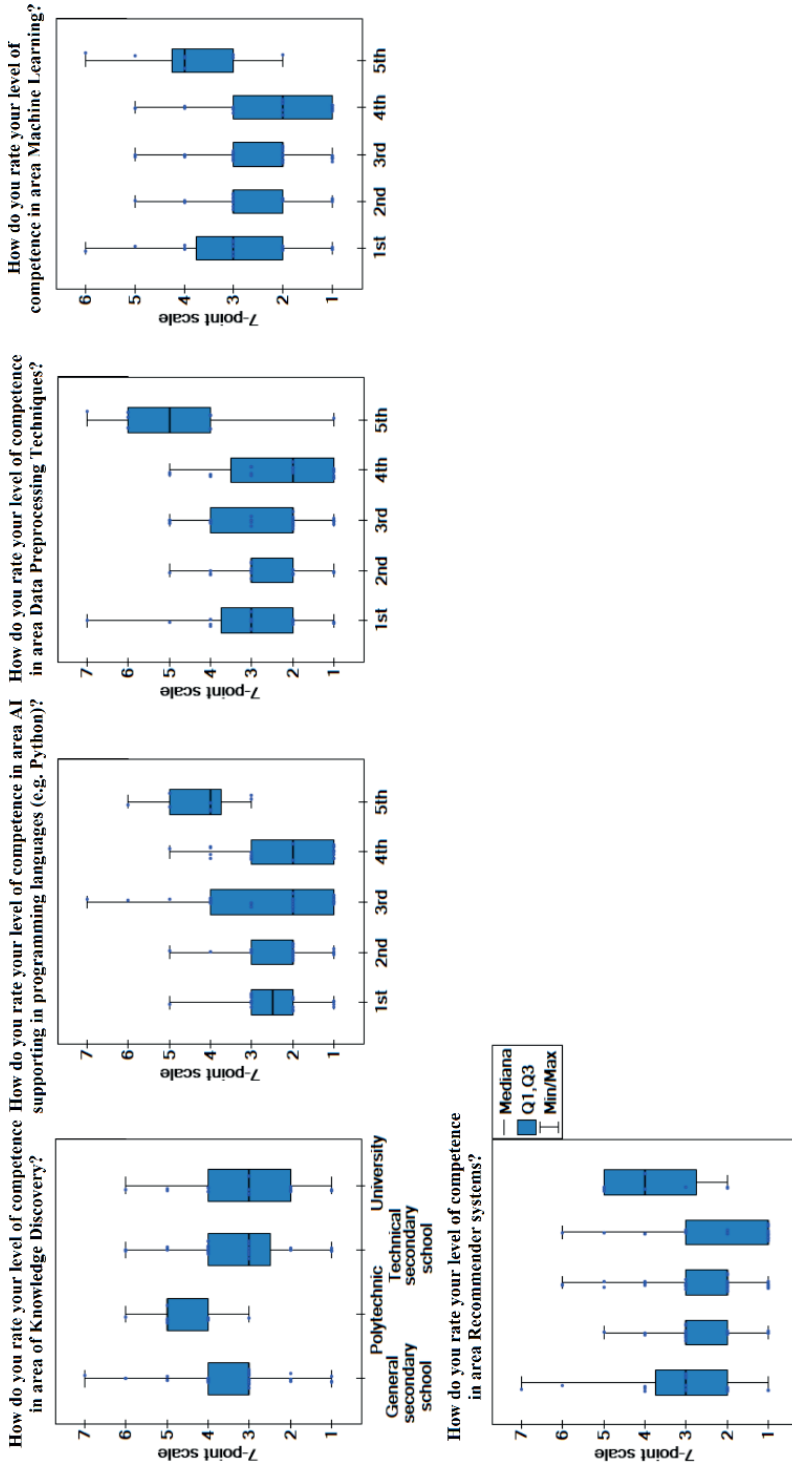

Figure 3. Comparison of the responses obtained for questions related to AI competence for which statistically significant differences are confirmed in Table 3

Bar charts of the obtained responses related to the assessment of AI competences are shown in Figure 4. As can be seen from the figures, respondents have no doubt that artificial intelligence can be useful in areas such as medicine, transport, business, finance and banking, space and NASA, information technology and cybersecurity. In all of these questions, the highest response – rate 7 – was indicated by about 35% to even 50% of respondents. By far the highest responses were given to the use of AI in space and NASA. However, in the case of AI applications for people, education or public services, respondents were not so strongly convinced of the answers for the other questions. In these cases, AI received support, but the results are rather spread around an intermediate intensity: responses of 4, 5, 6 were the most frequent. Respondents also gave moderate support for more active use of AI issues in education to personalize teaching-learning and the use of social robots in the development of children including those with special needs. Negative answers to these two questions were rather rare. But the most frequently indicated answers were average intensities 4, 5, 6.

Statistical tests were performed in order to test the significance of differences in the results obtained for groups defined by study specialization, age, gender, year of study and previous school (each issue was considered separately). All the results examined are for the ordinal variable. The Mann-Whitney test was used to detect differences in the two independent samples defined by field of study and gender. The results obtained are presented in Table 4: sum of ranks across groups and p-value. There are statistically significant differences in the results obtained for all aspects studied – questions 1, 2, 3a)–3j) – in the groups defined by study specialization. It can be seen that computer science students rate the possibility of using AI issues in all aspects studied higher and better than education students. This confirms hypothesis H4. Perhaps this is due to a greater awareness of the possibilities offered by AI. As far as groups defined by gender are concerned, practically in all questions the differences in ratings are significant – the only exceptions being the questions on: Can and should AI be used more actively in, for example, education to personalize teaching/learning? Where can the application of AI be most useful and effective: cyber security and safety? It was found that the majority of women study education, and the majority of men study computer science (only 7 women in computer science specialization took part in the questionnaire, the remaining 54 were men). Thus, the results obtained for groups defined by gender are probably also related to the specialization of students.

In the next stage of the study, the Kruskal-Wallis tests were performed for groups defined by age, year of study and previous school (in each case the number of groups was greater than 2). The results obtained group size, group rank mean, p-value and test statistic value are presented in Table 5. Significant results are shown in bold. As can be seen, age, type of previous school and year of study have little influence on the evaluation of the applicability of AI issues in different fields. Among the grouping conditions tested, it can be seen that the year of study

has the greatest influence. We notice a regularity that students of the first and the fifth year of study rate the applicability of AI for people, education, economy and management and computer science higher than students of the second, third or fourth year of study (see Figure 5). This confirms hypothesis H5. This may be related to the first fascination with AI issues in the first year of study, and the greatest knowledge about the possibilities of AI in the fifth year of study. Another trend is that master's students who have already completed a bachelor's degree at a university or technical university also rate the applicability of AI issues in the fields of medicine and transport higher than bachelor's students. This is probably related to these students' greater knowledge and experience with AI issues.

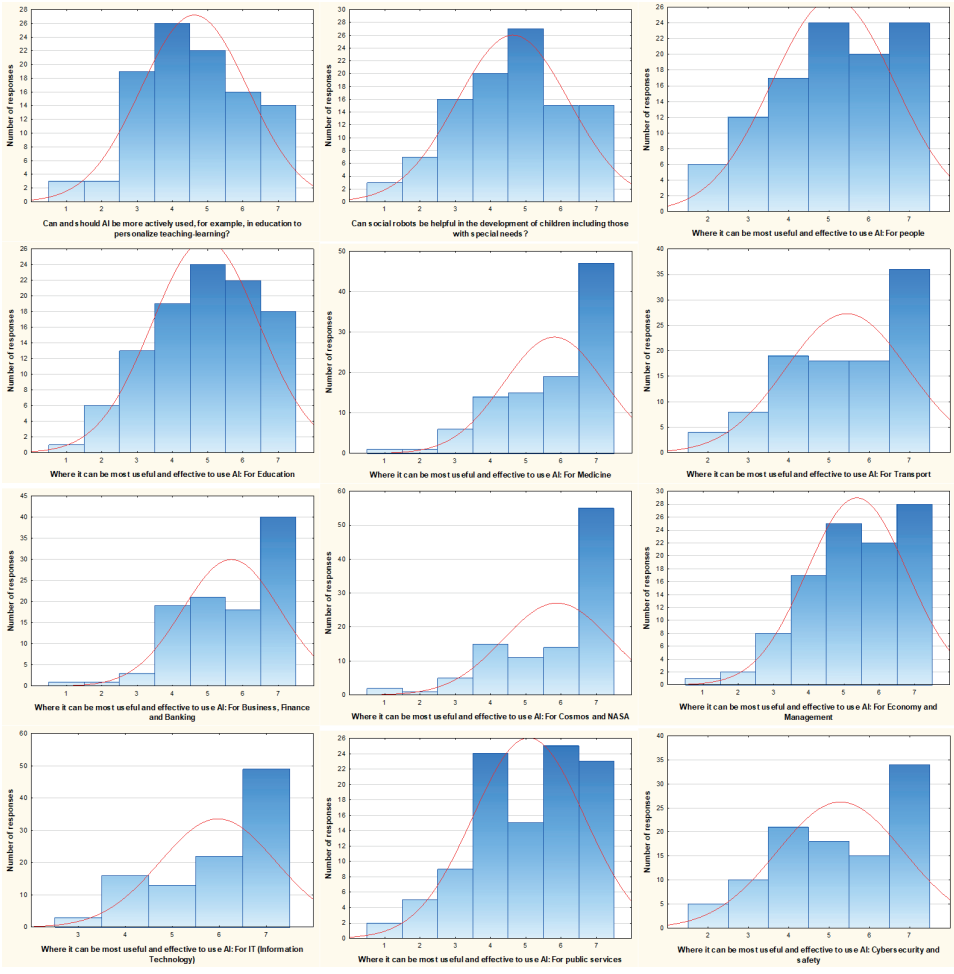

Figure 4. Bar charts of the responses obtained related to social, educational and development aspects of AI

Table 4.
The Mann-Whitney test results for AI possibilities and applications and groups defined by study specialization and gender

Question	Groups defined by the study specialization: education and computer science			Groups defined by gender: male and female		
	Sum of the ranks for computer science	Sum of the ranks for education	p-value	Sum of the ranks for male	Sum of the ranks for female	p-value
1	3462	1894	**0.048**	3049	2308	0.106
2	3525	1831	**0.016**	3113	2243	**0.041**
3a)	3661	1695	**0.001**	3254	2103	**0.003**
3b)	3515	1842	**0.019**	3101	2255	**0.049**
3c)	3555	1801	**0.007**	3217	2139	**0.004**
3d)	3692	1665	**0.000**	3333	2024	**0.000**
3e)	3626	1730	**0.002**	3150	2206	**0.019**
3f)	3494	1862	**0.019**	3101	2255	**0.035**
3g)	3531	1825	**0.014**	3110	2246	**0.041**
3h)	3509	1847	**0.016**	3104	2252	**0.037**
3i)	3498	1858	**0.026**	3066	2291	0.083
3j)	3544	1812	**0.010**	3146	2211	**0.026**

Table 5.
The Kruskal-Wallis test results for AI possibilities and groups defined by age, year of study and previous school

	Groups defined by age			
	<19–21>	<22–25>	<26–30>	>30
n	33	55	10	5
Question	Rank avg and results			
1	49	55	48	52
	H(4,103)=1.015; p-value=0.798			
2	45	52	75	54
	H(4,103)=7.750; p-value=0.052			
3a)	49	51	63	57
	H(4,103)=1.883; p-value=0.597			
3b)	48	52	67	53
	H(4,103)=3.295; p-value=0.348			
3c)	42	55	73	41
	H(4,103)=11.029; p-value=0.012			

3d)	46	53	64	55
		H(4,103)=3.076; p-value=0.380		
3e)	52	52	55	46
		H(4,103)=0.304; p-value=0.959		
3f)	44	54	64	55
		H(4,103)=5.536; p-value=0.137		
3g)	48	52	63	61
		H(4,103)=2.665; p-value=0.446		
3h)	48	54	63	34
		H(4,103)=4.377; p-value=0.224		
3i)	50	51	65	53
		H(4,103)=2.140; p-value=0.544		
3j)	52	51	61	51
		H(4,103)=1.185; p-value=0.757		

Groups defined by previous school				
	Technical secondary school	General secondary school	University	Technical university
n	31	33	17	12
Question		Rank avg and results		
1	52	41	47	52
		H(3,93)=3.229; p-value=0.358		
2	45	40	54	61
		H(3,93)=7.138; p-value=0.068		
3a)	47	39	58	56
		H(3,93)=7.293; p-value=0.063		
3b)	46	42	55	53
		H(3,93)=3.222; p-value=0.359		
3c)	47	38	56	59
		H(3,93)=8.543; p-value=0.036		
3d)	42	41	60	58
		H(3,93)=9.013; p-value=0.029		
3e)	44	40	56	60
		H(3,93)=7.599; p-value=0.055		
3f)	45	41	59	52
		H(3,93)=6.694; p-value=0.082		
3g)	45	40	62	48
		H(3,93)=7.557; p-value=0.056		

3h)	45	44	51	55
		H(3,93)=2.280; p-value=0.516		
3i)	46	43	57	44
		H(3,93)=3.490; p-value=0.322		
3j)	45	43	56	51
		H(3,93)=3.003; p-value=0.391		

	Groups defined by year of study				
	1st	2nd	3rd	4th	5th
n	18	19	35	23	8
Question			Rank avg and results		
1	61	48	48	50	63
		H(4,103)=3.826; p-value=0.431			
2	62	40	47	59	58
		H(4,103)=7.573; p-value=0.109			
3a)	66	35	51	52	64
		H(4,103)=11.871; p-value=0.018			
3b)	68	40	46	57	54
		H(4,103)=11.085; p-value=0.026			
3c)	57	39	49	61	59
		H(4,103)=7.930; p-value=0.094			
3d)	56	42	50	53	70
		H(4,103)=5.938; p-value=0.204			
3e)	60	49	43	54	71
		H(4,103)=8.586; p-value=0.072			
3f)	60	42	47	59	58
		H(4,103)=7.557; p-value=0.109			
3g)	67	45	43	56	63
		H(4,103)=10.952; p-value=0.027			
3h)	67	40	46	59	55
		H(4,103)=11.957; p-value=0.018			
3i)	59	41	50	55	61
		H(4,103)=5.015; p-value=0.286			
3j)	68	47	46	48	63
		H(4,103)=8.937; p-value=0.063			

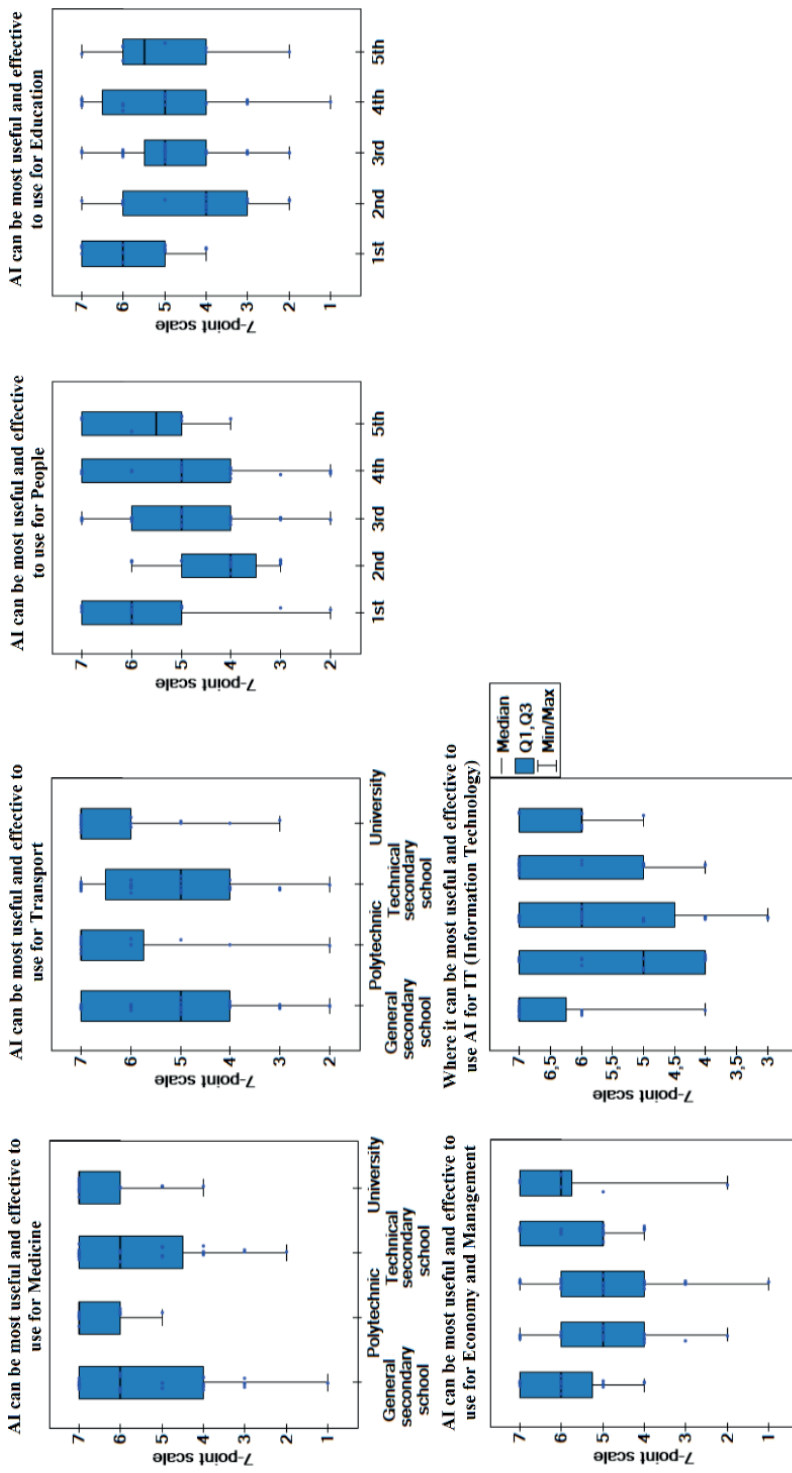

Figure 5. Comparison of the responses obtained for questions related to AI possibilities for which statistically significant differences are confirmed in Table 5

Correlation analysis between perception of AI possibilities and applications and self-assessment of AI literacy

In the previous section it has already been found that master's students evaluate the applicability of AI issues in practice higher than bachelor's students. A hypothesis arose that this was due to the higher level of competence of these students. An exhaustive study was conducted to see if there was indeed a link between the level of competence of students and their perception of the applicability of AI issues in various areas of life and the economy. The correlation between responses to questions on self-assessment of AI competence and the assessment of the applicability of AI issues in practice was investigated. Spearman's rank correlation coefficient was used for this purpose as we have ordinal categorical data. Table 6 shows the values of the correlation coefficient. Significant results with the level of significance, p-value smaller than 0.05 are shown in bold.

Table 6.
The values of Spearman's rank correlation coefficient between questions about applicability of AI issues and questions about self-assessment of AI competence

Questions**	Questions about self-assessment of AI competence								
	1*	2*	3*	4*	5*	6*	7*	8*	9*
1	**0.271**	**0.258**	**0.322**	**0.334**	**0.290**	**0.377**	0.168	0.091	0.136
2	0.054	0.054	0.173	0.032	0.070	0.179	–0.067	–0.102	–0.100
3a)	0.076	0.099	0.040	0.044	–0.007	0.147	–0.128	**–0.220**	–0.165
3b)	0.046	0.165	**0.246**	0.065	0.040	0.116	–0.053	–0.099	–0.010
3c)	0.007	0.103	0.149	0.049	0.114	0.099	–0.115	–0.114	–0.077
3d)	0.020	0.070	0.174	0.109	0.041	0.148	–0.133	–0.066	–0.047
3e)	0.030	–0.040	**0.215**	0.072	0.018	–0.002	**–0.229**	–0.108	**–0.228**
3f)	–0.183	–0.084	0.045	–0.096	0.001	–0.021	**–0.239**	–0.142	–0.115
3g)	0.000	0.019	0.050	0.020	–0.078	0.084	**–0.202**	–0.107	–0.154
3h)	–0.043	–0.017	0.105	–0.040	–0.023	0.015	–0.174	–0.078	–0.183
3i)	–0.071	0.019	0.031	–0.093	–0.175	0.040	**–0.230**	–0.165	–0.151
3j)	–0.064	–0.004	0.093	0.012	–0.101	0.093	**–0.209**	–0.193	**–0.211**

Designations: 1* – AI supporting in programming languages (e.g. Python); 2* – Ethical and social aspects of AI; 3* – Data Pre-processing Techniques; 4* – Knowledge Machine Learning; 5* – Deep Learning; 6* – Natural Language Processing; 7* – Learning Analytics; 8* – Cyber security; 9* – Recommender systems. 1 – Can and should AI be more actively used, for example, in education to personalize teaching-learning?; 2 – Can social robots be helpful in the development of children including those with special needs?; 3a) – Where it can be most useful and effective to use AI for People; 3b) – for Education; 3c) – for Medicine; 3d) – for Transport; 3e) – for Business, Finance and Banking; 3f) – for Space and NASA; 3g) – for Economy and Management; 3h) – for IT (Information Technology); 3i) – for public services; 3j) – for Cybersecurity and safety. ** Questions about applicability of AI issues.

As can be seen, the correlation between both aspects: competence of AI and applicability of AI issues is not very high. Only in sixteen cases it turned out to be significant. This confirms hypothesis H6. A significant correlation is between:

- Question 1 – Can and should AI be more actively used, for example, in education to personalize teaching-learning? and Questions 1*–6* – competence in programming languages, ethical and social aspects of AI, data Preprocessing Techniques, Knowledge Machine Learning, Deep Learning and Natural Language Processing. In all these cases, a significant positive correlation of medium to weak intensity was confirmed. This means that a higher range of competence influences a higher evaluation of the applicability of AI issues in education to personalize teaching-learning.
- Question 7* – Learning Analytics and Questions 3e)–3g) and 3i), 3j) – the possibility of using AI in Business, Finance and Banking, for Space and NASA, for Economy and Management, for public services and for Cybersecurity and safety. Negative correlations of weak intensity was found here. Thus, an increase in knowledge of Learning Analytics causes on average a decrease in belief that AI can be applied to these issues.
- Question 3* – competences in Data Preprocessing Techniques and Questions 3b) and 3e) – the possibility of using AI in Education and Business, Finance and Banking. Positive correlations of weak intensity was found here. This is very sensible, as financial and business data often require advanced data preprocessing, which takes sometimes up to 60%–70% of total analysis time. Students familiar with this subject are probably simply aware of it.
- Question 8* – competences in Cybersecurity and Question 3a) – the possibility of using AI for People. A negative correlation of weak intensity was found here. Thus, an increase in knowledge of Cyber security causes on average an increase in evaluating the applicability of AI for People. Perhaps this is related to students' awareness of the risks posed by the use of AI in cybersecurity.
- Question 9* – competences in Recommender systems and Questions 3e) and 3j) the possibility of using AI for Business, Finance and Banking and for Cybersecurity and safety. Negative correlations of weak intensity were found here. Thus, an increase in knowledge of Recommender systems causes on average a decrease in belief that AI can be applied to Business, Finance and Banking and for Cybersecurity and safety. To be honest, this is quite a strange result as in business, finance and banking recommendation systems are used with great success. Although, on the other hand, in cybersecurity recommendation systems are not very applicable.

Evaluation of potential risks in relation to study specializations, age, gender, year of study and previous schools

The next part of the survey is related to the potential risks associated with the development of artificial intelligence. The aim of this study was to analyse the attitudes and fears about AI among students of different study specializations, age, gender, year of study and previous schools. Also, the correlation between the level of knowledge of AI in a variety of contexts and students' concerns was studied. The questions in this part and possible responses included in the questionnaire were defined using Likert scales to the 7-point scale. Higher scores correspond to higher intensity of the problem. The questions are listed below.

What risks can AI bring:

1. Imposing a course of action depending on the analysis made by AI and its recommendations;
2. Increasing threat of interference in private life. Threats to fundamental rights and democracy;
3. Negative impact on the labour market;
4. Increasing role of robots, controlled by AI and in the future threats of robots going out of control;
5. Concurrency;
6. Transparency challenges;
7. Security risks;

Bar charts of the obtained responses related to the views on AI potential risks are shown in Figure 6.

As can be seen, respondents have the greatest fears in relation to increasing threat of interference of AI in private life – threats to fundamental rights and democracy. The largest number of respondents indicated a very high risk in this question. Similarly, it can denote the intensity of fear regarding security. Here again, a large number of respondents indicated the highest values. On the other hand, to the question concerning the role of robots, controlled by AI and possibility that in the future robots will go out of control respondents did not show such a significant concern. Practically, equal numbers of students indicated each value from the answer scale. For the remaining questions, rather, respondents mostly indicated the middle value on the scale, which means rather their neutrality towards the threat.

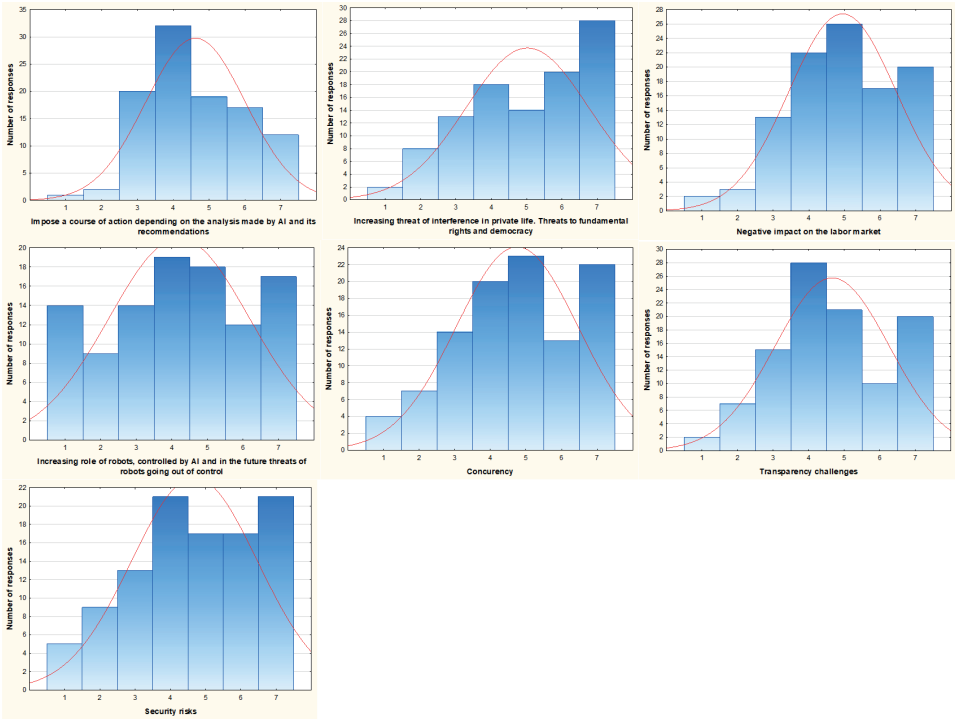

Figure 6. Bar charts of the responses obtained related to AI potential risks

Statistical tests were performed in order to test the significance of differences in the results – attitudes towards various threats – obtained for groups defined by study specialization, age, gender, year of study and previous school (each issue was considered separately). All the results examined are for the ordinal variable. The Mann-Whitney test was used to detect differences in the two independent samples defined by field of study and gender. The results obtained are presented in Table 7: sum of ranks across groups and p-value. There are statistically significant differences in the results obtained for two aspects studied; Imposing a course of action depending on the analysis made by AI and its recommendations; Increasing role of robots, controlled by AI and in the future threats of robots going out of control – questions 1 and 4 – in the groups defined by both study specialization and gender. Additionally, comparative box-whiskers charts for the responses to questions 1–7 grouped by specialization (Figure 7) and gender (Figure 8) were made. As can be observed, the values of the responses for the question 1 are much higher for computer science specialty students than for education specialty students. This means that computer science students are much more concerned about the threat of imposing a course of action depending on the analysis made by AI and its recommendations than education students. This confirms hypothesis H7. For question 4, the situation is quite opposite. Here, education students are more

concerned about the threat of increasing role of robots, controlled by AI and in the future threats of robots going out of control than computer science students. Similar conclusions can be drawn based on the box-whiskers charts presented in Figure 8. However, here it is the male students who show more concern about threat 1 and less concern about threat 4 than women. Probably this correspondence is due to the fact that significantly more women are studying in the specialty of education. There were only 7 women in computer science specialization who took part in the questionnaire, the remaining 54 were men. Thus, the results obtained for groups defined by gender are probably also related to the specialization of students. In reality, the probability of robots going out of control is low, and presumably the awareness of this is linked to the greater knowledge of AI issues that computer science specialty students have.

Table 7.
The Mann-Whitney test results for potential risks and groups defined by study specialization and gender

Question	Groups defined by the study specialization: education and computer science			Groups defined by gender: male and female		
	Sum of the ranks for computer science	Sum of the ranks for education	p-value	Sum of the ranks for male	Sum of the ranks for female	p-value
1	3604	1752	**0.004**	3278	2078	**0.002**
2	3249	2107	0.608	2883	2473	0.623
3	3237.5	2118.5	0.663	3003.5	2352.5	0.198
4	2683.5	2672.5	**0.001**	2348	3008	**0.002**
5	3045	2311	0.396	2801	2555	0.966
6	3254	2102	0.584	2894.5	2461.5	0.570
7	3030	2326	0.342	2689	2667	0.434

In the next stage of the study, the Kruskal-Wallis tests were performed to test the significance of differences in the results for groups defined by age, year of study and previous school (in each case the number of groups was greater than 2). The results obtained group size, group rank mean, p-value and test statistic value are presented in Table 8. Significant results are shown in bold. As can be seen, age and type of previous school have little influence on the AI-related anxiety. In contrast, the year of study has a significant impact on various types of AI related fears. A comparative box-whiskers charts for the responses to questions 1–7 grouped by year of study (Figure 9) were made. As can be observed, the greatest anxiety in relation to all investigated aspects – questions 1–7 – is felt by first and fourth-year students. In contrast, the lowest level of anxiety about the impact of AI is felt

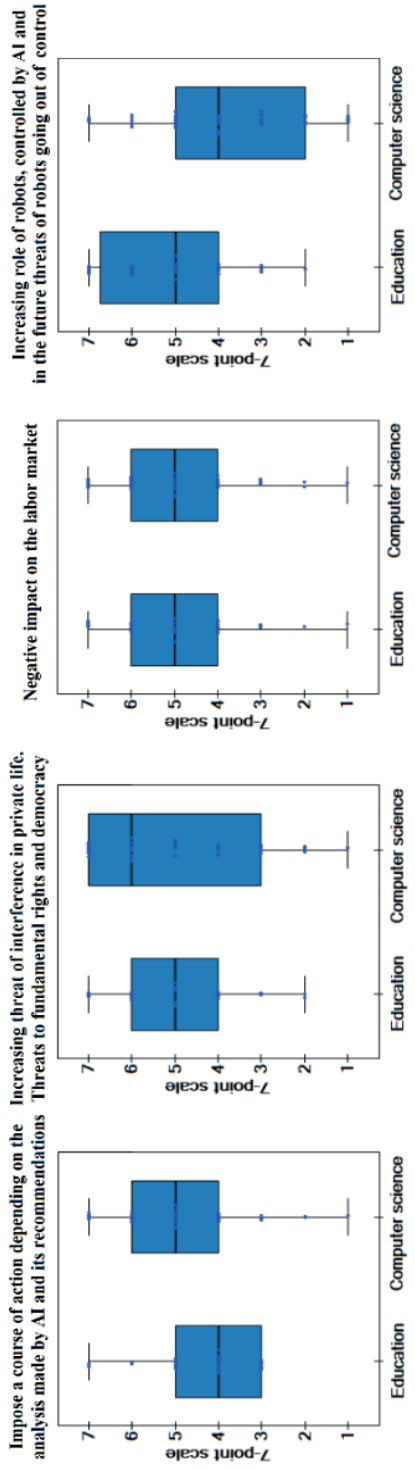

Figure 7. Comparison of the responses obtained for questions 1–7 in the groups defined by study specialization

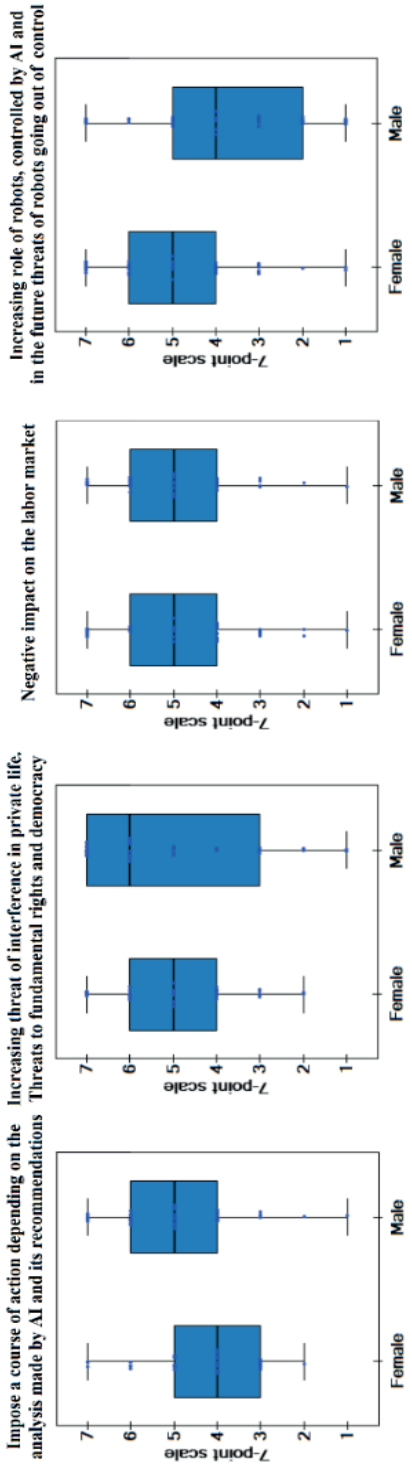

Figure 8. Comparison of the responses obtained for questions 1–7 in the groups defined by gender

by second and fifth-year students. This confirms hypothesis H8. The explanation we find for this phenomenon is that first-year students in both bachelor's and master's programs feel the biggest concern (the fourth year of study is the first year of master's studies). Considering question 1 where grouping in terms of previous school had a significant impact on the differences in results, it can be concluded that students who previously graduated from a technical university or technical secondary school consider this risk as more significant than students who previously graduated from a general secondary school or university. So, it can be concluded that for students with more technical knowledge, the issue of imposing a course of action depending on the analysis made by AI and its recommendations is more likely to occur.

Table 8.
The Kruskal-Wallis test results for potential risks and groups defined by age, year of study and previous school

	Groups defined by age			
	<19–21>	<22–25>	<26–30>	>30
n	33	55	10	5
Question		Rank avg and results		
1	43	55	64	57
		H(4,103)=5.367; p-value=0.147		
2	51	53	64	31
		H(4,103)=4.541; p-value=0.209		
3	46	56	57	40
		H(4,103)=3.325; p-value=0.344		
4	46	54	66	43
		H(4,103)=4.207; p-value=0.240		
5	47	56	50	45
		H(4,103)=2.456; p-value=0.483		
6	46	53	63	56
		H(4,103)=2.897; p-value=0.408		
7	45	56	59	40
		H(4,103)=4.266; p-value=0.234		

Groups defined by previous school				
	Technical secondary school	General secondary school	University	Polytechnic
n	31	33	17	12
Question	Rank avg and results			
1	52	37	50	59
	H(**3,93)=8.084; p-value=0.044**			
2	51	43	41	58
	H(3,93)=4.360; p-value=0.225			
3	54	41	44	51
	H(3,93)=3.995; p-value=0.262			
4	56	47	42	32
	H(3,93)=7.734; p-value=0.052			
5	54	41	48	45
	H(3,93)=3.732; p-value=0.292			
6	50	41	50	50
	H(3,93)=2.445; p-value=0.485			
7	53	44	40	50
	H(3,93)=3.377; p-value=0.337			

Groups defined by year of study					
	1st	2nd	3rd	4th	5th
n	18	19	35	23	8
Question	Rank avg and results				
1	60	32	53	61	50
	H(**4,103)=12.529; p-value=0.014**				
2	70	39	45	59	54
	H(**4,103)=13.553; p-value=0.009**				
3	63	34	52	62	41
	H(**4,103)=13.680; p-value=0.008**				
4	52	49	48	67	33
	H(**4,103)=10.478; p-value=0.033**				
5	67	41	46	64	37
	H(**4,103)=14.380; p-value=0.006**				
6	73	35	49	57	43
	H(**4,103)=16.910; p-value=0.002**				
7	52	38	55	60	49
	H(4,103)=6.316; p-value=0.177				

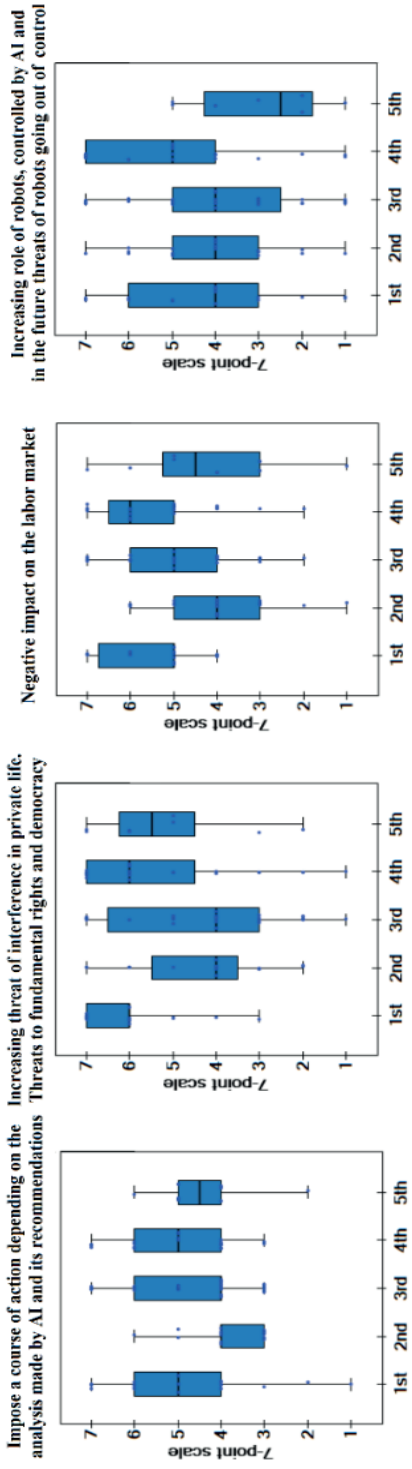

Figure 9. Comparison of the responses obtained for questions 1-7 in the groups defined by year of study

Correlation analysis between feelings of anxiety toward AI and self-assessment of AI literacy

After an analysis on the differences in feelings of anxiety toward AI by groups specified by study specialization and year of study, an assumption arose that fear toward AI is related to students' knowledge of AI. Therefore, the correlation between responses to questions on self-assessment of AI competence and the level of anxiety toward various AI threats was investigated. Spearman's rank correlation coefficient was used for this purpose as we have ordinal categorical data. Table 9 shows the values of the correlation coefficient. Significant results with the level of significance, p-value smaller than 0.05 are shown in bold.

Table 9.
The values of Spearman's rank correlation coefficient between questions about risk and questions about self-assessment of AI competence

Questions about potential risks	Questions about self-assessment of AI competence								
	1*	2*	3*	4*	5*	6*	7*	8*	9*
1	–0.002	–0.087	0.105	–0.024	0.058	–0.053	–0.100	0.036	–0.089
2	–0.111	–0.105	0.030	–0.141	0.007	0.002	–0.103	–0.121	–0.002
3	–0.125	–0.080	0.031	**–0.223**	–0.087	–0.106	–0.137	–0.054	–0.097
4	–0.048	–0.112	–0.124	–0.154	0.014	–0.095	0.016	0.093	0.077
5	–0.134	**–0.195**	–0.063	**–0.262**	–0.108	–0.097	–0.101	–0.007	–0.010
6	0.054	0.028	0.087	–0.041	0.013	0.096	–0.101	–0.071	0.069
7	0.014	–0.023	0.015	0.066	**0.181**	0.060	0.110	0.091	0.104

Designations: 1* – AI supporting in programming languages (e.g. Python); 2* – Ethical and social aspects of AI; 3* – Data Pre-processing Techniques; 4* – Knowledge Machine Learning; 5* – Deep Learning; 6* – Natural Language Processing; 7* – Learning Analytics; 8* – Cyber security; 9* – Recommender systems. 1 – Imposing a course of action depending on the analysis made by AI and its recommendations; 2 – Increasing threat of interference in private life. Threats to fundamental rights and democracy; 3 – Negative impact on the labour market; 4 – Increasing role of robots, controlled by AI and in the future threats of robots going out of control; 5 – Concurrency; 6 – Transparency challenges; 7 – Security risks.

As can be seen, the correlation between both aspects; competence of AI and anxiety towards AI is low. Only in four cases it turned out to be significant. This confirms hypothesis H9. A significant correlation is between:

- Question 2* – Knowledge about ethical and social aspects of AI and Question 5 – anxiety about Concurrency with AI. A negative correlation of weak intensity was found here. Thus, an increase in knowledge of ethical and social aspects of AI causes on average a decrease in concurrency anxiety.

- Question 4* – Knowledge Machine Learning and Question 3 – Negative impact on the labour market. A negative correlation of weak intensity was found here. Thus, an increase in knowledge of Machine Learning causes on average a decrease in a sense of fear about negative impact on the labour market.
- Question 4* – Knowledge Machine Learning and Question 5 – anxiety about Concurrency with AI. A negative correlation of weak intensity was found here. Thus, an increase in knowledge of Machine Learning causes on average a decrease in concurrency anxiety.
- Question 5* – Knowledge Deep Learning and Question 7 – Security risks. A positive correlation of weak intensity was found here. Thus, an increase in knowledge of Deep Learning causes on average an increase in concerns about security risks.

The rationale for the above found correlations may be as follows. Awareness of the social and ethical aspects of AI increases knowledge of regulations regarding AI, thereby reducing the fear that AI could compete with humans. Knowledge about machine learning models increases relevance in the job market and gives awareness of what aspects/tasks AI modules can really be applied to. Thus, it reduces the fear of lack of jobs as a consequence of AI occupying them and reduces the fear of competiting with AI. A good knowledge of deep learning issues gives an awareness of the capabilities of this tool and thus awareness how it can be used in the context of cybersecurity. Therefore, it increases concern about this issue.

Discussion

In the paper, nine different hypotheses were posed. Extensive statistical hypothesis testing and correlation analysis were carried out. The following hypotheses were able to be fully or partially proven:

I. Computer science students have a higher level of AI competence than education students. This hypothesis has only been proven for skills relating to programming languages supporting AI. In all other AI competences studied, no significant differences in competence levels in groups defined by faculty were observed.

II. Students who have completed engineering technical studies (Bachelor's degree) have a higher level of AI competence than, students who are just after high school. This hypothesis could only be proven for the skills concerning Knowledge Discovery. It was indicated that, in fact, students who graduated with a bachelor's degree from a technical university had higher competences in this area. In all other AI competences studied, no significant differences in competence levels were observed.

III. Students in their fifth year of study have higher AI competences than students in earlier years of study. This hypothesis has been fully proven. For four different AI competences (AI supporting in programming languages, Data Preprocessing Techniques, Machine Learning and Recommender systems) there are statistically significant differences in the level of competence in groups defined by the year of study, with the fifth-year students showing the highest level.

IV. Computer science students are more aware of the possibilities and applications that AI brings than education students. This hypothesis has been fully proven using the statistical tests. In all studied aspects of AI application there are statistically significant differences in the results, computer science students rated AI capabilities higher than education students.

VIII. Students in their fifth year of study have lower concerns, fear about AI development than students in earlier years of study. This is due to greater experience and knowledge of these students. This hypothesis has been fully proven. Virtually in all aspects studied, a statistically significant differences in results related to the AI concerns of students of different years of study was confirmed. The boxplot charts clearly show that it is the fifth-year students who show the lowest level of concern.

Certain regularities that seemed reasonable have not been demonstrated. The predicted correlations are not covered by the data. Hypotheses that could not be confirmed:

V. Fifth-year students have a higher awareness of AI possibilities and applications than students in earlier years of study. Although it was shown that there was a statistically significant difference in the ratings of the importance of AI in the four application areas studied. However, it was not only the fifth-year students who rated AI capabilities the highest. Often, it was the first-year students who assigned higher ratings. This is probably related to an initial fascination with AI issues more than knowledge of the subject.

VI. Awareness of AI possibilities and applications increases proportionally to the level of AI competence. The higher the students' AI competence, the more they appreciate the possibilities of AI. On the other hand, a statistically significant positive correlation was shown to exist in eight out of one hundred and eight relationships tested between AI competence and awareness of AI use. However, firstly these correlations are of weak intensity, secondly, also in eight cases a significant negative correlation was discovered (this applies to competences in Learning Analytics; Cyber security; Recommender systems). Therefore, this hypothesis cannot be confirmed.

VII. Computer science students have less concern, fear about the development of AI than education students. In two out of the seven hypotheses tested, we obtained a significant difference in the level of concern towards AI issues

between students of different faculties. However, in case of "increasing role of robots, controlled by AI and in the future threats of robots going out of control" computer science students had less concern, but in the case of "imposing a course of action depending on the analysis made by AI and its recommendations" they had more concern than education students.

IX. The increase in AI competence influences a calm attitude towards AI and a decrease in fear of AI development. In only three out of the sixty-three correlations tested statistically significant negative correlations were confirmed. Furthermore, the correlation is of weak intensity. The competences that influence a small but significant reduction in the level of concern are Ethical and social aspects of AI and Knowledge Machine Learning. However, in the overwhelming number of cases, an increase in competences does not affect the reduction of concerns towards AI.

The final model showing the confirmed relations between the studied concepts is presented in Figure 10.

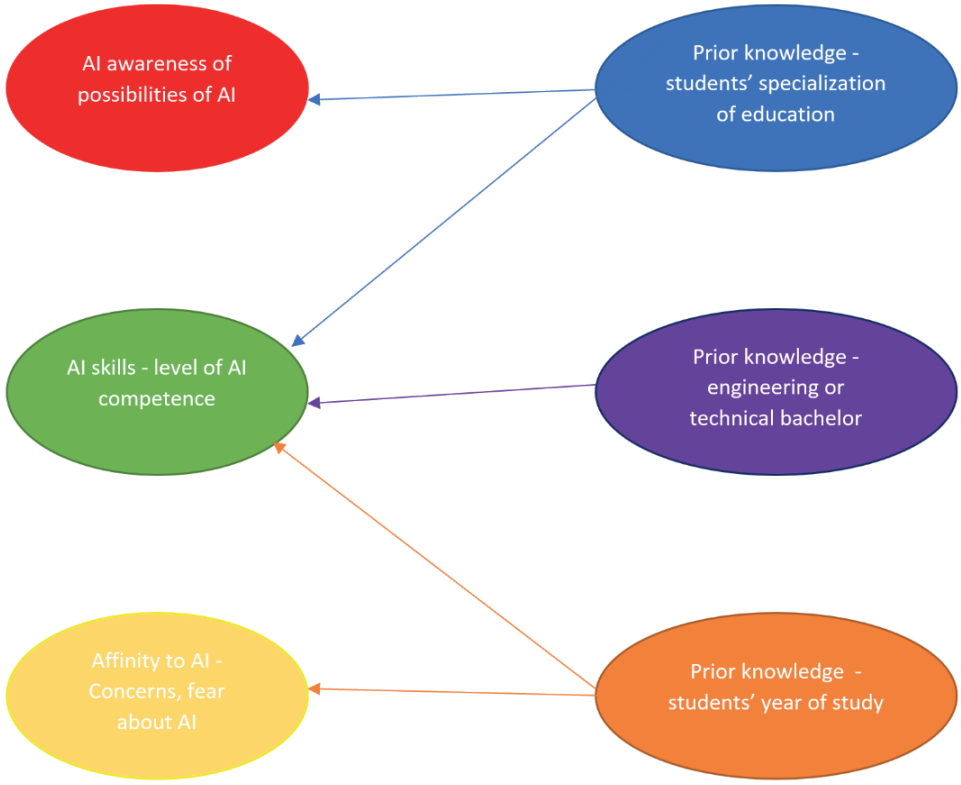

Figure 10. Six factors final model and investigated relations

Source: Own work based on Asghar, Minichiello, & Iqbal, 2022.

Based on the results, much attention should be paid to learning about AI issues for computer science and education students. The competence of students is low. It is worrying that there is no significant correlation between the extent of competence and awareness of AI applications and capabilities. Here there indeed remains a large field of work for university teachers. It is encouraging that students in their fifth year of study already have a greater awareness of the possibilities of using AI issues and have a positive attitude towards them. Thus, the greatest emphasis is placed on AI-related education in the fifth year of study. Arguably, it should be strengthened in the earlier years of study. However, students are mostly aware of AI's impact on the ethical aspects of life and are aware of the risks, so they will likely be able to recognize the school potential negative impacts of AI in their life. The natural conclusion is that if they can recognize it, they will also be able to respond to it. The main recommendations are to strengthen the education related to AI capabilities and competence in prematurely years of study.

Conclusions

In conclusion, it is possible to emphasize some of the findings regarding the attitudes of IT and pedagogy students to the educational, social and ethical aspects of AI implementation, as well as their competence in AI. Their self-assessment has shown an unsatisfactory level in the main areas of AI, while at the same time the students' attitude towards the prospect of using AI in some social areas was positive. Among the grouping conditions examined, it can be seen that the year of study has the greatest influence. We notice a regularity that students in the first and fifth year of studies rate the possibilities of using AI for people, education, economy and management and computer science higher than students in the second, third or fourth year of study. This may be related to an initial fascination with AI issues in the first year of study and the greatest knowledge about the possibilities of AI in the fifth year of study. Their interest in the topic is the motivation for the development of a platform and courses in the research area for students to deepen their knowledge and use it in their education and future professional career, which is what the FITPED-AI project serves, partly described in Skalka, & Drlik (2022), and Smyrnova-Trybulska, Skalka, & Drlik (2023). Other experiences and achievements may also be taken into account. The authors of the study (Larionov, et al., 2022) analyse digital trends in the development of higher education. The transition from a quantitative state of digitalization to a qualitative one is noted, associated with the introduction of artificial intelligence, blockchain, and work with large databases into education (Larionov, et al., 2022). The next study explores the prospects for improving the scientific and educational system

based on innovative methods of education using neural network technologies, the need for a transition to online education with integrated systems of natural and artificial intelligence (Akhmetshin et al., 2020). The researchers (Huang et al., 2023) described an interesting study, concerning applying AI-enabled personalized video recommendations to stimulate students' learning motivation and engagement during a systems programming course in a flipped classroom setting and some research results (Huang, Lu, & Yang, 2023). The Project FITPED-AI will create high-quality educational resources in a user-friendly online virtual environment to respect privacy and ethical standards. The chosen strategy of inclusion and diversity implemented in a virtual learning environment enables education for disabled users through created digital courses and resources. Any number of repetitions is allowed during learning, and educators are positively motivated to achieve partial goals. At the same time, the created educational content will be freely available via the Internet for those interested, regardless of cultural, social, geographical or economic barriers (Smyrnova-Trybulska, Skalka, & Drlik, 2023).

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Data Availability Statement

The datasets generated during the current study are available from the corresponding author on reasonable request. None of the data or materials for the experiments reported here is available, and none of the experiments was preregistered.

References

Ahmed, A. A. A. & Ganapathy, A. (2021). Creation of Automated Content with Embedded Artificial Intelligence: a Study on Learning Management System for Educational Entrepreneurship.

Academy of Entrepreneurship Journal, 27(3), 1–10. Print ISSN: 1087-9595; Online ISSN: 1528-2686.

Akhmetshin, E., Barmuta, K., Vasilev, V., Okagbue, H. & Ijezie, O. (2020). Principal Directions of Digital Transformation of Higher Education System in Sustainable Education (2020) E3S Web of Conferences, 208, art. no. 09042. https://doi.org/10.1051/e3sconf/202020809042.

Asghar, M., Minichiello, A. & Iqbal, A. (2022). Perceived Factors Contributing to the Subjective Wellbeing of Undergraduate Engineering Students: An Exploratory Study. Int. J. Environ. Res. Public Health 2022, 19, 16284. https://doi.org/10.3390/ijerph192316284.

Azevedo, A. & Almeida, A. H. (2021). Grasp the challenge of digital transition in smes – a training course geared towards decision-makers. *Education Sciences,* 11 (4). https://doi.org/10.3390/educsci11040151.

Baek, C. & Doleck, T. (2020). A bibliometric analysis of the papers published in the Journal of Artificial Intelligence in Education from 2015–2019. *International Journal of Learning Analytics and Artificial Intelligence for Education*, 2(1), 67–84. https://doi.org/10.3991/ijai.v2i1.14481.

Fedotova, G. V., Ushamirskaya, G. F., Sigidov, Y. I., Kuzmina, T. I. & Mandrik, N. V. (2020). Industry 4.0 as a new vector of growth and development of the knowledge economy. In Janusz Kacprzyk (Ed.) *Advances in Intelligent Systems and Computing*, 1100 AISC, (pp. 88–97). https://doi.org/10.1007/978-3-030-39319-9_9.

Hinojo-Lucena, F. J., Aznar-Díaz, I., Cáceres-Reche, M. P. & Romero-Rodríguez, J. M. (2019). Artificial intelligence in higher education: a bibliometric study on its impact in the scientific literature. *Education Sciences,* 9(1). https://doi.org/10.3390/educsci9010051.

Huang, Anna Y. Q., Lu, Owen H. T. & Yang, Stephen J. H., (2023). Effects of artificial Intelligence–Enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom. *Computers & Education,* 194, March 2023, 104684. https://doi.org/10.1016/j.compedu.2022.104684.

Huang, L. & Peissl, W. (2023). Artificial Intelligence – A New Knowledge and Decision-Making Paradigm?. In: Hennen, L., Hahn, J., Ladikas, M., Lindner, R., Peissl, W., van Est, R. (eds) *Technology Assessment in a Globalized World.* Springer, Cham. https://doi.org/10.1007/978-3-031-10617-0_9.

Karnouskos, S. (2022). Symbiosis with artificial intelligence via the prism of law, robots, and society. *Artificial Intelligence and Law,* 30, 93–115. https://doi.org/10.1007/s10506-021-09289-1.

Khaperskaya, A. & Minin, M. (2020). Artificial intelligence as an instrument of successful pedagogical monitoring and affect assessment for disabled people employment. CEUR Workshop Proceedings, 2770, *Proceedings of the 4th International Conference on Informatization of Education and E-learning Methodology: Digital Technologies in Education (IEELM-DTE 2020),* Krasnoyarsk, October 6–9, 2020, (pp. 220–227).

Kozlova, E. P., Morozova, G. A., Kuznetsov, V. P., Romanovskaya, E. V. & Andryashina, N. S. (2021). Interaction of Human and Smart Technologies in Modern Conditions. *Lecture Notes in Networks and Systems,* 155, (pp. 609–618). https://doi.org/10.1007/978-3-030-59126-7_68.

Larionov, V. G., Sheremetyeva, E. N. & Barinova, E. P. (2022). Digital Trends in Higher Education, Izvestiya Vysshikh Uchebnykh Zavedenii, Seriya Teknologiya Tekstil'noi Promyshlennosti, (1), (pp. 322–329). https://doi.org/10.47367/0021-3497_2022_1_322.

Martins, R. M., von Wangenheim, C. G., Rauber, M. F. et al. (2023). Machine Learning for All! – Introducing Machine Learning in Middle and High School. *International Journal of Artificial Intelligence in Education*. https://doi.org/10.1007/s40593-022-00325-y.

Mata-Rivera, M. F., Zagal-Flores, R. & Barria-Huidobro, C. (Eds.) (2022). Telematics and Computing: 11th International Congress, WITCOM 2022, Cancún, México, November 7–11, 2022, Proceedings (*Communications in Computer and Information Science, 1659*) 1st ed. 2022, CCIS, 466 p.

Mhlanga, D. (2022). Human-Centered Artificial Intelligence: The Superlative Approach to Achieve Sustainable Development Goals in the Fourth Industrial Revolution Sustainability 2022, 14(13), 7804. https://doi.org/10.3390/su14137804.

Oprea, M. (2021). Integration of Artificial Intelligence in STEM Education Through IOT Projects Based on Machine Learning. *eLearning and Software for Education Conference*, (pp. 211–221). https://doi.org/10.12753/2066-026X-21-096.

Pikkarainen, A. & Tihinen, M. (2023). Education as a Promoter of Digital Transformation in the Manufacturing Industry. In: Kahraman, C., Haktanır, E. (eds) *Intelligent Systems in Digital Transformation. Lecture Notes in Networks and Systems*, vol 549. Springer, Cham. https://doi.org/10.1007/978-3-031-16598-6_8.

Ramírez, M. R. (2021). Digital transformation in the universities: Process in the time of covid 19 [Article@Transformación digital en las universidades: Proceso en épocas de covid 19] RISTI - Revista Iberica de Sistemas e Tecnologias de Informacao, 2021 (E42), pp. 573–582.

Ratten, V. (2020). Coronavirus (Covid-19) and the entrepreneurship education community. Journal of Enterprising Communities, 14 (5), (pp. 753–764). https://doi.org/10.1108/JEC-06-2020-0121.

Richardson, M. & Clesham, R. (2021) Rise of the machines? The evolving role of AI technologies in high-stakes assessment. London Review of Education. 19(1). art. no. 9. https://doi.org/10.14324/LRE.19.1.09.

Skalka, J. & Drlik, M. (2022). Proposal of Artificial Intelligence Educational Model Using Active Learning in a Virtual Learning Environment. In E. Smyrnova-Trybulska (ed.) *E-learning in the Transformation of Education in Digital Society. „E-learning" Series*. Vol. 14. Katowice-Cieszyn: STUDIO NOA for University of Silesia, (pp. 15–25) ISSN 2451-3644 (print edition), ISSN 2451-3652 (digital edition), ISBN 978-83-66055-31-5. https://doi.org/10.34916/el.2022.14.02.

Smyrnova-Trybulska, E., Drlik, M. & Skalka, J. (2023). Wymiana doświadczeń i najlepsze praktyki w nauczaniu AI. [Exchange of experiences and best practices in teaching AI.] *Gazeta Uniwersytecka, [University Newspaper]* 304, 28–29. https://gazeta.us.edu.pl/sites/gazeta.us.edu.pl/files/PDF/Gazeta_Uniwersytecka_nr_304%20(internet)%20(1).pdf.

Smyrnova-Trybulska, E., Przybyła-Kasperek, M. & Kommers, P. (2023). Educational, Social, and Ethical Aspects of AI in the Opinion of IT and Pedagogy Students – a Case Study In P. Iasias (Ed.), *Conference Proceedings E-Society*, 11–13 March, 2023, Lisbon IADIS Lisbon, (pp. 171–178), ISBN: 978-989-8704-47-4.

Sosnovsky, S., Brusilovsky, P., Baraniuk, R. & Lan, A. (2020). iTextbooks 2020 – *Proceedings of the 2nd International Workshop on Intelligent Textbooks 2020, co-located with 21st International Conference on Artificial Intelligence in Education, AIED 2020 (2020) CEUR Workshop Proceedings*, 2674, 104 p.

Xu, W. & Fan, O. (2022). The application of AI technologies in STEM education: a systematic review from 2011 to 2021. *International Journal of STEM Education,* 9, Article 59. https://doi.org/10.1186/s40594-022-00377-5.

Yam, J. & Skorburg, J. A. (2021). From human resources to human rights: Impact assessments for hiring algorithms. *Ethics and Information Technology* 23(4): 611–623. https://doi.org/10.1007/s10676-021-09599-7.

Yu, H. & Nazir, S. (2021). Role of 5g and Artificial Intelligence for Research and Transformation of English Situational Teaching in Higher Studies. *Mobile Information Systems*, 2021, art. no. 3773414. https://doi.org/10.1155/2021/3773414.

Factors Enhancing Students' Views on Artificial Intelligence

Małgorzata Przybyła-Kasperek, Eugenia Smyrnova-Trybulska, Piet Kommers

Czynniki warunkujące postrzeganie sztucznej inteligencji przez studentów

S t r e s z c z e n i e

Sztuczna inteligencja (AI) jest obecnie jednym z ważniejszych i współczesnych kierunków rozwoju nauki w kontekście interdyscyplinarnym. Podejście UE do sztucznej inteligencji koncentruje się na doskonałości i zaufaniu, mając na celu zwiększenie potencjału badawczego i przemysłowego przy jednoczesnym zapewnieniu bezpieczeństwa i praw podstawowych (Europejskie podejście do sztucznej inteligencji). Wzmocnienie wspierania doskonałości w dziedzinie sztucznej inteligencji wzmocni potencjał Europy w skali globalnej. Jednocześnie nie rozwiązano jeszcze wielu wyzwań i kwestii. Problemem poruszonym w artykule jest zbadanie i przeanalizowanie podejścia studentów informatyki i pedagogiki do edukacyjnych, społecznych i etycznych aspektów wdrażania sztucznej inteligencji. Celem jest odkrycie i analiza postaw studentów informatyki i pedagogiki wobec edukacyjnych, społecznych i etycznych aspektów wdrażania sztucznej inteligencji. O wypełnienie ankiety poproszono studentów dwóch wydziałów Uniwersytetu Śląskiego w Katowicach. Byli to głównie studenci dwóch specjalności – informatyki i pedagogiki. W badaniu wzięło udział 103 studentów. Do weryfikacji wykorzystano testy Kruskala-Wallisa. Głównymi badanymi zagadnieniami był poziom kompetencji studentów w zakresie AI, ich świadomość zastosowań AI w różnych dziedzinach życia i gospodarki oraz znaczenie dziedziny AI. Badanie obejmowało również poziom zaufania do AI oraz poziom lęku wobec AI. Zbadano różnego rodzaju zależności i powiązania między tymi aspektami. Hipotezy zostały w większości potwierdzone. Na koniec artykułu przedstawiono dyskusję i główne wnioski.

S ł o w a k l u c z o w e: Sztuczna inteligencja (AI), aspekty edukacyjne, społeczne i etyczne, studenci informatyki i pedagogiki, opinia, testy Kruskala-Wallisa

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Factores que causando en la opinión de los estudiantes sobre la inteligencia artificial

R e s u m e n

La Inteligencia Artificial (IA) es actualmente una de las direcciones más importantes y contemporáneas del desarrollo de la ciencia en un contexto interdisciplinar. El planteamiento de la UE en materia de inteligencia artificial se centra en la excelencia y la confianza, con el objetivo de impulsar la investigación y la capacidad industrial, garantizando al mismo tiempo la seguridad y los derechos fundamentales (Un planteamiento europeo de la inteligencia artificial). Reforzar el fomento de la excelencia en IA fortalecerá el potencial de Europa para competir a nivel mundial. Simultáneamente, aún no se han resuelto muchos retos y problemas. El problema planteado en el artículo consiste en explorar y analizar la actitud de los estudiantes de informática y educación ante los aspectos educativos, sociales y éticos de la aplicación de la IA. El propósito es descubrir y analizar la actitud de los estudiantes de informática y pedagogía hacia los aspectos educativos, sociales y éticos de la implementación de la IA. Se pidió a los estudiantes de dos facultades de la Universidad de Silesia en Katowice (Polonia) que respondieran a una encuesta. Se trataba principalmente de estudiantes de dos especialidades: Informática y Pedagogía. Se encuestó a 103 estudiantes. Para la verificación

se utilizaron las pruebas de Kruskal-Wallis. Las principales cuestiones estudiadas fueron el nivel de competencia de los estudiantes en IA, su conocimiento de las aplicaciones de la IA en diversos ámbitos de la vida y la economía, y la importancia del campo de la IA. El estudio también incluyó el nivel de confianza hacia la IA y el nivel de ansiedad hacia la IA. Se investigaron varios tipos de dependencias y conexiones entre estos aspectos. Las hipótesis se confirmaron en su mayoría. Por último, el artículo presenta la discusión y las principales conclusiones.

P a l a b r a s c l a v e: Inteligencia Artificial (IA), aspectos educativos, sociales y éticos, estudiantes de informática y educación, opinión, pruebas de Kruskal-Wallis

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Факторы, обуславливающие взгляды студентов на искусственный интеллект

А н н о т а ц и я

Искусственный интеллект (ИИ) в настоящее время является одним из наиболее важных и современных направлений развития науки в междисциплинарном контексте. Подход ЕС к искусственному интеллекту основан на совершенстве и доверии, направлен на повышение исследовательского и промышленного потенциала при обеспечении безопасности и основных прав (Европейский подход к искусственному интеллекту). Укрепление передового опыта в области искусственного интеллекта укрепит потенциал Европы в глобальной конкуренции. Одновременно с этим еще не решены многие вызовы и вопросы. Проблема, поднятая в статье, заключается в изучении и анализе отношения студентов факультетов компьютерных наук и наук об образовании к образовательным, социальным и этическим аспектам внедрения ИИ. Цель – выявить и проанализировать отношение студентов института компьютерных наук и наук об образовании (будущих педагогов) педагогики к образовательным, социальным и этическим аспектам внедрения ИИ. Студентам двух факультетов Силезского университета в Катовицах (Польша) было предложено ответить на вопросы анкеты. В основном это были студенты двух специальностей – компьютерных наук и педагогики. Всего было опрошено 103 студента. Для проверки использовались тесты Крускала-Уоллиса. Основными изучаемыми вопросами были уровень компетентности студентов в области ИИ, их осведомленность о применении ИИ в различных областях жизни и экономики, а также важность области ИИ. Исследование также включало уровень уверенности в отношении ИИ и уровень тревожности в отношении ИИ. Были исследованы различные виды зависимостей и связей между этими аспектами. Гипотезы в основном подтвердились. В конце статьи представлены обсуждение и основные выводы.

К л ю ч е в ы е с л о в а: Искусственный интеллект (ИИ), образовательные, социальные и этические аспекты, студенты факультетов информатики и наук об образовании, мнение, тесты Крускала-Уоллиса