The Influence of Education Using Artificial Intelligence Technologies on the Formation of Moral Behavior and Self-Efficacy in Medical Students

Nataliya Kasimovskaya*, Elena Fomina, Olga Morugina, Olga Malkina, Mariya Zhukova, and Tatyana Biryukova

Department of Nursing Management and Social Work, Sechenov First Moscow State Medical University (Sechenov University), Moscow, Russia

Email: n.kasimovskaya@onmail.com (N.K.); fomina_el@outlook.com (E.F.); olmorugina@outlook.com (O.M.); malk_ol@outlook.com (O.M.); mrzhukova@outlook.com (M.Z.); biryukovatat@outlook.com (T.B.)

*Corresponding author

Manuscript received November 8, 2024; revised December 11, 2024; accepted February 10, 2025; published May 16, 2025

***Abstract*—This article examines the specific features of moral education in medical professionals. The aim of the study is to assess the impact of Artificial Intelligence (AI) technologies on the formation of moral behavior and self-efficacy among students, as well as to investigate the factors that contribute to or hinder the professional self-actualization of medical workers and their strategies for coping with occupational stress. The study employed testing and interview methods. A total of 150 medical professionals participated in the experiment. Participants were randomly divided into two groups: an experimental group, which was trained using artificial intelligence, and a control group, which followed traditional learning methods. For the experimental group, interactive artificial intelligence modeling was utilized, incorporating AI Assistants along with the Augmented Reality (AR) application HoloHuman. Students engaged with AI through the HoloLens headset. The study revealed that the use of AI increased academic performance by 13% compared to 4% in the control group, moral behavior by 17.1% compared to 2.9%, and self-efficacy by 17.6% compared to 2.9%. The results of paired t-tests confirmed statistically significant improvements in both groups, although the experimental group demonstrated a more pronounced progress. Among the factors negatively affecting the efficiency and psychological well-being of medical professionals was the issue of complex relationships with colleagues. The practical significance of this study lies in its provision of valuable insights for improving working conditions and fostering the professional development of medical workers. The contribution of this study lies in confirming the effectiveness of artificial intelligence in enhancing students' academic performance, moral behavior, and self-efficacy in medical education. It highlights the comprehensive impact of innovative technologies not only on knowledge acquisition but also on the ethical and psychological development of students, thereby broadening the understanding of the role of artificial intelligence in shaping the modern educational environment.**

***Keywords*—Artificial Intelligence (AI), deontology, innovative education, innovative technologies, medical universities, morality**

I. Introduction

Modern medical education faces a number of complex and multifaceted challenges, including the need to train specialists who not only possess advanced professional skills but also have a deep understanding of moral norms and principles [1]. Currently, medical ethics is a mandatory course in medical universities [2]. The medical profession encompasses five "spheres of morality": medical care, clinical research, scientific knowledge, public health, and the market [3]. In a narrower sense, the term "medical ethics" refers to the full range of ethical issues in the doctor-patient relationship [4, 5]. Medicine is constantly evolving, demanding new methods of work, new approaches, and new ways of training specialists capable of shaping the next generation of healthcare professionals. Contemporary medicine requires a greater focus on ethics and deontology, especially in programs aimed at developing new specialists.

The challenge of fostering moral behavior among medical students is one of the key tasks of modern education. A physician's moral behavior is a set of actions and decisions made by healthcare professionals, based on the principles of bioethics, aimed at ensuring respect for life and the dignity of patients, safeguarding their rights and interests, and harmonizing medical practice with ethical norms and societal values [3–5]. The moral behavior of a healthcare professional covers a wide range of issues related to the ethical and moral aspects of medical practice, including confidentiality, informed consent, fairness in resource allocation, and more [4]. Moral behavior is an integral part of a healthcare professional's work and plays a crucial role in building trust between the medical worker and the patient [6]. It contributes to the improvement of the quality of care, the protection of patients' rights, and the enhancement of public trust in the medical profession. Thus, it is particularly important to ensure the integration of innovative technologies into medical practice so that future healthcare professionals—nurses and medical practitioners alike—develop a strong foundation of moral behavior.

Modern medical technologies provide physicians and other healthcare professionals with access to more advanced and detailed diagnostic and treatment methods [7]. However, these technologies also bring more complex clinical practices, requiring specialists not only to be familiar with new techniques but also to integrate this knowledge into their daily work [8]. The acquisition of such skills demands time and effort from both students and instructors. The development of self-efficacy is another critical aspect of training medical specialists in their moral development. Self-efficacy refers to an individual's confidence in their ability to achieve set goals and effectively manage professional tasks [9]. A high level of self-efficacy among healthcare workers is associated with better professional performance, job satisfaction, and reduced levels of occupational burnout [10]. The use of innovative

technologies in the educational process can contribute to the development of self-efficacy in students by offering opportunities for independent learning, feedback, and the improvement of professional skills in controlled settings. Therefore, with the rapid advancement of technology, there is a growing need to integrate new methods and approaches into the educational process [11], including the development of ethical and deontological competencies and self-efficacy in medical students. The significance of this study lies in addressing the persistent challenges associated with adherence to ethical codes in healthcare, which remain prevalent due to the rapid advancement of technology, cultural differences, and deficiencies in the training of medical professionals [12]. Evidence suggests that ethical codes do not always align with contemporary standards. For instance, numerous reports of medical negligence, breaches of professional confidentiality, and insufficient consideration of patients' cultural specificities indicate that the moral education of healthcare professionals requires further improvement [13].

This underscores the importance of innovative approaches, such as the integration of artificial intelligence, which can facilitate more interactive, realistic, and personalized training in ethical principles. The study is pioneering in that it is the first within the national context to demonstrate the integration of artificial intelligence technologies in medical education, particularly their impact on the ethical, academic, and psychological development of medical students.

It transcends the traditional approach to medical training by implementing interactive AI models, such as AI Assistants and Augmented Reality (AR) applications, to create realistic learning scenarios. This not only enables students to acquire theoretical knowledge but also equips them with essential ethical and professional standards, which are critically important in the healthcare sector.

II. Literature Review

A. Medical Ethics and Deontology

Professional ethics, as a branch of ethics, governs the development of communication strategies in professional interactions, particularly within the context of professional (in this case, medical) activities [14, 15]. Thus, there is a meaningful differentiation among terms related to the domain of professional communication for medical workers. Medical deontology refers to the set of ethical norms governing the professional behavior of healthcare workers in their interactions with patients [16, 17]. While deontology reflects ethical concepts, it possesses a more pragmatic and specific nature. Unlike medical ethics, which does not differentiate between various medical specialties (e.g., there is no separate ethics for therapists or surgeons), medical deontology has adopted specialized characteristics due to its applied nature and its association with specific medical professions (e.g., surgical deontology, pediatrics, oncology, radiology, venereology, etc.) [16, 17].

Moral behavior encompasses the actions and decisions of individuals based on widely accepted moral norms and values that regulate human relationships and are directed toward the welfare of society [3, 18, 19]. In the medical profession, moral behavior is particularly crucial as it directly impacts the quality of care provided, patient trust, and the professional reputation of healthcare workers [19, 20]. Physicians and nurses who demonstrate high moral standards contribute to the improvement of medical practice and the reinforcement of ethical foundations within the medical profession.

Studies on the impact of ethical education on the moral behavior of nursing students have shown improvements following the implementation of an ethics program [21]. Other researchers have found that such programs effectively enhance the ability to make ethical decisions and moral judgments [22]. Thus, ethical training has proven effective in improving the moral behavior of healthcare workers [1].

B. Innovative Technologies in Medical Education

In recent years, there has been a significant increase in research focused on the application of innovative technologies in education, including medical specialties. Innovative technologies such as Artificial Intelligence (AI), Virtual Reality (VR), and AR are becoming integral to the educational process, offering new approaches to teaching and enhancing the quality of specialist training [23, 24]. Internationally, there are increasing examples of AI being used to individualize learning, tailor educational programs to student needs, and provide continuous feedback.

AI technologies are being actively integrated into medical education to simulate clinical scenarios and assess student skills [25, 26]. One such example is the use of simulation systems, which allow students to practice clinical skills in a virtual environment while receiving immediate feedback and recommendations [26]. However, despite numerous studies and successful instances of AI implementation, there are several unresolved issues and controversies. First, there is an ongoing debate about the ethics and confidentiality of data when using AI in the educational process [8]. Some researchers point to potential risks of data breaches and privacy violations, which could negatively impact students' trust in AI technologies [27]. The primary reasons for using AI include its ability to provide feedback, guide learning pathways, and reduce costs. A recent survey highlights that medical students are not fully aware of AI and its applications; however, they are eager to learn more about AI and related computer logistics [28]. They also recognize AI's potential in medical science, suggesting that current medical curricula should be oriented toward AI integration.

Moreover, methodological approaches to evaluating the effectiveness of AI also provoke debate. Some studies have identified two main negative factors related to AI applications: the complexity of assessing AI's effectiveness in medical education and technical issues in developing AI applications [27]. This leads to discrepancies in data interpretation and complicates meta-analyses. For instance, if a study employed both quantitative and qualitative methods to assess the impact of AI on medical student education, it would provide a more comprehensive view but also raise concerns about the representativeness and generalizability of the results.

An important area of research is the impact of AI on the development of students' moral behavior. Medical ethics plays a crucial role in shaping ethical norms and principles for future professionals, as well as in forming their moral behavior; it remains a priority in medical education.

However, the question of how AI usage affects the ethical aspect of student training remains underexplored [29, 30]. Specifically, it is necessary to investigate how AI can contribute to the development of critical thinking, the ability to make ethically sound decisions, and an awareness of the significance of bioethical norms, thereby influencing the moral behavior of medical personnel.

Artificial intelligence projects require skills and knowledge related to data quality, as they involve intensive data analysis and knowledge-based management [31]. Indeed, medical ethics necessitates a deep understanding of the social context, empathy, and the ability to make moral judgments—qualities that are difficult to replicate through algorithmic systems [32]. However, the role of AI in this context should not be perceived as a replacement for human ethics or critical thinking but rather as a tool that enhances these aspects.

Firstly, AI can serve as an educational instrument for simulating complex ethical scenarios, allowing students to practice decision-making [33]. Through interactive scenarios and outcome analysis, students have the opportunity to develop their critical thinking skills and moral reasoning within a controlled environment. This approach prepares them for real-world ethical challenges rather than substituting their capacity for independent decision-making.

Secondly, while AI itself lacks empathy, it can be utilized for analyzing large datasets and providing evidence-based decision support, thereby allowing medical professionals to allocate more time and resources to the human aspect of patient care [34]. In this regard, AI complements human capabilities rather than replacing them.

With respect to concerns regarding excessive reliance on AI, it is essential to ensure a balanced approach to its integration [35]. This involves incorporating teaching methodologies that foster students' independence, analytical abilities, and capacity to operate in uncertain conditions. For instance, students can be encouraged to critically analyze AI-generated recommendations, assess their validity, and justify their own decisions.

Thus, the use of AI in medical education should not be directed toward the full automation of ethical processes or the replacement of human skills. Instead, it should be regarded as a tool that facilitates the creation of an interactive, innovative, and adaptable learning environment while fostering students' confidence, autonomy, and ethical competence.

The novelty of this research lies in its comprehensive approach to studying the impact of AI on the educational process in medical universities, with a focus on the psychological aspects and moral behavior of students, and the development of competencies in professional ethics and self-efficacy. The research findings could contribute to improving educational programs, enhancing the quality of medical training, and developing new teaching approaches based on advanced technologies and methods, including pedagogy and artificial intelligence. Additionally, this study aims to evaluate the impact of AI technologies on the formation of moral behavior and self-efficacy among medical students. Consequently, this article is highly relevant and scientifically novel, as it addresses critical issues in contemporary medical education amid the rapid advancement of AI technologies.

C. Problem Statement

Contemporary medical education faces numerous challenges, including the need to prepare professionals capable of operating within a rapidly evolving technological environment. Despite significant advances in studying the application of AI in education, the psychological impact of AI on students and its role in shaping moral behavior remain insufficiently explored. This article aims to address this gap by providing a comprehensive analysis of the impact of AI on the educational process in medical universities.

The hypothesis of this study is that the use of artificial intelligence technologies in the educational process of medical students significantly enhances their academic performance, moral behavior, and self-efficacy. It is also hypothesized that positive psychological interactions with colleagues and effective strategies for overcoming professional stress contribute to the professional self-realization and motivational resilience of medical practitioners. The objective of this research is to evaluate the impact of AI technologies on the formation of moral behavior and self-efficacy among medical students, as well as to explore the factors that facilitate and hinder the professional self-realization of medical practitioners and their strategies for managing professional stress.

Research objectives:

- To conduct a comparative analysis of the academic performance of students trained using traditional methods versus those utilizing AI technologies.
- To examine the influence of artificial intelligence technologies on the development of moral behavior and self-efficacy in medical students.
- To identify factors that contribute to or hinder the professional self-realization of medical practitioners.

III. Methods and Materials

A. Study Design

The study was designed as an experimental investigation. The experimental design enables more precise control over variables and learning conditions, which is crucial for assessing the impact of AI on the educational process. This approach is particularly effective for testing the hypothesis that the use of AI enhances educational outcomes in the areas of medical ethics and self-efficacy. The research employed both testing and interview methods.

B. Participants

The participant sample was drawn from several leading medical institutions across three regions of the country: Moscow, St. Petersburg, and Perm. The study involved 150 nurses working in key areas of medicine: therapy, surgery, and obstetrics-gynecology. The average age of the participants was 37 years. Of the 150 participants, 68% were male and 32% were female. Nurses were selected for participation as, at this stage of their careers, they possess substantial knowledge and skills in medicine and are engaged in specialized disciplines, including ethical principles and standards.

Participants were divided into two groups: an experimental group and a control group, with 75 individuals in each. To participate in the study, individuals had to meet the following

criteria: be employed as a nurse and be between the ages of 25 and 45. Participants who were on leave, sick leave, or who declined to participate were excluded from the study.

Additionally, the study involved five instructors from Sechenov University. These instructors were responsible for designing the research program, conducting training, and evaluating the experimental participants. The instructors held doctoral degrees and had at least 10 years of professional experience.

C. Procedure

The training lasted one semester and focused on developing moral behavior in future nurses within the framework of the course "Ethics and Deontology," a subfield of medical ethics, aimed at exploring innovative technologies in medical education. Before the start of the training, all participants underwent an initial assessment, which included evaluating moral behavior and self-efficacy levels. At the end of the semester, participants were retested to assess changes in moral behavior and self-efficacy. The objective of the final assessment was to determine the effectiveness of the training according to the developed program. The effectiveness of pre-experiment training was evaluated based on semester grades from the previous term. Both preliminary and final assessments were conducted online over a period of 2 hours. The testing was carried out on a remote learning platform, with proctoring by teaching assistants via video conference. The experimental group utilized AI technologies throughout all stages of training, while the control group was taught using traditional methods. The frequency of classes for students was three times a week for 2 hours each session.

After confirming the equivalence of the groups, participants were randomly assigned to either the control group or the experimental group. The control group received traditional instruction without the use of AI. Teaching methods included lectures and seminars (traditional sessions conducted by instructors covering fundamental principles of bioethics and self-efficacy in medical practice), practical sessions (clinical exercises and scenarios without the use of AI), group discussions, and case studies (discussion of clinical cases in groups under the guidance of instructors, aimed at developing moral skills).

The experimental group comprised students who received training utilizing AI technologies. The following methods and tools were employed for this group:

Interactive AI Simulations: Students engaged in virtual practical scenarios created with the assistance of AI, which simulated real medical situations requiring ethical decision-making. For instance, the simulation was used, allowing students to create AI entities that learn and adapt to their environment or possess specific capabilities, such as communication or problem-solving. As these AI entities interacted with each other and the environment, the evolving behavior patterns and societal evolution of AI could be observed and analyzed.

AI Assistants: AI programs were employed to assist students in analyzing practical cases and making decisions based on ethical principles. Examples include the AR application "HoloHuman," which displays a human model on an examination table. Moderators could interact with the model and user interface via the HoloLens headset. Structures, organs, and systems could be examined individually or in combination, supported by visual storytelling tools and digital analysis. More detailed information is provided in Fig. 1.

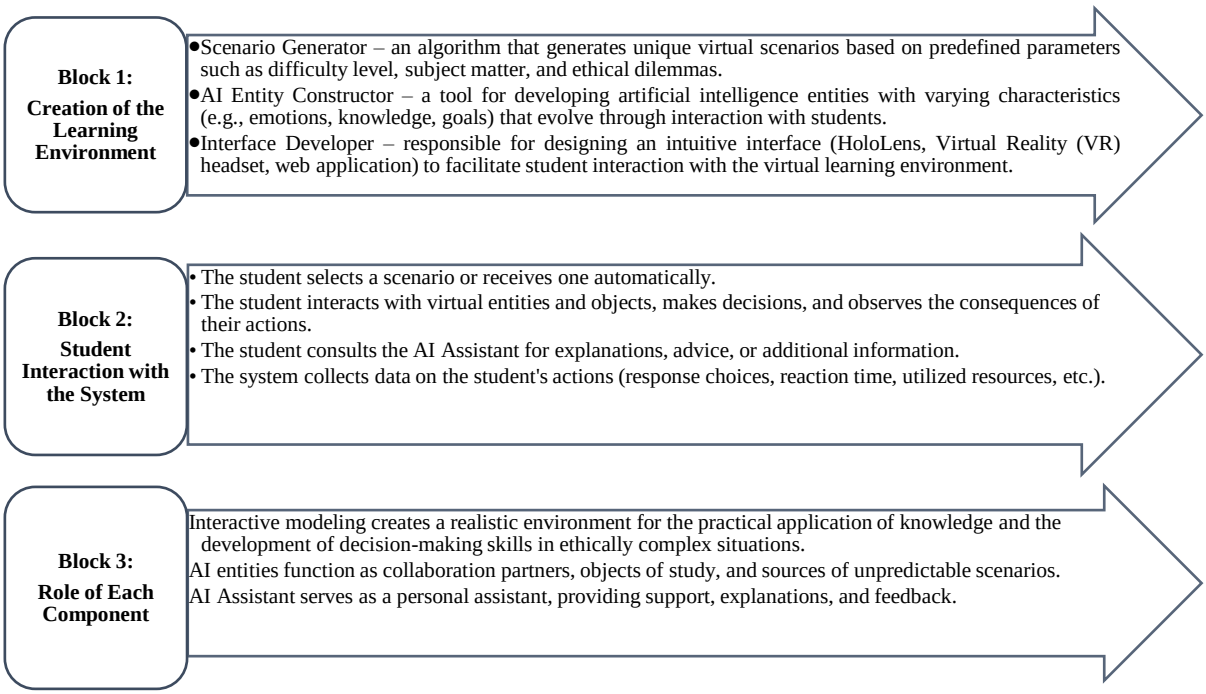

Fig. 1. A detailed examination of AI-based learning (Source: author's development).

The proposed AI-based system differs from traditional teaching methods by offering a more individualized and interactive approach. Through the use of virtual simulations and AI Assistants, students are not merely passive recipients of information but actively engage with the learning material, make decisions, and analyze their consequences. This fosters the development of essential competencies such as critical thinking, problem-solving, and ethical reasoning.

Unlike traditional lectures and seminars, which are typically static in nature, this system enables the creation of

dynamic learning environments that continuously adapt to the needs and progress of each student.

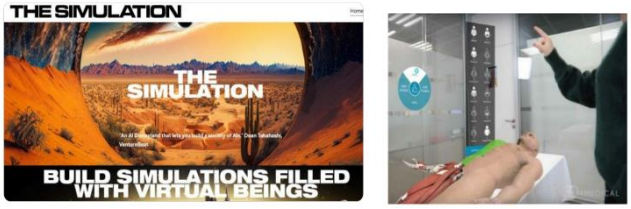

Fig. 2. Interface of the simulation and holohuman applications (Source: author's development).

Personalized Learning Programs: AI technologies tailored educational materials to the individual needs and proficiency levels of each student. The interfaces of these applications are illustrated in Fig. 2.

D. Research Tools

The following metrics were employed in this study to evaluate the effectiveness of the new training program utilizing AI technologies: academic performance, moral behavior, and self-efficacy of students.

Academic Performance: Standardized exams and tests designed by the faculty members involved in the study were used to assess academic performance. The exams covered core subjects of medical education, as well as specialized topics in bioethics. The questions were selected to evaluate both theoretical knowledge and practical skills. The exam structure included multiple-choice questions (50 items), short-answer questions (20 items), and case studies (5 items). These tests were validated and verified for reliability through internal reviews at the participating universities and meet state educational standards.

Moral Behavior: The moral behavior test, developed based on existing scales and tests in medical ethics, was used to assess moral behavior. The test included situational tasks and questions evaluating ethical decision-making. The test structure comprised situational tasks, multiple-choice questions, and open-ended questions for self-analysis. The moral behavior test was validated and tested for reliability through a pilot study conducted on a small sample of students (N = 30), with a Cronbach's alpha coefficient of 0.87, indicating high reliability.

Self-Efficacy: The evaluation of self-efficacy was based on self-reported assessments and standardized scales designed to measure students' confidence in their ability to achieve goals and effectively manage professional tasks.

To measure self-efficacy, the College Academic Self-Efficacy Scale (CASES) was utilized, as enhanced by Ifdil *et al*. [36]. The validity of the scale was assessed using Cronbach's alpha analysis, which indicated a coefficient $\alpha > 0.3$, confirming the validity of 33 CASES items. Additionally, reliability analysis using Cronbach's alpha revealed a reliability coefficient of 0.931 for the CASES. The scale structure consisted of 10 statements rated on a 4-point Likert scale (ranging from "strongly disagree" to "strongly agree").

Participants were also interviewed to identify factors that facilitate or hinder professional self-realization among medical workers and the strategies they employ to manage professional stress. The interview questions included:

1) What ethical issues might arise in your professional practice?
2) What additional knowledge and skills would be beneficial for your professional activities?
3) According to you, what factors most significantly impact the effectiveness of patient treatment?
4) What factors, in your opinion, determine the rating of a medical professional from the patients' perspective?
5) What factors define the success of a medical professional?
6) What do you consider the main goals of professional psychological interactions with patients, their relatives, and colleagues?

Each participant answered the interview questions in a calm and confidential setting, which facilitated openness and honesty in their responses.

E. Data Analysis

Data analysis for this study was conducted using SPSS (Statistical Package for the Social Sciences), a widely recognized tool for statistical analysis in social and medical sciences. A paired t-test was employed to compare the mean scores before and after training within each group (control and experimental). This approach allowed for the assessment of significant improvements within each group as a result of the training. An independent t-test was used to compare the mean scores between the control and experimental groups following the completion of the training. This comparison provided insights into the significance of the differences between the results of the two groups.

Analysis of Variance ANOVA () was utilized to evaluate the overall impact of various factors on learning outcomes. Specifically, it analyzed the effect of the training method (traditional versus innovative) on academic performance, moral behavior, and self-efficacy of the students. All data were checked for missing values and anomalies. Means and standard deviations for all indicators (academic performance, moral behavior, self-efficacy) were calculated. The use of these statistical tests facilitated a comprehensive assessment of the effectiveness of the developed training program and confirmed the hypothesis regarding the impact of AI technologies on the formation of moral behavior and self-efficacy among medical students.

The analysis of interview data involved transcribing recorded responses and subsequently coding the data for further examination. The recorded responses were subjected to content analysis to identify key themes and factors mentioned by the participants. The frequency of mentions for each factor was counted, and percentage values were computed based on these frequencies. The average significance of factors was assessed using a scale where participants rated the importance of each factor from 1 (least important) to 5 (most important).

F. Ethical Issues

The study was conducted in strict adherence to all necessary ethical principles, ensuring respect, confidentiality, and the well-being of participants. All participants provided informed consent prior to their involvement. They were given comprehensive information about the study's objectives, procedures, potential risks, and benefits. All data collected during the study were anonymized to protect participants' confidentiality. Personal data were neither used nor disclosed to third parties. Participation in the study was entirely

voluntary, and participants had the right to withdraw at any time without facing any negative consequences. No methods or procedures that could cause physical or psychological harm to participants were employed during the research.

IV. Results

A. The Impact of Technologies on the Formation of Moral Behavior and Self-Efficacy in Students

Table 1 demonstrates a significant improvement in all metrics within the innovative training group. These findings support the hypothesis that the integration of artificial intelligence into the educational process positively impacts key aspects of student learning and personal development.

Table 1. Student performance statistics

Indicator	Traditional Instruction		Innovative Instruction	
	Pre-Training	Post-Training	Pre-Training	Post-Training
Academic Performance (Mean ± SD)	75 ± 5	78 ± 6	75 ± 5	85 ± 5
Level of Moral Behavior (Mean ± SD)	70 ± 4	72 ± 5	70 ± 4	82 ± 4
Self-Efficacy (Mean ± SD)	68 ± 3	70 ± 4	68 ± 3	80 ± 3

Source: author's development

The academic performance of students undergoing traditional instruction increased from 75 to 78 points, reflecting a 4% improvement. In contrast, the average score in the innovative training group rose from 75 to 85 points, representing a 13% increase. This substantial enhancement indicates that the integration of AI technologies facilitates deeper comprehension of the educational material and improves students' academic achievements.

The level of moral behavior in the control group improved from 70 to 72 points (an increase of 2.9%). In the experimental group, where AI technologies were employed, this metric increased from 70 to 82 points (an increase of 17.1%). These results suggest that innovative teaching methods significantly positively influence the development of ethical standards of moral behavior among students in medical specialties.

Students' self-efficacy in the control group increased from 68 to 70 points (an improvement of 2.9%). In the experimental group, the increase was notably higher, rising from 68 to 80 points (an improvement of 17.6%). This demonstrates that AI technologies help students feel more confident in their skills and abilities, which is a crucial aspect of professional development in medicine.

Table 2. Results of the paired t-test

Indicator	Group	Paired t-test		Independent t-test	
		t-value	*p*-value	t-value	*p*-value
Academic Performance	CG	3.58	<0.01	4.85	<0.001
	EG	9.12	<0.001	-	-
Moral Behavior Level	CG	2.45	<0.05	5.44	<0.001
	EG	10.01	<0.001	-	-
Self-Efficacy	CG	2.98	<0.05	5.98	<0.001
	EG	12.45	<0.001	-	-

Source: author's development

Paired and independent t-tests were conducted to compare the mean scores before and after training within each group (control and experimental), with results presented in Table 2. The paired t-test results reveal statistically significant improvements across all measured indicators in both groups, with notably greater enhancements in the innovative training group. The independent t-test results indicate that post-test scores in the innovative training group were significantly higher than those in the traditional training group, thereby confirming the effectiveness of the AI-based training program.

The results presented in Tables 1 and 2 demonstrate substantial improvements across all measured aspects for the innovative training group. Data from Table 2 indicate that the integration of AI technologies in the training of medical students positively impacts all evaluated metrics: academic performance, moral behavior level, and self-efficacy. The significant enhancement in results within the innovative group compared to the traditional group underscores the high efficacy of AI-based methods. These findings emphasize the importance and necessity of incorporating innovative technologies into educational processes, particularly in medical institutions where both a high level of knowledge and adherence to ethical standards, as well as confidence in professional skills, are essential.

ANOVA was employed to assess the overall impact of various factors on training outcomes. Specifically, the analysis examined the effect of the training method (traditional vs. innovative) on academic performance, bioethical behavior level, and student self-efficacy. The results are presented in Table 3. The ANOVA findings reveal that the training method significantly influenced all performance indicators, with the innovative training method yielding superior results compared to the traditional approach.

Table 3. ANOVA results

Indicator	Factor	F-value	*p*-value
Academic Achievement	Teaching Method	29.34	<0.001
Moral Behavior Level		32.77	<0.001
Self-Efficacy		38.12	<0.001

Source: author's development

The results of the ANOVA analysis demonstrate that the teaching method significantly impacts students' academic performance. The high F-value and *p*-value less than 0.001 indicate a statistically significant difference between traditional and innovative teaching methods. This suggests that students who received instruction incorporating AI technologies achieved notably higher academic results compared to those who were taught using traditional methods. Similarly, a significant impact of the teaching method was found on the level of moral behavior. The highest F-value among all indicators was observed for self-efficacy, which is also supported by an extremely low *p*-value. This indicates that the use of AI technologies in education significantly enhances students' self-efficacy, an important factor for their professional development and confidence in their abilities.

Effectiveness of AI Technologies: The integration of artificial intelligence technologies into educational processes demonstrates high effectiveness, significantly improving academic performance, moral behavior, and self-efficacy among students in medical fields. Therefore, the study's

results confirm the hypothesis regarding the substantial positive impact of AI technologies on the development of bioethical behavior and self-efficacy in medical students, offering new perspectives for enhancing educational processes and professional training.

B. Factors Contributing to Professional Self-Actualization

Table 4 presents the results obtained from the survey and semi-structured interviews, analyzing the impact of various factors on the professional self-actualization of medical professionals. A statistically significant difference has been identified in the challenges related to patient interaction between nurses and physicians in terms of their perception of these difficulties. Physicians encounter such challenges more frequently, as indicated by a higher mean score and a statistically significant deviation from the results observed among nurses.

While the difference between the groups is not entirely statistically significant (*p*-value close to 0.05) regarding colleagues' ambitions and career aspirations, there is a notable trend suggesting that nurses exhibit a slightly greater concern about their colleagues' ambitions and career progression compared to physicians.

For other indicators, such as the psychological characteristics of colleagues, the complexity of work, and the tendency of colleagues to conceal insufficient competence, no statistically significant differences were observed between the groups. This may indicate that these factors have an equally influential role in the professional self-actualization of both nurses and physicians.

Table 4. Mean significance of factors contributing to professional self-actualization

Indicator	Nurses	Doctors	t-statistic	*p*-value
Prevalence of Significant Factors	72.7 ± 9.2	79.6 ± 8.1	1.87	0.063
Issues in Colleague Relationships	73.6 ± 5.8	73.6 ± 5.8	1.54	0.125
Issues in Patient Interaction	1.8	3.4	2.56	0.012
Ambitions and Career Aspirations of Colleagues	41.3 ± 5.7	36.5 ± 4.6	−1.98	0.051
Psychological Characteristics of Individual Colleagues	32.6 ± 4.1	28.9 ± 3.2	−1.72	0.089
Complexity and Hyperintensity of Work	17.07 ± 3.6	15.8 ± 3.0	−0.45	0.654
Colleagues' Desire to Conceal Inadequate Competence	-	8.3 ± 0.6	-	-
Personal Difficulties and Envy Among Colleagues	-	7.7± 0.4	-	-

Source: author's development

The average significance score of the factor was found to be the most prevalent in responses: 72.7 ± 9.2% among mid-level medical staff and 79.6 ± 8.1% among general medical professionals. Among the factors negatively impacting work efficiency and psychological well-being in the professional context, complex relationships with colleagues emerged as a leading issue, affecting 73.6 ± 5.8% of mid-level medical staff. Psychological difficulties in interactions with patients or their representatives were identified as a significant and frequent issue in the professional lives of mid-level medical staff, with an average score of 1.8. For physicians, this problem was also highly significant, with an average ranking of 3.4 in the factor hierarchy.

Among the primary causes of professional relationship issues in the studied group of mid-level medical staff, colleagues' ambitions and excessive career aspirations were noted. Complexity and hyperintensity of work were regarded as a major problem by 17.07 ± 3.6% of mid-level medical staff and 15.8 ± 3.0% of physicians. Physicians indicated that issues with colleagues were often due to colleagues' attempts to conceal inadequate competence in 8.3 ± 0.6% of cases and personal difficulties and envy among colleagues in 7.7 ± 0.4% of cases. Thus, the study demonstrates that psychological well-being and effective communication skills play a crucial role in the professional self-realization of medical professionals.

A significant finding was the strong inclination to acquire additional skills and knowledge related to positive communication with colleagues within the professional context. Moreover, the effectiveness of treatment, according to the surveyed specialists, is believed to depend substantially on several factors: 20% on the material and technical support of the treatment process, 60% on professional knowledge and skills, and the remaining portion on the psychological atmosphere created during interactions between the physician and the patient. This was also highlighted among the leading factors determining the rating of medical professionals according to patients, with psychological factors being identified as primary.

Unexpected results emerged in response to the question about the primary objectives of professional psychological interaction. A substantial portion of responses described these objectives largely in formal terms, listing the duties of the physician and medical staff, with over 80% of responses reflecting this view. There was a notable prevalence of hyper-conformist attitudes, such as the tendency to adopt the viewpoint of another specialist and to please the patient. Responses rarely reflected a differentiation in communication goals and approaches with patients, their relatives, and colleagues. Frequently, responses were dominated by the choice of a single stereotypical approach, while the differentiation of recommended psychological interaction strategies within the framework of psychological ethics and its specific subdivision, deontology, was often ignored.

The data presented above indicate a significant issue concerning the psychological training of medical professionals, including both registered nurses with intermediate and advanced medical education, in relation to the psychology of professional communication. This deficit in professional communication skills and understanding of their differentiation with respect to interactions with patients, their relatives, and within the context of professional activities creates a substantial foundation for professionally induced psychological conflicts, thereby leading to a decrease in the effectiveness of treatment.

C. Research Limitations

Despite the achieved results, the study has several limitations that should be considered when interpreting the findings and planning future research. The total number of participants was 150, which may restrict the generalizability of the results to a broader population of healthcare

professionals. Although the study sample includes representatives of key medical specialties from three major cities in Russia, it has several limitations. The geographical concentration in large urban centers does not fully reflect the situation in other regions of the country, particularly in rural areas. Additionally, the relatively small sample size limits the statistical power of the study and complicates the generalization of the findings to the entire population of nurses within the country and beyond. The research was conducted solely within one educational institution, which may not reflect conditions in other regions or countries. Additionally, the study was limited to students pursuing a degree in nursing at a university, specifically those in their third year. The use of semi-structured interviews may introduce subjectivity into the results, as participants' responses could be influenced by personal perceptions and social expectations. Testing and interviews may involve subjective biases, as participants might respond in ways they perceive as socially desirable rather than reflecting their true experiences or behaviors.

The study was conducted within a limited timeframe, which does not allow for the consideration of long-term changes in indicators and the dynamics of factors affecting self-realization and stress resilience among healthcare professionals. Understanding the long-term effects of the proposed teaching methods is critically important for assessing their effectiveness and developing more efficient training strategies in the field of medical ethics. Further research in this area will contribute to a more comprehensive understanding and facilitate the development of practical recommendations for implementation.

When studying the moral behavior and self-efficacy of medical professionals, numerous factors may influence the results. Among these, individual differences such as prior ethical training, professional experience, personal characteristics, and religious or cultural beliefs play a significant role. Additionally, contextual factors, including the work environment, social pressure, and stress levels, may also impact the findings. Potential confounding factors include participants' prior experience with technology, which may have influenced their ability to adapt more quickly to AI-assisted learning. Additionally, variations in teaching quality among instructors could have contributed to inconsistencies in outcomes between groups.

V. Discussion

The results of this study convincingly demonstrate that instruction utilizing AI technologies significantly enhances academic performance, ethical behavior, and self-efficacy among students compared to traditional teaching methods. Paired t-tests within each group revealed that both teaching methods improved student outcomes, but the innovative method led to more substantial improvements. Independent t-tests confirmed that post-test scores in the AI-based learning group were significantly higher than those in the traditional learning group. ANOVA results further corroborated that the teaching method has a significant impact on learning outcomes, with a clear advantage favoring the AI-based method.

These findings indicate that integrating AI technologies into educational practices, particularly in medical education, can substantially improve learning outcomes. This has broad implications for educational policy and curriculum development, underscoring the need for incorporating advanced technologies to enhance teaching effectiveness and student performance. Future research should explore the long-term effects of AI-based instruction and its impact on other educational domains.

In another study involving 189 nursing students from Gyeonggi-do [37], results showed that awareness of AI ethics ($t = -4.32$, $p < 0.001$), positive attitudes toward AI ($t = -2.60$, $p = 0.010$), and self-efficacy ($t = -2.65$, $p = 0.009$) were higher among third- and fourth-year nursing students compared to first- and second-year students. Factors influencing behavioral intent included positive attitudes toward AI ($\beta = 0.58$) and self-efficacy ($\beta = 0.22$). In this study, self-efficacy in the control group increased by 2.9%, while the experimental group saw a significantly higher increase of 17.6%. Thus, AI technologies help students feel more confident in their abilities, which is a crucial aspect of professional development in medicine. Complexity and hyper-intensity of work were identified as major issues, and problems with colleagues were attributed to colleagues' attempts to conceal their lack of competence.

In another study, statistically significant differences in overall self-efficacy among medical professionals were observed following a seminar: before the seminar (mean score = 2.42), after the seminar (mean score = 2.13), and among graduates (mean score = 1.58), with a p-value < 0.000 on a scale of 1 to 5 [1]. The average ratings of students after the seminar and of graduates were 7.8 and 7.25, respectively, on a scale of 1 to 10, where 10 indicates high self-efficacy. The levels of self-efficacy in addressing ethical dilemmas increased over time, suggesting that the seminar reinforced students' and graduates' self-perception of ethical competence. Our study and the research under discussion share a common focus on enhancing participants' self-efficacy through the implementation of innovative teaching methods. Both studies demonstrate statistically significant improvements in self-efficacy following educational interventions, highlighting the importance of specially designed training programs in strengthening participants' confidence in their professional skills. Moreover, both studies emphasize that educational interventions influence not only professional competence but also the development of moral qualities.

The findings of our study exhibit similarities with a Turkish study in the context of the impact of artificial intelligence on professional development and the perception of ethical norms [38]. Specifically, in our research, the moral behavior of medical students in the experimental group improved by 17.1%, confirming the effectiveness of innovative methodologies in shaping ethical norms. The Turkish study also underscores the significance of ethical aspects, reporting that 44.7% of participants expressed confidence in the ability to safeguard professional confidentiality when utilizing artificial intelligence. This suggests a relationship between the integration of new technologies and the cultivation of ethical culture in the professional domain.

Furthermore, the increase in students' self-efficacy observed in our study (17.6% in the experimental group)

aligns with the findings of the Turkish study, where 85.8% of medical students considered artificial intelligence an effective tool for facilitating access to information. This underscores that AI not only enhances students' confidence in their professional abilities but also fosters a positive attitude toward technology as a tool for improving the quality of medical practice and reducing the incidence of errors (70.5%).

Thus, both studies demonstrate that artificial intelligence contributes to the development of moral and professional qualities, albeit with differing emphases: our study primarily focuses on ethical and psychological aspects, whereas the Turkish study places greater emphasis on functional and technological advantages. Regarding innovative training, AR-based learning enhances outcomes in several key educational areas, including professional knowledge, cognitive and practical skills, social skills, innovation, competence, and creativity [39]. Additionally, support for integrating AI instruction into core curricula has been widespread globally; however, only a few students received AI instruction [40]. According to the study, students demonstrated knowledge of the application of AI in medical disciplines and the development of competencies in ethics and deontology; they expressed interest in learning about practical applications, algorithm development, coding, and evaluation of AI algorithms. Another study indicated that the use of AI in medicine will create numerous opportunities for improving patient care, real-time data analysis, and continuous patient monitoring [41]. However, there are limitations to the use of artificial intelligence in medical education. These include reliance on high-quality data for training models, the risk of algorithmic bias, technical challenges in integrating AI into educational processes, and the need for additional resources to ensure access to these technologies [27, 42]. Difficulties also arise in assessing the effectiveness of AI in medical education, as well as in addressing technical issues during the development of AI applications [43].

Ethical considerations pertain to safeguarding the confidentiality of both students and patients, preventing breaches of professional ethics, and ensuring that technology serves as a complement to, rather than a replacement for, the human element in education [43]. Additionally, it is crucial to guarantee equal access to AI for all students, prevent potential discrimination, and maintain transparency in system operations.

VI. Conclusions

The findings of the study indicate a significant impact of innovative technologies on the development of moral behavior, self-efficacy, and academic performance among students. According to the obtained data, the experimental group, which utilized AI-based learning methodologies, demonstrated a statistically significant improvement across all measured aspects compared to the control group.

In the traditional group, academic performance increased by only 4%, whereas in the innovative group, it rose by 13%, highlighting the greater effectiveness of novel teaching methods in facilitating knowledge acquisition. Moral behavior improved by 2.9% in the control group and by 17.1% in the experimental group, confirming the positive influence of innovative methodologies on the development of ethical norms among students. Similarly, self-efficacy increased by 2.9% in the control group and by 17.6% in the experimental group, indicating a higher level of confidence in students' skills and professional abilities.

Paired t-tests confirmed statistically significant improvements in all indicators following the training, while independent t-tests demonstrated that the experimental group significantly outperformed the control group. Additionally, ANOVA analysis revealed that the teaching methodology had a substantial effect on academic performance, moral behavior, and self-efficacy.

The research identified factors that both facilitate and hinder professional self-realization: issues with colleague relationships, problems with patient interactions, colleagues' ambitions and career aspirations, psychological characteristics of certain colleagues, the complexity and hyperintensity of labor, and others. To mitigate professional stress and psychological issues arising from interactions with colleagues, patients, and their representatives, it is essential to systematize philosophical and ethical knowledge and to avoid conflating ethics, medical deontology, and professional ethics. A crucial objective of medical education should be the development of ethical-professional thinking among future specialists, which necessitates the expansion of bioethical content within the medical education system. The medical school should not merely address isolated aspects of bioethics but rather implement a comprehensive set of specialized courses designed to cultivate criteria for bioethically responsible thinking.

The scientific value of this study lies in validating the hypothesis that innovative AI-based training methods offer significant advantages over traditional methods. The significance of the achieved results is highly relevant in the context of modern education. The integration of artificial intelligence technologies into educational programs contributes not only to the improvement of academic performance but also to the development of ethical norms and self-confidence, which are essential components of professional training. These findings underscore the necessity of further implementing innovative technologies in medical education to ensure the preparation of highly qualified professionals capable of effectively operating in contemporary healthcare settings.

The practical value of the research is demonstrated through the effectiveness of AI technologies in the educational process, which opens avenues for their broader implementation in medical curricula. This could enhance the quality of future medical professionals' training by equipping them with essential knowledge and skills, while also fostering high ethical standards and self-efficacy.

The findings have applicability across various domains, including the development of curricula in medical schools, continuing education for healthcare professionals, and other educational fields where ethical standards and high self-efficacy are critical. Additionally, these results could be of interest to educational policymakers and administrators aiming to improve educational quality through modern technologies.

Future research prospects include exploring the long-term effects of AI use in educational processes and its impact on

other crucial aspects of learning, such as critical thinking, creativity, and teamwork. It is also important to investigate the potential for adapting AI technologies to other educational fields and levels, which would enable an even broader utilization of their potential to enhance educational outcomes.

Thus,

- Innovative Contribution: This study provides empirical evidence of the specific impact of artificial intelligence on the moral development and self-efficacy of medical professionals.
- Findings: The results demonstrate that the use of AI significantly enhances academic performance (by 13%), moral behavior (by 17.1%), and self-efficacy (by 17.6%) among students.
- Practical Contribution: The study contributes to the development of recommendations for the integration of innovative technologies in medical education, enabling simultaneous improvements in academic, ethical, and psychological aspects of medical training.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualization, NK and EF; Methodology, OM; Software, OM; Validation, MZ, TB, NK, EF, OM and OM; Formal Analysis, MZ; Investigation, TB; Resources, EF; Data Curation, OM; Writing – Original Draft Preparation, NK; Writing – Review & Editing, OMa; Visualization, MZ; Supervision, TB; Project Administration, NK; Funding Acquisition, EF. All authors read and approved the final manuscript.

REFERENCES

[1] S. Obeid and M. Man, "Strengthening perceptions of ethical competence among nursing students and graduates," *SAGE Open Nurs.*, vol. 6, pp. 1–9, 2020. doi: 10.1177/2377960820924170

[2] E. Yoshioka and S. Kaneko, "The acquisition of ethical competence in basic education and the present state of ethics education," *Open J. Nurs.*, vol. 9, no. 7, pp. 676–686, 2019. doi: 10.4236/ojn.2019.97052

[3] S. Doernberg and R. Truog, "Spheres of morality: The ethical codes of the medical profession," *American J. Bioeth.*, vol. 23, no. 12, pp. 8–22, 2023. doi: 10.1080/15265161.2022.2160514

[4] R. Rhodes, "Why not common morality?" *J. Med. Eth.*, vol. 45, no. 12, pp. 770–777, 2019. doi: 10.1136/medethics-2019-105621

[5] B. Varkey, "Principles of clinical ethics and their application to practice," *Med. Princ. Pract.*, vol. 30, no. 1, pp. 17–28, 2021. doi: 10.1159/000509119

[6] R. F. Chadwick and U. Schüklenk, *This Is Bioethics: An introduction*, vol. 27, Hoboken: John Wiley and Sons, 2020.

[7] K. Masters, "Artificial intelligence in medical education," *Med. Teach.*, vol. 41, no. 9, pp. 976–980, 2019. doi: 10.1080/0142159X.2019.1595557

[8] K. Paranjape, M. Schinkel, R. N. Panday, J. Car, and P. Nanayakkara, "Introducing artificial intelligence training in medical education," *JMIR Med. Educ.*, vol. 5, no. 2, p. e16048, 2019. doi: 10.2196/16048

[9] H. Wu, S. Li, J. Zheng, and J. Guo, "Medical students' motivation and academic performance: The mediating roles of self-efficacy and learning engagement," *Med. Educ. Onl.*, vol. 25, no. 1, 1742964, 2020. doi: 10.1080/10872981.2020.1742964

[10] B. W. Ommering, F. M. Blankenstein, M. Diepen, and F. W. Dekker, "Academic success experiences: Promoting research motivation and self-efficacy beliefs among medical students," *Teach. Learn. Med.*, vol. 33, no. 4, pp. 423–433, 2021. doi: 10.1080/10401334.2021.1877713

[11] F. Tuma, "The use of educational technology for interactive teaching in lectures," *Ann. Med. Surg.*, vol. 62, pp. 231–235, 2021. doi: 10.1016/j.amsu.2021.01.051

[12] C. Wang, S. Liu, H. Yang, J. Guo, Y. Wu, and J. Liu, "Ethical considerations of using ChatGPT in health care," *J. Med. Internet Res.*, vol. 25, e48009, 2023. doi: 10.2196/48009

[13] K. Fyanka and C. M. Ekpendu, "An assessment of the right to privacy and confidentiality of patients in the context of medical negligence, error and malpractice in Nigeria," *AJLHR*, vol. 7, no. 1, pp. 1–8, 2023.

[14] M. S. Alnamlah, S. A. Itani, M. M. Alqahtani, A. A. Abdrabalnabi, A. Muammar, and R. G. Menezes, "Common medical ethics dilemmas: Few reflections from a Saudi perspective," *J. For. Leg. Medi.*, vol. 90, p. 102394, 2022. doi: 10.1016/j.jflm.2022.102394

[15] R. W. Parsa-Parsi, R. Gillon, and U. Wiesing, "The revised International code of medical ethics: An exercise in international professional ethical self-regulation," *J. Med. Eth.*, vol. 50, no. 3, pp. 163–168, 2024. doi: 10.1136/jme-2023-109027

[16] M. P. Mytchenok and A. V. Mytchenok, "Medical ethics and deontology," in *Proc. III International Science Conference on e-Learning and Education*, Lisbon: International Science Group, 2021, pp. 203–205.

[17] A. Sganzerla, J. E. D. Siqueira, and T. R. Guérios, "Ethics of virtue applied to medical deontology," *Rev. Bioét.*, vol. 30, pp. 482–491, 2022. doi: 10.1590/1983-80422022303541EN

[18] E. Avci, "Evaluating the effectiveness of bioethics education through quality standards and indicators," *Intern. J. Eth. Educ.*, vol. 7, no. 1, pp. 5–19, 2022. doi: 10.1007/s40889-021-00132-4

[19] J. F. Childress and T. L. Beauchamp, "Common morality principles in biomedical ethics: Responses to critics," *Cambridge Quar. Healthc. Eth.*, vol. 31, no. 2, pp. 164–176, 2022. doi: 10.1017/S0963180121000566

[20] S. Holm, "What is the foundation of medical ethics—common morality, professional norms, or moral philosophy?" *Cambridge Quar. Healthc. Eth.*, vol. 31, no. 2, pp. 192–198, 2022. doi: 10.1017/S0963180121000591

[21] A. M. Polczynski, C. L. Rozmus, and N. Carlin, "Beyond silos: An interprofessional, campus-wide ethics education program," *Nurs. Eth.*, vol. 26, no. 7–8, pp. 2314–2324, 2019. doi: 10.1177/0969733019832948

[22] W. J. Kim and J. H. Park, "The effects of debate-based ethics education on the moral sensitivity and judgment of nursing students: A quasi-experimental study," *Nur. Educ. Tod.*, vol. 83, p. 104200, 2019. doi: 10.1016/j.nedt.2019.08.018

[23] P. Dhar, T. Rocks, R. M. Samarasinghe, G. Stephenson, and C. Smith, "Augmented reality in medical education: Students' experiences and learning outcomes," *Med. Educ. Onl.*, vol. 26, no. 1, p. 1953953, 2021. doi: 10.1080/10872981.2021.1953953

[24] P. S. Goh and J. Sandars, "A vision of the use of technology in medical education after the COVID-19 pandemic," *MedEdPublish.*, vol. 9, pp. 49, 2020. doi: 10.15694%2Fmep.2020.000049.1

[25] E. R. Han, S. Yeo, M. J. Kim, Y. H. Lee, K. H. Park, and H. Roh, "Medical education trends for future physicians in the era of advanced technology and artificial intelligence: An integrative review," *BMC Med. Educ.*, vol. 19, pp. 460, 2019. doi: 10.1186/s12909-019-1891-5

[26] H. Y. So, P. P. Chen, G. K. C. Wong, and T. T. N. Chan, "Simulation in medical education," *J. Royal Coll. Physic. Edinburgh*, vol. 49, no. 1, pp. 52–57, 2019. doi: 10.4997/jrcpe.2019.112

[27] K. S. Chan and N. Zary, "Applications and challenges of implementing artificial intelligence in medical education: integrative review," *JMIR Med. Educ.*, vol. 5, no. 1, p. e13930, 2019. doi: 10.2196/13930

[28] A. Jindal and M. Bansal, "Knowledge and education about artificial intelligence among medical students from teaching institutions of India: A brief survey," *MedEdPublish.*, vol. 9, p. 200, 2020. doi: 10.15694/mep.2020.000200.1

[29] M. Ashok, R. Madan, A. Joha, and U. Sivarajah, "Ethical framework for artificial intelligence and digital technologies," *Intern. J. Inform. Manag.*, vol. 62, p. 102433, 2022. doi: 10.1016/j.ijinfomgt.2021.102433

[30] I. Munoko, H. L. Brown-Liburd, and M. Vasarhelyi, "The ethical implications of using artificial intelligence in auditing," *J. Busin. Eth.*, vol. 167, no. 2, pp. 209–234, 2020. doi: 10.1007/s10551-019-04407-1

[31] S. Secinaro, D. Calandra, A. Secinaro, V. Muthurangu, and P. Biancone, "The role of artificial intelligence in healthcare: A structured literature review," *BMC Med. Inform. Decis. Mak.*, vol. 21, p. 125, 2021. doi: 10.1186/s12911-021-01488-9

[32] S. F. Alhashmi, M. Alshurideh, B. Al Kurdi, and S. A. Salloum, "A systematic review of the factors affecting the artificial intelligence implementation in the health care sector," in *Proc. the International Conference on Artificial Intelligence and Computer Vision (AICV2020)*, Springer International Publishing, 2020, pp. 37–49. doi: 10.1007/978-3-030-44289-7_4

[33] C. P. Dai and F. Ke, "Educational applications of artificial intelligence in simulation-based learning: A systematic mapping review," *Comput.*

Educ. Artif. Intell., vol. 3, p. 100087, 2022. doi: 10.1016/j.caeai.2022.100087

[34] M. Zarei, H. E. Mamaghani, A. Abbasi, and M. S. Hosseini, "Application of artificial intelligence in medical education: A review of benefits, challenges, and solutions," *Med. Clín. Práct.*, vol. 7, no. 2, p. 100422, 2021. doi: 10.1016/j.mcpsp.2023.100422

[35] M. Sajjad, "Curse or a blessing: Excessive use of ChatGPT in academia," *Bulletin of Business and Economics (BBE)*, vol. 13, no. 2, pp. 290–297, 2024. doi: 10.61506/01.00329

[36] I. Ifdil, K. Bariyyah, A. K. Dewi, and I. B. Rangka, "The College Academic Self-Efficacy Scale (CASES); An Indonesian validation to measure the self-efficacy of students," *J. Kajian Bimb. Kons.*, vol. 4, no. 4, p. 11, 2024.

[37] Y. Kwak, J. W. Ahn, and Y. H. Seo, "Influence of AI ethics awareness, attitude, anxiety, and self-efficacy on nursing students' behavioral intentions," *BMC Nurs.*, vol. 21, no. 1, p. 267, 2022. doi: 10.1186/s12912-022-01048-0

[38] M. M. Civaner, Y. Uncu, F. Bulut, E. G. Chalil, and A. Tatli, "Artificial intelligence in medical education: A cross-sectional needs assessment," *BMC Med. Educ.*, vol. 22, no. 1, p. 772, 2022. doi: 10.1186/s12909-022-03852-3

[39] A. Klimova, A. Bilyatdinova, and A. Karsakov, "Existing teaching practices in augmented reality," *Proc. Comp. Scie.*, vol. 136, pp. 5–15, 2018. doi: 10.1016/j.procs.2018.08.232

[40] H. Ejaz, H. McGrath, B. L. Wong, A. Guise, T. Vercauteren, and J. Shapey, "Artificial intelligence and medical education: A global mixed-methods study of medical students' perspectives," *Dig. Heal.*, vol. 8, pp. 1–11, 2022. doi: 10.1177/20552076221089099

[41] A. H. Sapci and H. A. Sapci, "Artificial intelligence education and tools for medical and health informatics students: Systematic review," *JMIR Med. Educ.*, vol. 6, no. 1, p. e19285, 2020. doi: 10.2196/19285

[42] H. A. Younis, T. A. E. Eisa, M. Nasser, T. M. Sahib, A. A. Noor, O. M. Alyasiri, S. Salisu, I. M. Hayder, and H. A. Younis, "A systematic review and meta-analysis of artificial intelligence tools in medicine and healthcare: Applications, considerations, limitations, motivation and challenges," *Diagnostics*, vol. 14, no. 1, p. 109, 2024. doi: 10.3390/diagnostics14010109

[43] X. Wang and X. Q. Liu, "Potential and limitations of ChatGPT and generative artificial intelligence in medical safety education," *World J. Clin. Cases*, vol. 11, no. 32, p. 7935, 2023. doi: 10.12998/wjcc.v11.i32.7935

Copyright © 2025 by the authors. This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (CC BY 4.0).