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Artificial intelligence in education: analysis of dynamics, perception, and prospects for integration

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Abstract

This article delves into the intricate relationship between Artificial Intelligence (AI) and the educational ecosystem, particularly within higher education. It embarks on a detailed examination of how AI's integration influences teaching methodologies, learning experiences, and research processes while also casting a spotlight on the accompanying challenges and concerns. Specifically, it scrutinizes the repercussions on pedagogical communication and student engagement, underpinning its analysis with a study that encompasses an array of dimensions: the fluctuation in student populations and the density of higher educational institutions, the degree of digitalization within these entities, and comprehensive questionnaire responses from students that reveal their perceptions and attitudes towards AI's role in education. This study aims to explore the perspectives and experiences of a critical stakeholder group: students. By dedicating focused attention to both the opportunities and obstacles presented by AI in education, this study aims to foster a nuanced comprehension of its impact. It critically evaluates the potential benefits and drawbacks, equipping stakeholders with the insight needed to navigate the evolving educational landscape. Furthermore, this research aims to spotlight trends in digital competitiveness within the educational sector and propose strategic recommendations for achieving a harmonious balance between innovative and traditional pedagogical approaches. Such balance is pivotal for crafting forward-thinking educational strategies amidst the rapid integration of AI technologies. Through this comprehensive analysis, the study seeks to contribute to the broader discourse on optimizing AI's potential in education while mitigating its challenges, thereby supporting the advancement of an education system that is both innovative and inclusive.

Keywords: artificial intelligence, education, higher education, integration of artificial intelligence, university

Білім берудегі жасанды интеллект: интеграцияның динамикасын, қабылдауын және болашағын талдау

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Түйін

Жасанды интеллектті (AI) білім беру процесіне біріктіру білім беру мекемелерінде, әсіресе университет деңгейінде оқыту, оқыту және зерттеу тәжірибесінде төңкеріс жасай алады. Бұл мақалада AI интеграциясының оқыту әдістемесіне, оқу процестеріне және ғылыми зерттеулерге қалай әсер ететінін егжей-тегжейлі талдау ұсынылады, сонымен бірге ілеспе қиындықтар мен мәселелерді қамтиды. Атап айтқанда, зерттеу бірқатар аспектілерді қамтитын талдауға сүйене отырып, педагогикалық коммуникация мен студенттердің қатысуының салдарына назар аударады: студенттер санының өзгеруі және жоғары оқу орындарының тығыздығы, осы мекемелерді цифрландыру дәрежесі, сондай-ақ студенттердің білім берудегі AI рөліне деген көзқарасы мен көзқарасын ашатын сауалнамаларға кең жауаптары. Мақаланың мақсаты-мүдделі тараптардың негізгі тобының болашағы мен тәжірибесін зерттеу: студенттер. Білім берудегі AI ұсынған мүмкіндіктер мен кедергілерге назар аудара отырып, бұл зерттеу оның әсерін терең түсінуге ықпал етуге тырысады. Ол ықтимал артықшылықтар мен кемшіліктерді сыни тұрғыдан бағалайды, осылайша мүдделі тараптарға өзгермелі білім беру ландшафтында шарлау үшін қажетті түсінік береді. Сонымен қатар, бұл зерттеу білім беру секторындағы цифрлық бәсекеге қабілеттілік тенденцияларын бөліп көрсетуге және инновациялық және дәстүрлі педагогикалық тәсілдер арасындағы үйлесімді тепе-теңдікке қол жеткізу үшін стратегиялық ұсыныстарды ұсынуға тырысады. Мұндай тепе-теңдік жасанды интеллект технологияларының жылдам интеграциясы аясында прогрессивті білім беру стратегияларын әзірлеудің кілті болып табылады. Осы жан-жақты талдау арқылы зерттеу білім берудегі AI әлеуетін оңтайландыру, оның қиындықтарын азайту, осылайша инновациялық және білім беру жүйесін дамытуды қолдау бойынша кеңірек дискурсқа үлес қосуға тырысады.

Кілттік сөздері: жасанды интеллект, білім, жоғары білім, жасанды интеллект интеграциясы, университет

Искусственный интеллект в образовании: анализ динамики, восприятия и перспектив интеграции

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Аннотация

Интеграция искусственного интеллекта (ИИ) в образовательный процесс может революционизировать практику преподавания, обучения и исследований в образовательных учреждениях, особенно на университетском уровне. Эта статья представляет подробный анализ того, как интеграция ИИ влияет на методики преподавания, учебные процессы и научные исследования, одновременно освещая сопутствующие вызовы и проблемы. В частности, исследование сосредотачивается на последствиях для педагогической коммуникации и вовлеченности студентов, опираясь на анализ, который охватывает ряд аспектов: изменения в численности студентов и плотности высших учебных заведений, степень цифровизации этих учреждений, а также обширные ответы студентов на анкеты, раскрывающие их восприятие и отношение к роли ИИ в образовании. Целью статьи является изучение перспектив и опыта ключевой группы заинтересованных сторон: студентов. Уделяя сосредоточенное внимание как возможностям, так и препятствиям, представляемым ИИ в образовании, данное исследование стремится способствовать глубокому пониманию его влияния. Оно критически оценивает потенциальные преимущества и недостатки, тем самым предоставляя заинтересованным сторонам необходимое понимание для навигации в меняющемся образовательном ландшафте. Кроме того, данное исследование стремится выделить тенденции в цифровой конкурентоспособности в образовательном секторе и предложить стратегические рекомендации для достижения гармоничного баланса между инновационными и традиционными педагогическими подходами. Такой баланс является ключевым для разработки прогрессивных образовательных стратегий на фоне быстрой интеграции технологий ИИ. Посредством этого всестороннего анализа исследование стремится внести вклад в более широкий дискурс по оптимизации потенциала ИИ в образовании, снижая его вызовы, тем самым поддерживая развитие инновационной и включающей образовательной системы.

Ключевые слова: искусственный интеллект, образование, высшее образование, интеграция искусственного интеллекта, университет

Introduction

The rapid advancements in artificial intelligence (AI) have sparked a significant transformation in various sectors, including education. In today's rapidly evolving world, the traditional one-size-fits-all approach to teaching is becoming increasingly informal. Students come from diverse backgrounds with varying learning styles, abilities, and paces of comprehension. AI-powered educational technologies can address these individual needs by tailoring instructional methods and content to each student's unique strengths, weaknesses, and preferences. One of the most promising applications of AI in education is adaptive learning systems. These intelligent systems analyze a student's performance, comprehension levels, and learning patterns in real-time and dynamically adjust the content, pace, and delivery methods to optimize their understanding and retention. By continuously adapting to the learner's needs, these systems ensure that no student is left behind or held back, fostering a more personalized and practical learning experience.

The relevance of the study is due to the rapid development of artificial intelligence technologies and their increasingly widespread implementation in various spheres of society, including education. The integration of AI into the educational process opens up new opportunities for personalization and adaptation of educational programs, increasing the accessibility and quality of education. However, along with this, new challenges arise related to the ethical aspects of using AI, the need to train qualified personnel and the development of a regulatory framework. In this regard, the study is aimed at a deep understanding of the current state of integration of AI in the educational sphere and determining the prospects for its further development.

The purpose of this study is to analyze the current state and prospects for the integration of artificial intelligence (AI) into the educational sphere. The study is aimed at studying the dynamics of the number of students and higher education institutions, the level of digitalization in education, as well as the perception and attitude of students towards the use of AI in the educational process. Based on the analysis of these data, the study seeks to identify key trends, opportunities, and challenges associated with the implementation of AI in educational practice, as well as assess the potential impact of AI on access and quality of education.

Literature review

This study discusses the possibility of mastering artificial intelligence for students in the digital era, as well as the relevance of this topic, considering the growing use of AI in all spheres of life. Based on the example of Hong Kong, an initiative was launched to provide a course on artificial intelligence for university students called "Understanding Artificial Intelligence", which is a pilot program to promote artificial intelligence literacy among the public [1]. The goal of this initiative is not only to disseminate knowledge about artificial intelligence but also to prepare students to interact with this technology in the digital age. In the context of Hong Kong, where artificial light is beginning to play a more significant role in various aspects of life and work, including economics and education, students and citizens in general must understand not only the benefits but also

the potential risks associated with the use of artificial intelligence. Conducting courses such as the one in Hong Kong helps students master key concepts of artificial intelligence, develop assessment skills and the use of this technology in teaching.

A very important object of study in any research paper is medicine. The advent of artificial intelligence has significantly changed medical science, according to researchers [2], and medical education must embrace AI-enhanced practices. Accordingly, medical students may realize the relevance of medical artificial intelligence for their careers, become more confident in learning machine learning, and thus develop a strong intention to study this learning for medical practice.

Another paper also notes that there needs to be more effort to teach critical concepts of artificial intelligence to university students from different educational backgrounds. Most approaches focus on algorithms and programming, which excludes a large portion of university students from non-computer science majors. Accordingly, we can conclude that students of non-computer specialties incorrectly use the capabilities of artificial intelligence in their studies. Therefore, it is possible to propose a concept of artificial intelligence literacy that includes three components: a) understanding the concept of artificial intelligence, b) using the concept of artificial intelligence for assessment, c) using the concept of artificial intelligence to understand the natural world through problem-solving [3]. Moreover, we will return to the definition of AI literacy suggested by Long and Magerko [4], who proposes the concept of a course on literacy in the field of artificial intelligence, which is intended for students from different educational programs and genders. Three stages of the course are proposed: the basis of machine learning, the basis of deep learning, and the development of artificial intelligence applications.

One important goal in proposed AI literacy programs is to empower participants, thereby providing them with devices to improve control over their lives and expand their skills. Makinin's [5] approach to empowering individuals is providing them with the devices and tools they need to manage their lives and expand their adaptive skills. Viewed from this perspective, artificial intelligence literacy aims to provide people with opportunities and ways to participate in a digital society such as artificial intelligence. This understanding points to the goal of increasing student confidence through interaction with artificial intelligence.

An important component when working with AI learning is relevance, that is, the value of AI literacy, as it is helpful for lifelong learning and can be used in many everyday circumstances. Inherent influence refers to the degree to which task performance is perceived as affecting the overall picture of things. Our interest in impact concerns student perceptions of AI literacy and societal implications. A person who feels that interacting with artificial intelligence has a high impact usually has a greater intrinsic motivation to learn the relevant skills. Moreover, creative self-confidence refers to a student's belief that they can come up with new ideas and solutions. Therefore, empowerment through AI literacy has the potential to inspire future technology producers, not just enable the consumption of existing technologies in AI learning.

At the same time, intelligent learning systems personalize learning based on the characteristics of the specific learner, which are stored in the learning model of that student. Most automated profiling methods map monitored learner behavior onto typical

behaviors described in psychological models (such as personality traits and learning styles [6] to infer learner preference traits. Conversational intelligent training systems (CITS) have a conversational agent interface, which allows training through a mixed initiative in a conversation with the student [7]. Their advantage is that the student does not need to be motivated himself, since the conversation is conducted during training, however, the student can ask a question and research the answer himself.

Besides, AI literacy will help narrow the widely observed digital gender gap. According to OECD [9; 10], gender disparities in knowledge and learning experiences in artificial intelligence led to unequal participation in educational programs and increased the potential for accidental bias in the design of various applications, even for learning.

Thus, the topic of using AI in the educational process is relevant from the aspect of gender accessibility to learning with artificial intelligence to students' educational background. In general, research on the use of machine learning in student training is relevant as many researchers focus on making this training suitable for all participants, regardless of their background and gender.

Methodology

Despite the extensive research conducted to date in the field of artificial intelligence literacy, its assessment still needs to be improved. Problems with conceptualization, combined with the predominance of articles created in educational institutions, hinder the development and widespread implementation of measurement scales in various contexts.

The compiled questionnaire included the following stages (Figure 1):

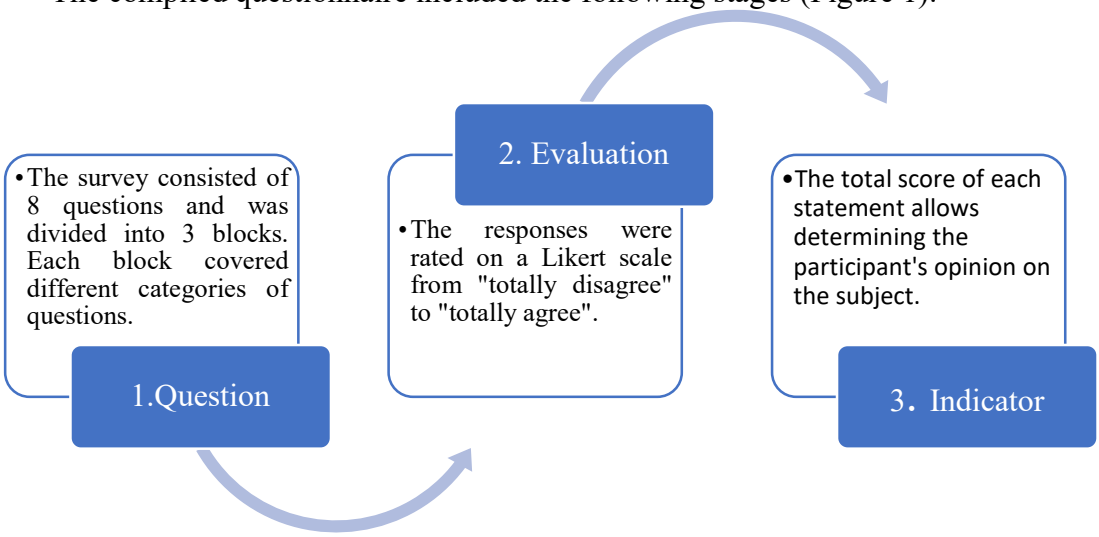


Figure 1 – Description

Note: compiled by authors

To address this issue, a measuring instrument developed by Carolus et al. [11] was utilized in this study. This instrument builds upon existing literature on AI literacy, offering modularity, ease of application in professional settings, adherence to psychometric standards, and inclusion of additional psychological skills beyond classic

AI literacy facets. It has been validated for factorial structure and adapted to the Russian language for the purposes of this research. since context plays a role and therefore, we cannot generalize the results of the study to all countries. Therefore, it is necessary to conduct a study in the context of Kazakhstan. The instrument comprises 8 questions categorized into three dimensions: AI Literacy, AI Self-Efficacy, and AI Self-Management, measured using a 5-point Likert scale (ranging from 1 = "totally disagree" to 5 = "completely agree"). However, for the study, we have made changes to this method.

Findings and Discussion

4.1 Trends in the number of students and higher education institutions

During the last five years, the student population in higher education showed an initial growth followed by a decline and then a period of stabilization. The dynamicsof the number of students in higher education institutions from 2018 to 2022, ares provided in Figure 2.

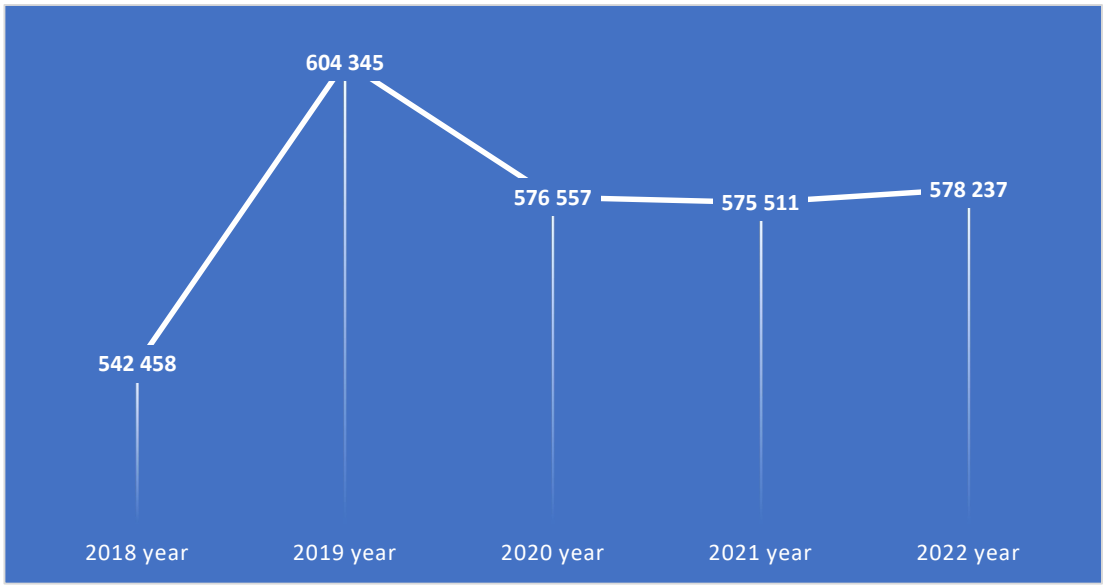


Figure 2 - The number of students in HEI

Note: compiled by authors

Between 2018 and 2019, there was a significant increase in student numbers, from 542,458 to 604,345. This represents a growth of approximately 11.4%, which could be indicative of higher enrollment rates. Following that, there was a noticeable decrease to 576,557 in 2020, which is roughly a 4.6% drop. During the next two years, the numbers remained relatively stable, with a slight decline to 575,511. The minor change in 2021 of about 0.2% suggests a stabilization of the factors that caused the initial decline. In 2022, there was a marginal increase to 578,237, an approximately 0.5% rise. This indicates a possible recovery or a renewed interest in higher education, albeit at a slower pace.

Changes in the number of higher educational institutions (Figure. 5) in these years may be related to the development of artificial intelligence technology in education since several universities and colleges have been introducing new technologies related to artificial intelligence to improve the learning process and adapt to the requirements of the modern educational environment. This may lead to the consolidation of some educational institutions or their merger to optimize resource use and develop modern (innovative) approaches to education. It is also likely that some educational institutions, especially those that strive to remain competitive and provide contemporary education, are actively using artificial intelligence in their teaching and research programs. This may lead to increased interest from students and researchers, as well as attracting additional financial resources.

The overall trend in the number of higher educational institutions (HEI) showed a slight increase initially, followed by a period of stability, and then a decrease in the final years. The dynamic of higher educational institutions from 2018 to 2022 is represented in Figure 3.

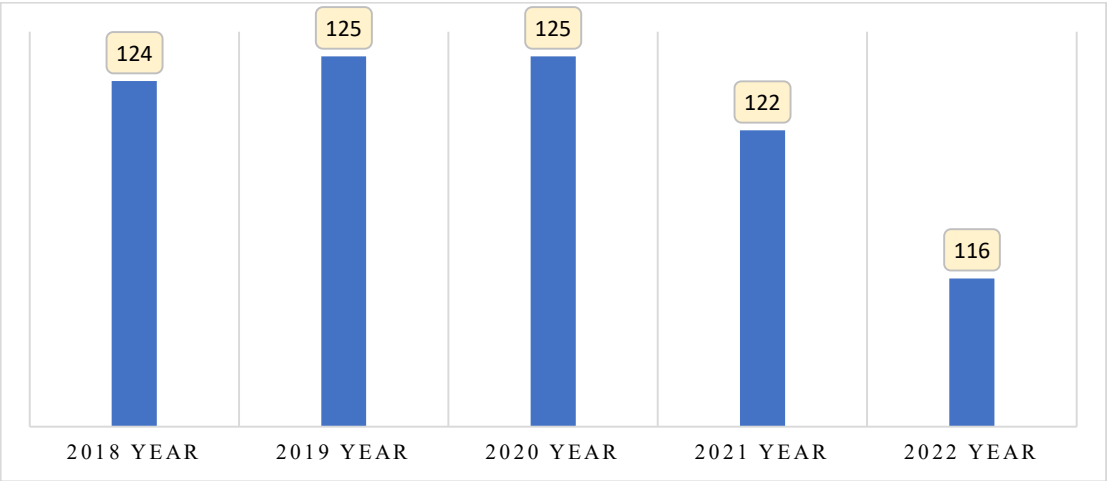


Figure 3 - Number of higher education institutions for 2018 to 2022

Note: compiled by authors

The dynamics of the number of higher education institutions from 2018 to 2022 reveal a pattern of initial stability followed by a decline. The count began at 124 in 2018, indicating a baseline level of established institutions. A modest increase to 125 institutions in 2019 suggests a period of slight growth or the effects of policies encouraging the development of new educational entities. A decrease of 2.4% was observed in 2021, with the number dropping to 122 institutions. This reduction could correlate with external economic and social challenges, particularly the ramifications of global events such as the COVID-19 pandemic, impacting the financial viability of higher education institutions. In 2022, there was a notable decrease to 116 institutions, amounting to a significant 4.9% reduction from the previous year. This contraction may reflect intensifying competitive pressures, a shift in educational preferences towards

online learning modalities, or increased economic difficulties impacting the higher education sector. The digital rankings from 2018 to 2022 are represented in Figure 4.

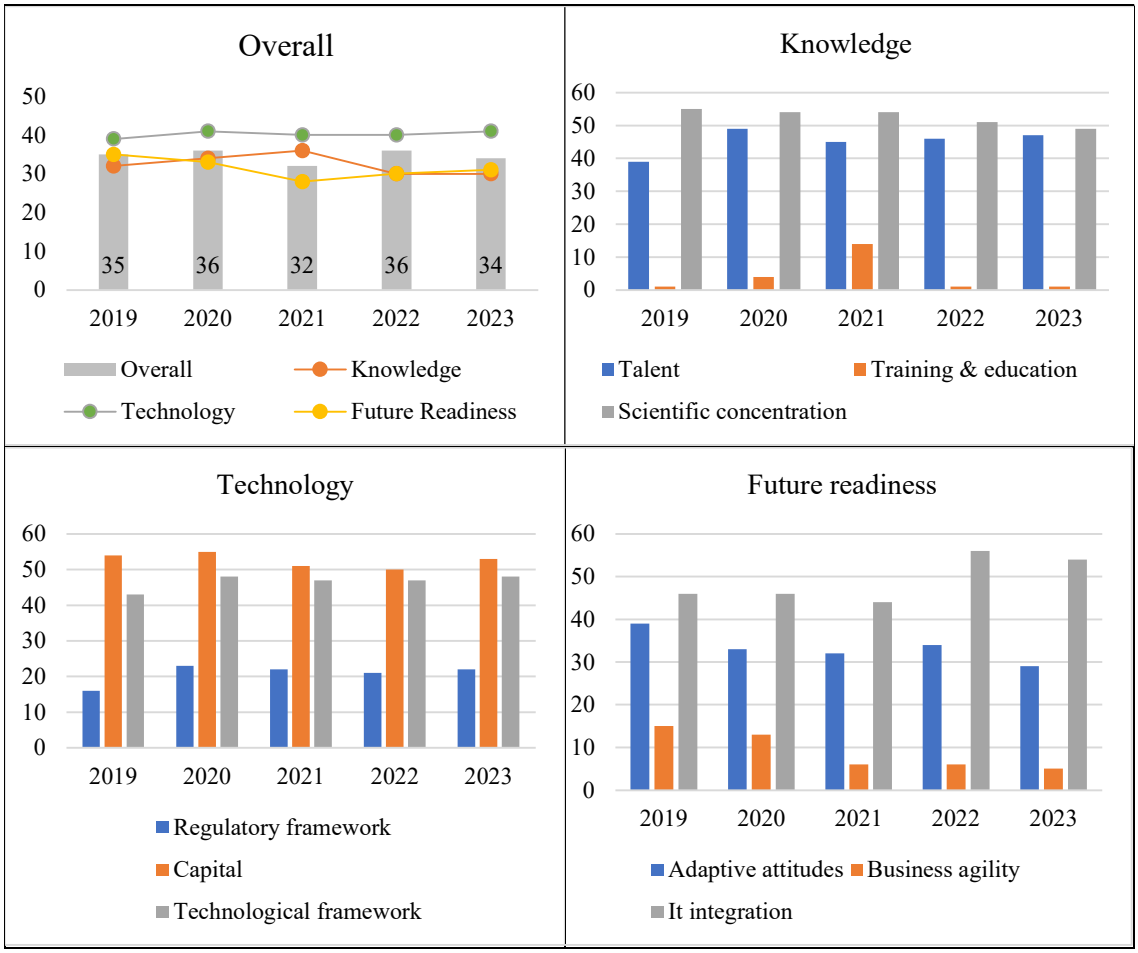


Figure 4 – World Digital Competitiveness Rankings

Note: compiled by authors

Analysis of the presented data in Figure 4 allows us to assess the dynamics of the country's digital competitiveness for the period from 2019 to 2023 in three main categories: Overall rating, Knowledge, Technology and Readiness for the future. The overall ranking shows slight fluctuations in position: starting from 35th place in 2019, it experienced a slight decline in 2020, reached a low of 32nd place in 2021, fell again to 36th place in 2022, and partially recovered to 34th place in 2023.

In the Knowledge category, significant variation can be observed across subcategories. “Talent” shows a deterioration in its position from 39 in 2019 to 47 in 2023. "Training and Education" shows strong improvement dynamics: from 1st place in

2019 and 2022 to 14th in 2021, and back to 1st place in 2023. "Scientific concentration" also improves, from 55th in 2019 to 49th in 2023.

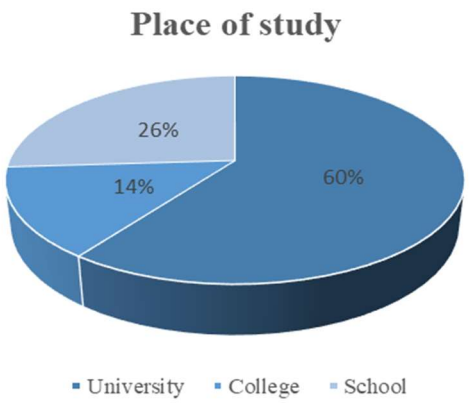
The Technology category shows relative stability, although with some deterioration in its position. "Regulatory Environment" fluctuates around 21-23 in 2020-2023, up from 16 in 2019. Capital experienced a slight decline from 54th place in 2019 to 53rd in 2023. The "Technology Environment" remains relatively stable, although it shows a slight deterioration from 43rd place in 2019 to 48th place in 2023.

In the Future Ready category, significant improvement can be seen. "Adaptive Installations" improved its position from 39th place in 2019 to 29th in 2023. "Business agility" shows the most significant improvement, from 15th place in 2019 to 5th place in 2023. "Integration of information technologies" worsened its position, falling from 46th place in 2019 to 54th in 2023.

4.2 Questionnaire

4.2.1 Participants

In the AI Literacy dimension, concepts such as using and applying AI and knowing and understanding AI were explored based on existing literature. The AI Self-Efficacy dimension encompassed factors such as accessibility. The study sample comprised 50 survey participants (see Figure 5).



1. Mostf surveyed participants were from Almaty, predominantly affiliated with the International Business University.
2. Distribution across educational levels revealed 30 out of 50 participants from universities, 14% (7/50) from colleges, and 13 from schools.
3. The diverse representation across educational institutions highlights the need for comprehensive analysis considering various educational backgrounds.

Figure 5 - Distribution of participant's educational institutions

Note: compiled by authors

The participants came from various educational backgrounds, most of whom were university students. The remaining participants were students from other educational institutions (colleges, schools). Data collection involved administering the questionnaire, which covers the three dimensions.

4.2.2 The main advantages of AI in education

The survey showed (Figure 2) that 53% of respondents believe that the use of artificial intelligence simplifies tasks, 22% believe that it makes the learning process

more efficient, and 25% claim that it saves time. Artificial intelligence can be helpful in the field of education by providing tools and technologies that make tasks more accessible, help students better absorb material, and optimize learning processes, which ultimately saves time for both students and teachers.

From the obtained data, it can be seen that 48% of respondents (24 participants) believe that the use of artificial intelligence in education simplifies the learning process. At the same time, 17 out of 50 individuals note that it saves time. However, only 18% of participants consider it to make the learning process more effective. This may suggest that many recognize the potential of using artificial intelligence to improve education, but doubts remain about its actual impact on the effectiveness of the learning process.

In the survey, 50 participants participated, with half (25) being women. The remaining 25 were men. School students are less familiar with artificial intelligence: of the 13 schoolchildren, 30% either lack information or have insufficient knowledge about it. University students, without exception, are familiar with this term and actively or frequently use this technology. Women often highlight decreased productivity as a negative aspect of AI, while men are more concerned about spreading false information. The survey results (see Figure 6) clearly highlight three major issues associated with using artificial intelligence in education.

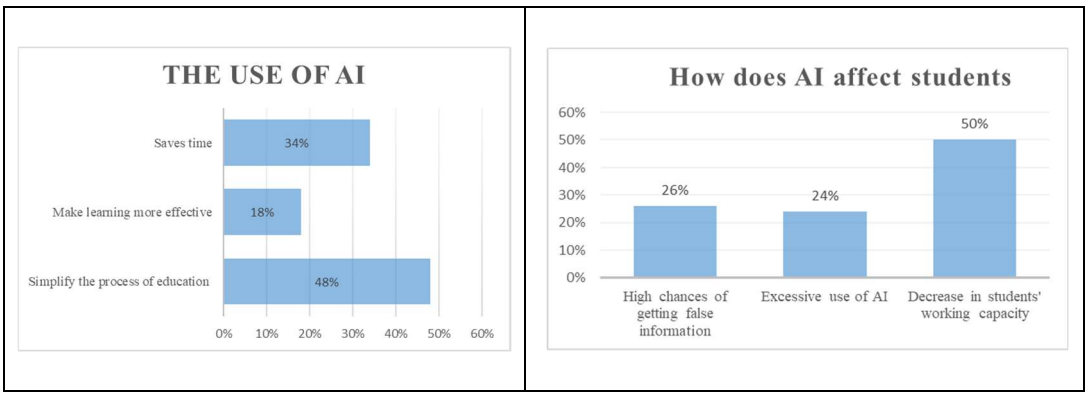


Figure 6 - The main advantages and disadvantages of AI in the education process

Note: compiled by authors

The first issue in Figure 6 is the high risk of obtaining false information. Notably, at least 26% of survey participants expressed concerns about this. Imagine relying on artificial intelligence to search for information, only to run the risk of receiving inaccurate or even false results due to algorithm errors or incorrect data interpretation. The second issue is the excessive use of artificial intelligence. Around a quarter of respondents voiced worries about this. Interestingly, this may suggest that excessive application of the technology could lead to dependency, ultimately negatively impacting the effectiveness of learning and student engagement. Finally, the third issue is the decline in students' working capacity. Half of the respondents highlighted this aspect. And it's not surprising. If students begin to rely on artificial intelligence instead of developing their own thinking

and analytical skills, it could lead to a decline in their productivity and ability to solve problems independently.

Thus, these findings underscore that integrating artificial intelligence into the educational process comes with significant challenges that must be addressed. Based on the results of the study, we can conclude that literacy in the field of AI has a positive, although not significant, impact on data security and privacy of students and teachers. Highlights the increased application of knowledge, concepts, and applications of artificial intelligence in various scenarios and awareness of ethical issues regarding artificial intelligence technologies such as equity, responsibility, transparency, and ethics given the recent emergence of public and widespread use of artificial intelligence applications by the educational community. It was found that with the help of artificial intelligence training, skill gaps between participants with different educational backgrounds could be bridged. Study participants who were previously familiar with the use of artificial intelligence algorithms in a learning system generally reacted positively to the idea of this study. Some of them find such tools useful and state that they use them to improve their own learning. This suggests that public groups believe that the benefits in these contexts outweigh the threats (e.g., privacy concerns). The ethical challenges of artificial intelligence are likely to increase in the context of education due to several characteristics such as working with minors, different genders of students (in some cases), individual characteristics of the learner, the sensitive nature of personal information, and the importance of this application along with its potential benefits for students.

Analyzing the results of the questionnaire, we can highlight the following key conclusions regarding the perception and use of artificial intelligence (AI) in the educational field:

1) the participants' awareness of the concept of AI is general, which implies widespread understanding and recognition of the importance of AI in modern education. This indicates that students from various educational institutions are aware of the growing role of technology in their academic lives.

2) the use of AI varies from rare occasions to regular use. Regular users of AI may indicate technology integration into the educational process, while occasional use may indicate barriers or lack of integration of AI into the educational environment.

3) the answers to the question of how AI can help improve learning comprehension offer a wide range of opinions. Some respondents expressed uncertainty, while others suggested specific features such as condensing information into key concepts and providing explanations in an accessible manner, which may indicate potential directions for developing educational AI tools.

4) the discussion on the positive impact of AI on the learning process has highlighted aspects such as flexibility in learning and significant improvement in the learning process. This highlights the perception of AI as a means to achieve adaptability and personalization of learning.

5) concerns about the use of AI in education include the risk of abuse, deepening educational divides, and potential misinformation. These concerns highlight the importance of taking a critical approach to AI integration and the need to develop effective mechanisms for monitoring and assessing information quality.

6) respondents largely agree that AI will have a significant impact on the future of learning, although there are some who suggest only minor changes. This diversity of opinions may reflect different expectations about the speed and scale of AI integration in education.

7) most participants expressed confidence that AI will increase access to education for all population segments, which emphasizes the perception of AI as a tool for social equality in the educational field.

Based on the questionnaire data provided and respondents' answers about artificial intelligence (AI) in education, respondents can be classified into several vital clusters:

1. AI Enthusiasts

Respondents in this group are well aware of AI and actively use it in the educational process. They see significant benefits from using AI, such as improving access to education, personalizing learning, and increasing the efficiency of the learning process. AI enthusiasts believe in the technology's potential to change education for the better and are actively exploring new applications for it.

2. AI pragmatists

This group of respondents uses AI in their studies but does so more consciously and selectively. Pragmatists see both positive and negative aspects of using AI. They strive to find a balance between technological innovation and traditional teaching methods, emphasizing the importance of critical thinking and a deep understanding of the material.

3. AI critics

Respondents in this cluster are skeptical about the use of AI in education. They express concerns about potential disadvantages, such as reduced depth of learning, risk of abuse, and dependence on technology. Critics highlight the importance of human interaction in education and possible concerns about the reliability and ethical aspects of using AI.

4. Undecided

This group includes respondents who do not have a clear opinion about AI in education or have limited experience using it. They may see the potential benefits of AI but also the possible risks without feeling confident in their assessments. Such respondents need additional information and education to develop an informed approach to the use of AI.

Conclusions

The integration of artificial intelligence (AI) into the educational process is a significant and multifaceted phenomenon. The analysis and results of the study show the variability of the number of students and universities against the backdrop of a constant increase in digital competence, which indicates transformation processes in the educational environment, partly due to the development and implementation of digital technologies.

The level of digitalization in education, as reflected in the "World Digital Competitiveness Rankings," demonstrates a trend toward increasing readiness and adaptation of the educational sector to future changes. This is confirmed by improved

indicators in the categories “Knowledge”, “Technology” and “Ready for the Future”, which indicates an increase in the digital competence of both students and educational institutions.

The results of the questionnaire highlight the positive attitude of students towards the integration of AI in education. The majority of respondents see AI as a tool for improving understanding of educational material, increasing flexibility and individualization of the educational process, as well as accessibility of education. However, concerns have also been expressed regarding the potential risks of misusing the technology, reducing the depth of learning and dependence on AI.

Thus, the integration of AI in education is a complex and multifaceted process that requires careful balancing between the use of technological innovations to achieve educational goals and consideration of potential risks. The creation of a regulatory framework should accompany the further development of AI in the educational sphere, the development of ethical principles for the use of AI, as well as training students and teaching staff in critical thinking skills and evaluating information in the context of the widespread use of artificial intelligence.

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