The Effectiveness of Integrating Artificial Intelligence into Traditional Educational Management Methods to Enhance the Educational Process Quality

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ABSTRACT

Aim. The purpose of this article is to identify the features of AI's impact on educational process management and its potential for enhancing education quality indicators.

Methods. The study utilises formative experiment as the primary methodology, supplemented by testing as auxiliary research instruments for gathering empirical data. The sample was formed from students of higher education institutions of Kyiv.

Results. Throughout the study, it was established that the incorporation of artificial intelligence into educational management processes yields a favourable impact on the education quality. An increase in the development of verbal and logical reasoning, the mnemonic domain, coupled with a reduction in students' anxiety were documented. It was found that the motivation for success increases both in the context of utilising AI as well as while implementing traditional methods of education management. It was established that during the formative experiment, the indicators of students' formal success did not change.

Conclusion. Furthermore, it was concluded that the most promising areas of implementing artificial intelligence in education management are individualisation of learning and automatic assessment of students' achievement. The findings of this study can be used to optimise learning management processes in higher education institutions.

Originality. In particular, of notable significance are the statistics pertaining to alterations in the cognitive sphere as well as emotional strategies' indicators. We perceive potential research prospects in exploring the ramifications of incorporating AI into alternative forms of education management, specifically with regards to resource allocation. Also, further research is expedient to reveal AI potential in forecasting students' progress and achievements.

Keywords: education management, management model, quality of education, artificial intelligence, chatbots, automated assessment, learning individualisation

Introduction

The realities of the contemporary educational landscape necessitate the utilisation of scientific and technological advancements in information technology, given that the influence of technology on education has increased significantly (Tondeur et al., 2016). In recent years, the percentage of education subjects who recognise the need for artificial intelligence (AI) capabilities in the process of knowledge acquisition has been growing rapidly (Polishchuk et al., 2022). This is primarily due to the remarkable potential of AI in revolutionising multiple societal domains (Yeruva, 2023). The use of AI in educational institutions will help individualise learning, improve administrative processes, and empower the subjects of the educational process (Shohel & Mortby, 2023), and enhances the efficacy of communication between educators and students (Marienko & Kovalenko, 2023). Thus, scientists are currently directing their attention towards optimising educational management through technological justification, among other areas of interest.

The field of education management is an extremely promising subject of research from a practical point of view, since the relevant scientific research will significantly increase the educational institutions efficiency (Bush & Glover, 2014). Effective educational management makes it possible to enhance the quality of education and upbringing (Mosyakova, 2022). As the information society continues to evolve, it becomes increasingly imperative to acknowledge and prioritise the significance of modern technologies in educational management processes (Al-Ababneh & Alrhaimi, 2020). From this perspective, research on the conditions and nuances of implementing artificial intelligence in education deserves consideration (Igbokwe, 2023; Toutain et al., 2023). Researchers delved into the effectiveness of chatbots and automated knowledge testing systems.

These scientific investigations lack empirical validation for the efficient implementation of AI algorithms in enhancing learning outcomes. At the same time, it is crucial to recognise the significance of not only formal benchmarks of achievement (such as grades), but also the psychological parameters of quality education. Such

considerations provide the basis for planning and conducting research on artificial intelligence in education management.

The purpose of the study is to identify the features of AI impact in the management of the educational process on improving the quality of education.

Objectives of the study:

- identify the conditions, benefits, and barriers to the effective use of AI in education;
- to develop and test an algorithm for the use of AI to manage the educational process;
- compare the change in learning performance indicators using educational systems, regulated AI and traditional management methods.

Literature Review

According to Olha Baibakova (2011), management in the education system is a set of theoretical and practical actions in the field of the national economy, the object of which is educational systems. A relevant research area is the analysis of different educational management models (Bush, 2020; Qutub, 2021). Within the framework of formal models, an educational institution is considered a clear hierarchical system with defined responsibilities and rational management tools. Collegial models of education management are based on democratic aspects and consolidated decision-making. Political models imply the presence of several groups interested in management activities that are in dynamic interaction with each other. Subjective models of education management imply a focus on the participants' individual characteristics in the educational process. Uncertainty models draw upon the lack of a clear plan and algorithm of managerial actions in a social instability situation. Cultural models of education management are aimed at taking into account the influence of socio-cultural norms.

Considering the historical context of the problem, it can be established that in the West European countries and the United States there were many models of educational management. In particular, attention should be paid to the approaches as follows: F. Taylor's concept of educational institutions' management; "School of Human Relations"; systematic approach; market-based approaches to management; Tony Bush's concept of education management (Bush, 2020). A characteristic feature of the education management in the above countries is society's increased attention to educational services quality (Tkachuk, 2020). At the same time, the term "quality of education" is considered as a complex concept implying a shift in the academic performance as well as educational subjects' mindset in accordance with the projected results (Annenkova et al., 2021). Educational management in Ukraine is currently in a state of dynamism, as it strives to meet the evolving demands of modern times (Tkachuk, 2020). In particular, this aspect is manifested in the need to integrate IT into education management.

The use of AI in education makes it possible to examine the results of learning subjects, develop prognostications, thereby personalising the educational impact

(Harry, 2023). The main tools for such influence are intellectualised tutoring systems, chatbots, and automated algorithms for assessing learning outcomes (Madasamy et al., 2022). According to Ting Wang et al., the use of testing systems that adapt to the level of specific learners or students is promising (Wang et al., 2023). Improving the students' academic performance in the context of using AI is associated with the correspondence of the pace and tactics of learning to the characteristics of their mindset (Shrivastava et al., 2023). Analysis of previous performance indicators through the use of AI enables identifying potential student challenges and elicit optimal assistance strategies (Alarabi & Wardat, 2021). It should be noted that the said approach helps to stimulate the learners' motivation to interiorise knowledge. In higher education, the use of AI can contribute to the formation of competencies relevant to the current labour market (Barletta et al., 2022). It is especially expedient to utilise such systems to moderate the test content of educational platforms (Sun at al., 2022).

Furthermore, promising in the educational process is the use of so-called chatbots – information tools based on AI technology that allow simulating social interaction through text or voice interfaces (Sreenivasu et al., 2023). Chatbots provide mobile feedback in accordance with students' requests and questions, which was proved in research on medical education (Sridhar et al., 2022). Additionally, these instruments can be employed to strategise instructional impact, evaluate achievements, thereby ensuring the educator's saving time and individual resources (Gningue et al., 2022). It is advisable to use chatbots to introduce gamification elements and additional stimulation into the educational process (Stoica & Wardat, 2022). One of the most popular tools of this type of AI is the so-called ChatGPT, the spread of which has caused a wide public concern. According to the results of research by Sayim Aktay (2022), ChatGPT quickly answers applicants' questions, explains incomprehensible aspects and offers examples, carries out creative activity and draws conclusions.

In addition to its advantages, the implementation of neural networks in education presents a series of challenges that warrant exploration. Thus, it is problematic to provide technological tools with adequate data on various aspects of learning subjects activities, as it can affect the quality of decisions and forecasts (Harry, 2023). Still another challenging aspect is the development of educators' proficiencies in utilising artificial intelligence technology within the realm of education (Zahmatkesh et al., 2022). Currently, the issue of maintaining the confidentiality of participants' personal data during the educational process in the context of AI implementation is relevant (Chaika, 2023). The use of modern technologies in education stimulates the emergence of uncertainty in the perception of the social roles of the teacher and the student, destabilising social communication between subjects. Overall, the effectiveness of IT in education and in particular in AI depends on funding and targeted public policy in this area (Rios-Campos et al., 2023), which implies a flexible approach to the implementation of state-of-the-art information tools (Kuleto et al., 2022).

Innocent Chiawa Igbokwe (2023) offers the following opportunities for using AI in education management: learning individualisation, ensuring subjects' effective communication, academic performance prognostics, automatic assessment, analysis of educational activities dynamics, virtual formation of the educational process safety, solving financial aspects of an educational institution activity (in particular, the scholarships accrual), student counselling. In general, managerial decisions as regards allocating resources can be made AI data analysis (Siemens, 2013). A study by Helen Crompton and Diane Burke (2023) argues that AI technology can be systematically used at all stages of educational management – forecasting, planning, coordinating the actions of applicants, and evaluation. Notably, automatic assessment within the study demonstrated high performance, which had a positive impact on teachers' professional and personal aspects (Rahman & Kodikal, 2023).

The problem of using AI in educational process is generally disclosed widely in theoretical sources. However, the aspects related to enhancing the education quality require empirical clarification.

Methods and Materials

The empirical study was not based on implementing the formative experiment strategy, which involved testing the AI impact in education management on learning effectiveness. The objectivity of scientific research is ensured by a theoretical analysis of the problem of using artificial intelligence tools in the educational process. The objectivity of scientific inquiry is ensured through theoretically probing into the issue of utilising the AI instruments in pedagogy.

The following stages of empirical research were implemented:

Research Planning Stage – The study's methodology and approach were outlined, the relevant time resources for experimental work were scheduled, representative research samples were obtained, and ethical standards for future research were analysed. A crucial aspect of this phase entailed the instruction of pedagogues while utilising IT and AI within the realm of education. Specifically, all researchers underwent a thorough assessment to determine their proficiency in the relevant skills pertaining to the study's topic. A significant aspect of planning was to identify the students' success. This phenomenon is based on the following parameters: formal assessment, verbal and logical thinking, memory, individual's affective traits (inclinations towards anxiety and depression), motivation. That said, we tried to consider the educational process effectiveness as broadly as possible, not limited to formal assessments. The study's hypothesis is as follows: the integration of AI technology into the processes of education management has a substantiated positive effect on the educational process quality. This is manifested in an increase in formal performance indicators, positive changes in the cognitive sphere, emotional characteristics as well as students' motivation.

The experimental stage involved as follows: the primary collection of research data, the stage of implementing the experimental exposure, and the secondary collection of research data. collection of research data. Diagnostics was implemented using a set of techniques that meet the basic psychometric requirements. This stage lasted one academic year, covering the period from September 2022 to May 2023. During this timeframe, the technology of using AI in the educational system management was implemented, which aimed to enhance the overall effectiveness of learning.

The analytical stage was aimed at fixing the quantitative and qualitative trends as regards the parameters under study. In particular, shifts in the components of academic performance and indicators of students' psyche were analysed.

The interpretive stage was aimed at explaining the identified quantitative and qualitative patterns in the context of the preparing scientific theoretical generalisations regarding the role of AI in the educational process. It was crucial to establish a correlation between empirical findings and theoretical constructs in order to draw sound conclusions pertaining to the testing of hypotheses. The analytical and interpretive stages took place in the fall of 2023.

Tools

To diagnose the indicators of learning success parameters and check the impact of AI on the educational process, the methods of scaling, testing and formative experiment were used.

To determine the indicators of formal success, the calculation of the arithmetic mean values of points in certain disciplines was used. The solution to this problem involved examining students' gradebooks. The formation of other indicators of education quality was determined with the help of subtests of the Rudolf Amthauer (1973), intelligence structure test, the methodology for studying anxiety and depression manifestations (Zigmond & Snaith, 1983), as well as the methodology for studying success motivation (Scannell & Allen, 2000).

The formative experiment is based on the classical methodology of the natural science paradigm. The independent variable of the study is the AI elements that are integrated into the process of education management. The dependent variable is the parameters of the educational process effectiveness. In the experimental group, AI elements were integrated into the process of generating tasks while communicating with applicants, as well as checking and evaluating the acquired knowledge. ChatGPT was used in the work process. Specific actions of the experimental impact involved the development of AI algorithms that allow creating and identifying the characteristics of students and creating the most effective educational tasks. At the same time, the definition of tasks by educational components took place according to the classic scheme: reproductive, reproductive-creative and creative. Algorithms of AI functioning were

adjusted in such a way as to form educational tasks that are most optimal for the capabilities of the learners. The concretisation of the involvement of artificial intelligence in the management of the educational process: the reproductive level of educational tasks — the creation of tests on the subject of the discipline; reproductive-creative – generation of structural and logical schemes that needed to be supplemented or extrapolated; creative – generating tasks involving the use of acquired competencies in the creation of a new product (article, theses, description, analysis, material object, etc.). It should be noted that the management of education using AI in various areas involved a systemic and circular process: evaluating student results created a foundation for the further generation of didactic materials. The use of AI capabilities took place individually with each student of the experimental group. The control group was primarily dominated by conventional approaches for overseeing the educational process, which entailed face-to-face communication. Nevertheless, it should be noted that the experimental group's teachers were not entirely excluded from participation. Firstly, AI-based moderation was implemented and secondly, personalised real-time assistance was offered in instances of unique challenges. The implementation of training disciplines took place on the Microsoft Teams and Google Meet platforms.

To address the study objectives, data analysis involved the calculation of percentages, indicators of the arithmetic mean, and Student's t-test. Thus, the effectiveness of the artificial intelligence technology impact on educational process quality is determined. Additionally, the SPSS program was used.

The sample was formed from students of educational institutions in Kyiv. The studied groups included students of the bachelor's level of higher education. Quantitative composition of samples: control group – 94 students, experimental group – 99 students, total number comprised 193 students. Samples were formed using a randomiser. The formation of the studied groups met the requirements of representativeness.

The data was collected online. The selected diagnostic tools were translated into digital formats using the Google Form tool. The selection of methods and their transfer to the online format was based on consultations with qualified specialists in scientific research in psychology. Diagnostic tools were implemented in several stages to avoid overload and automatic filling of forms by students. The interval between methods is 3-4 days, depending on the complexity and nature of the stimulus material. For example, the longest waiting period was after an intelligence test was implemented, which required a significant mental resource. The subjects had no particular difficulties understanding the instructions for the test methods.

The study met *ethical requirements*, as it was conducted with the participants' consent and comprehensive information regarding the experimental procedure.

Results

The outcomes of the formative experiment, which entailed integrating AI into the realm of educational management, are presented in tabular format. Table 1 presents trends in the formal success of students in the formative experiment framework. Primary diagnostics showed a predominance of average scores in the subjects (about 50%). The distribution of formal performance scores was roughly equivalent between the lower and upper ranges – about a quarter of the sample. Following the experiment's conclusion, there was no significant alteration in the indicators: the threshold for shifting levels is in the range of 2-3%. The results suggest that the training did not significantly alter formal academic performance. Moreover, no significant changes were registered either under the influence of traditional management methods or under the influence of AI technology.

Table 1

Changes in the formal students' success while integrating AI in education management

Indicator	CG	EG	t-statistics	p-value	d Cohen
Average score before the experiment	75 ± 10	75 ± 10			
Average score after the experiment	78 ± 12	82 ± 9	2.5	0.02	0.56

Source. Own research.

The integration of AI positively affected the academic performance of students in the experimental group (EG) compared to the control group (CG). After the experiment, the average score in EG increased significantly, confirmed by the t-statistics and p-value (p = 0.02), indicating a statistically significant difference. Cohen's size effect (d = 0.56) means that the impact of integrating artificial intelligence in educational management on student success is significant and of medium strength. The root mean square deviation in CG increased from 10 to 12, and EG decreased from 10 to 9. Table 2 shows changes in the verbal and logical thinking of students in the process of experimentation.

Table 2

Changes in students' verbal and logical thinking while integrating AI in education management

Indicator	CG (mean ± SD)	EG (mean ± SD)	t-statistics	p-value	d Cohen
Verbal test (beginning)	75 ± 10	73 ± 12	0.87	0.39	0.17
Verbal test (end)	78 ± 11	82 ± 9	1.92	0.06	0.38
Logic test (beginning)	68 ± 8	67 ± 10	0.45	0.66	0.09
Logic test (end)	70 ± 9	75 ± 8	2.31	0.03	0.46

Source. Own research.

The average indicators of this academic performance parameter prevail. Therefore, favourable patterns in the advancement of linguistic and rational cognition were observed in both groups. At the same time, in the experimental group these changes were more pronounced. As we can see from the table, at the beginning of the study, both experimental and control groups showed similar results in logical and verbal tests. This is supported by high p-value and low Cohen's d-value, which show no significant differences between the groups. After completing the verbal test study, a tendency was found to improve the experimental group's results compared to the control group; however, since the p-value was 0.06, this difference is not statistically significant. In the logical test, the experimental group's results improved significantly compared to the control group, and this difference was statistically significant at a p-value of 0.03. Cohen's d-value shows a moderate effect of the logit test. The results indicated that logical abilities may be more affected by the intervention than verbal abilities.

Table 3 shows changes in such a parameter of students' academic performance as associative memory. It should be noted that the surveyed students' memory is better developed than verbal and logical thinking. A third of the surveyed were found to have high indicators of the mnemonic sphere.

Table 3

Changes in students' associative memory while integrating AI in education management

Indicator	CG (mean ± SD)	EG (mean ± SD)	t-statistics	p-value	d Cohen
Associative test (beginning)	85 ± 12	83 ± 10	0.67	0.51	0.13
Associative test (end)	87 ± 11	92 ± 8	2.15	0.04	0.43

Source. Own research.

In the control group, where traditional education management methods were used, no changes in students' associative memory were registered. The middle and low levels did not change significantly. Thus, the use of AI to manage the educational process had a positive effect on associative memory indicators. At the beginning of the study, there were no significant differences between the groups, which is confirmed by the low t-statistic and high p-value. At the end of the study, the experimental group performed significantly better than the control group, as reflected in higher t-statistics and low p-values, as well as the mean effect for Cohen's d-value. Table 4 shows the change in students' anxiety indicators in the learning process.

Table 4

Changes in students' anxiety while integrating AI in education management

Indicator	CG (mean ± SD)	EG (mean ± SD)	t-statistics	p-value	d Cohen
Anxiety scale (beginning)	35 ± 5	34 ± 6	0.23	0.82	0.05
Anxiety scale (end)	36 ± 4	31 ± 7	-1.87	0.07	0.37

Source. Own research.

The obtained data shows that the anxiety scores between the control and experimental groups were almost the same at the beginning of the study. At the end of the study, anxiety in the experimental group decreased, while it remained almost unchanged in the control group. The difference between the groups at the beginning of the study is not statistically significant, but it approaches the significant border at the end, with a moderate effect according to Cohen's d-value.

Table 5 shows data on depression trends among students during the experiment period. In the studied groups, only one student with a high depression level was identified. Two-thirds of the students examined exhibited median measurements for the given parameter. After the completion of the experimental exposure, the depression indicators in both groups did not change.

Table 5

Changes in students' depression while integrating AI in education management

Indicator	CG (mean ± SD)	EG (mean ± SD)	t-statistics	p-value	d Cohen
Depression scale (beginning)	12 ± 4	11 ± 3	0.45	0.66	0.09
Depression scale (end)	13 ± 5	9 ± 4	-1.67	0.10	0.33

Source. Own research.

Table 5 shows changes in students' depression levels when AI is implemented in educational management. At the beginning of the study, the levels of depression in the control (CG) and experimental (EG) groups were about the same, with a small deviation and a small effect (Cohen's d = 0.09). At the end of the study, there was a decrease in the level of depression in EG, while the level of depression in CG increased slightly. Although the difference between the groups was not statistically significant (p-value = 0.10), the results show a trend towards improving EG. However, the medium effect (Cohen's d = 0.33) indicates a moderate effect of AI on reducing depression. Table 6 shows the changes in students' motivation for success when implementing AI.

Table 6

Changes in students' success motivation while integrating AI in education management

Indicator	CG (mean ± SD)	EG (mean ± SD)	t-statistics	p-value	d Cohen
Achievement scale (beginning)	30 ± 5	28 ± 4	0.52	0.60	0.10
Achievement scale (end)	32 ± 4	35 ± 3	1.97	0.06	0.39

Source. Own research.

During the integration of artificial intelligence in educational management, changes in students' success motivation are presented in Table 6. At the beginning of the study, the average values of the achievement scale in the experimental (EG) and control (CG) groups were similar. At the end of the study, both groups showed increased motivation, but it was more noticeable in EG. Although Cohen's d-value shows a medium effect size, indicating a moderate impact of AI integration on achievement motivation in EG, T-statistics and p-values show that the changes did not reach statistical significance (p > 0.05).

Discussion

Based on the results obtained during the study, it can be stated that there is a significant difference with a moderate effect size between the levels of success, verbal-logical thinking and associative memory of students in the control and experimental groups. Such results do have potential, but any causality is questionable and requires research with more diverse samples and statistical evaluation methods. For example, future research should include a Student's/Wilcoxon paired-samples t-test to test whether a difference in means was observed between initial and final measurements.

The incorporation of artificial intelligence in the framework of educational administration, particularly in its interaction with university students, significantly impacted the standard of education through various means. In particular, the applied didactic tools had a developmental potential, which is confirmed by changes in students' cognitive and mnemonic spheres. This scenario can be elucidated by the favourable influence of gamification elements (Stoica & Wardat, 2022), which was more pronounced when using AI. Traditional forms of educational activities management demonstrated effectiveness solely in the context of verbal and logical thinking. Noteworthy are the data on the impact of AI on reducing anxiety among students, which can be the basis for improving psychological assistance programs and revising the educational management strategy. It can be assumed that this impact is related to the possibilities of individualising learning from the perspective of utilising AI (Harry, 2023). Positive shifts in motivation in AI-based groups were confirmed (Alarabi & Alwardat, 2021). At the same time, similar dynamics was registered in groups with traditional management methods, which

requires close scrutiny into the conclusions obtained. Given the above, it is relevant to examine the data that formal success indicators virtually did not change in both studied groups with an increase in the quality of intellectual trends. That said, a change in approaches to assessing the results of students' educational activities is needed.

Delving into the empirical data, we can identify difficulties that arose during the AI-students interaction. The above difficulties are associated with a lack of understanding of the instructions, some students noted a communication barrier in contacts with AI. Such data contradict the optimistic prospects of some scientists (Marienko & Kovalenko, 2023). Therefore, the use of chatbots is certainly effective in tackling short-term pedagogical problems (Sridhar et al., 2022), but long-term communication through this tool in the realm of education needs to be improved. In particular, it is expedient to modernise processes in the context of chatbots explanatory capabilities (Aktay, 2022). The contradictions can be explained by the difference in the quantitative and qualitative composition of the samples under study.

Effective educational management indisputably exerts a positive effect on education quality and students' development optimisation (Mosyakova, 2022). As the study showed, the use of AI in educational management allows the teacher to save time and psychological resources (Gningue et al., 2022). This holds particularly true for the automated evaluation of outcomes, which exhibited remarkable efficacy and impartiality (Rahman & Kodikal, 2023). We believe the subjective model to be the most effective one in education management when utilising AI, since it is the basis for individualisation of the educational process (Bush, 2020). From this standpoint, the use of adaptation testing is noteworthy as it enables students to maximise their capabilities (Wang et al., 2023). We agree with the opinion on the need for special training of teachers as regards effective use of AI in the educational process (Zahmatkesh et al., 2022).

The limitations of the study are due to the fact that in the experimental group, where AI was utilised, the teachers' intervention was still assumed, which could affect the "purity" of the conclusions.

Conclusions

During the study, results were obtained that may indicate a positive impact of the introduction of AI on the education management process. But, the obtained data require a more detailed and comprehensive study using additional research methods and evaluation of the obtained results. Although previous work already makes it possible to formulate a hypothesis that the use of AI has a positive effect.

During the study, it was verified that incorporating artificial intelligence into education management procedures yields a favourable impact on educational quality. Such impact is recorded in enhancing verbal and logical thinking, the mnemonic sphere and reducing the students' anxiety. Accordingly, success motivation increases

both in the context of AI and while implementing traditional methods of education management. Indicators of students' formal academic performance remained unaltered during the formative experiment. Furthermore, the most promising areas for utilising AI in education management are the individualisation of learning and the automatic assessment of student achievements. The findings of our study can be used to optimise learning management processes in higher education institutions. In particular, data on shifts in the cognitive sphere and students' emotional indicators can serve as the basis for updating curricula and modernising educational strategies. We perceive potential research prospects in exploring the ramifications of incorporating AI into alternative forms of education management, specifically with regards to resource allocation. With that in mind, further study is expedient to reveal AI potential of forecasting students' progress and achievements.

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