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Investigating the impact of artificial intelligence technology in medical electronics education

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Abstract

The purpose of this research is to identify and explain the capabilities of artificial intelligence in medical e-learning. To review and analyze the strengths and weaknesses, opportunities and threats, the opinions of 25 managers, professors, experts and experts in the field of artificial intelligence and professors in the field of medicine and health have been used. Among the selected people in this field, we can refer to people who have books, articles, authorships, translations in the field of medicine and artificial intelligence, and also have work experience as university professors, doctors, hospital heads, and consultants in terms of education and position. Opportunities, threats, strengths and weaknesses were collected from the community of experts based on an open questionnaire and interviews using the grand theory method. Then weighting and ranking has been done using the Shannon entropy technique. After ranking, 18 opportunities, 13 threats, 15 strengths and 14 weaknesses were identified. Then, using the strategic planning quantitative matrix, the indicators were scored and weighted. The total score of the internal factors was 2.469 and the total of the external factors was 2.316, which was drawn on the matrix, and Tehaji's strategy was chosen to formulate strategies for the use of artificial intelligence in the field of electronic medical education. Therefore, the strategy was presented with an aggressive approach.

Keywords: artificial intelligence, e-learning, medicine, health and health, patient, SWOT

1. Introduction

With the passage of time and entering the field of information technology, many changes have occurred in various fields [1] One of the technologies that is growing and evolving at an increasing speed and has been able to influence all types of businesses in various fields and bring them along in a way is artificial intelligence. Artificial intelligence can be considered the biggest and most transformative technology of the current century, which has a very wide and unlimited capacity that has been able to influence various fields [2]. Artificial intelligence (AI) is a burgeoning field of study that emerged in the mid-20th century. This technology primarily utilizes computer systems to emulate human cognitive processes [3], While AI is primarily associated with computer science, it encompasses a broader scope, incorporating disciplines such as linguistics, psychology, philosophy, mathematics, and more. Since its inception in 1955, AI applications have witnessed remarkable growth, particularly in the rapidly evolving digital landscape driven by escalating public expectations, social media advancements, industrial leadership, and medical practitioners. In the educational realm, AI has made significant strides in addressing challenges related to language processing, reasoning, planning, and cognitive modeling over the past decade [2]

As the world transitions from the information age to the era of artificial intelligence (AI), the medical field is poised to undergo a profound transformation [3] AI technologies are rapidly advancing and have the potential to revolutionize diagnostic and therapeutic approaches, surgical procedures, drug discovery, and personalized medicine. This technological advancement holds immense promise for improving patient outcomes and enhancing healthcare delivery [4]. However, the rapid adoption of AI in medicine also raises ethical concerns regarding data privacy, the changing nature of the patient-doctor relationship, potential social disparities, and the possibility of AI robots replacing human professionals, leading to job displacement. Addressing these ethical considerations will be crucial as AI continues to integrate into the medical landscape, ensuring that its benefits are maximized while safeguarding the integrity of the healthcare system and the well-being of patients [5].

AI can be effectively employed in medical education through various avenues, including virtual question-answer systems, medical distance learning platforms, and the recording of instructional videos in medical institutions [6]. As AI applications continue to permeate the medical field, healthcare providers must ensure that these technologies are harnessed responsibly and effectively to enhance patient care. This responsibility necessitates that medical students acquire a thorough understanding of AI applications in medicine, preparing them to utilize these tools judiciously and ethically [7]. Medical education is a continuous lifelong learning journey that extends beyond undergraduate studies, encompassing postgraduate training, specialty certifications, and even ongoing professional development. This comprehensive approach applies to a diverse range of healthcare professionals, including physicians, nurses, and various allied health personnel. As technology rapidly evolves, it is imperative to build upon existing research and knowledge to advance the role of AI in medical education [8].

The World Medical Association and the Standing Committee of European Doctors both emphasize the need for AI education in medical curricula, recognizing its significance in preparing physicians for a future where AI is ubiquitous in healthcare settings [6]. However, several experts contend that current medical education structures are not adequately equipped to address the growing complexities of AI, advocating for a fundamental transformation in educational approaches. Developing specific curriculum proposals tailored to train future physicians on AI would be a valuable step in bridging the gap between medical education and the rapidly evolving landscape of AI-driven healthcare [1]. AI has the potential to elevate the non-analytical humanistic aspects of medicine, particularly in the face of the ever-expanding medical knowledge base [9], By handling the vast amount of digital data, AI can streamline diagnostic and problem-solving

processes, freeing healthcare professionals to focus on the critical judgment and empathy that define their profession [10].

In a globally interconnected healthcare environment, medical education must adapt to the changing landscape, including the digital revolution and the evolving needs of new generations of healthcare professionals [11], This transformation requires a collaborative effort from health institutions, accrediting bodies, and policymakers to ensure that medical training effectively prepares healthcare professionals for the challenges and opportunities of the digital age [12]. The adoption of artificial intelligence (AI) in medicine has gained momentum in the 21st century, raising concerns and challenges regarding privacy, ethical, legal, equity, and security issues [13]. Despite fears of AI replacing physicians, its diagnostic support in medical education is proving invaluable for early disease detection [14]. The integration of AI-powered decision support systems into medical education is fundamentally altering traditional medical curricula [15]. The rapid digitization of healthcare has driven a surge in AI tools and applications, fueled by the growing demand from medical educators, educational organizations, and industries within the medical field. However, despite this surge, there is a paucity of knowledge regarding the impact of AI on medical education [16]. A comprehensive investigation is necessary to understand the user experience and establish guidelines for AI integration in medical education. While some studies have explored the benefits and challenges of AI in medical education [17], curriculum review and assessment of student learning have received scant attention, primarily due to the lack of digitalization and the complex nature of examinations [18]. This study delves into the current utilization of AI in medical education, identifying gaps and outlining areas for future research. The findings will guide medical experts, educators, and policymakers in integrating AI into medicine to optimize healthcare training through the advancement of digital health concepts.

2. Methodology

Considering that the purpose of the current research is to identify and explain the capabilities of artificial intelligence in electronic medical education. According to the present research, it is useful in terms of purpose.÷ in the qualitative part of the developmental type and in the quantitative part; Applied and in terms of its nature, it is considered a descriptive-survey type of research. The collection tool in this research is a questionnaire, which has been used to prepare the questionnaire and compile the research literature using library methods, documents, interviews, internet, etc. It should be noted that, in this research, with the help of Shannon's entropy and using the experience and knowledge of experts in the desired field and considering the characteristics of the study area, appropriate factors have been determined and weighted. One of the advantages of this method is its simplicity and documentation. First, according to the results obtained from the knowledge and experience of experts and the use of available information, weight has been assigned to each of the factors. In this way, first the weights were calculated separately through expert knowledge and data, then the desired weight was determined by comparing the obtained values. As a result, the probability of mistakes will be reduced and the weights will be closer to reality. First step: We formed the decision matrix. Second step: We normalized the matrix. The third step: calculating the entropy of each index: the entropy Ej is calculated as follows:

K as a constant value, we have kept the value of Ej between 0 and 1.

$$E_j = -k \sum_{i=1}^{m} P_{ij} \times Ln_{ij} \qquad i = 1,2, \ldots . m$$

Step 4: Next, we calculated the degree of deviation, which indicates how much useful information the relevant index (dj) has provided to the decision maker. The closer the measured values of an index are to each other, it indicates that the competing options do not differ much from each other in terms of that index. Therefore, the role of that index in decision-making should be reduced to the same extent.

$$dj = 1 - Ej$$

Fifth step: Then the value of weight Wj is calculated and in fact the standard weight is equal to each dj divided by the sum of djs.

Table 1. SWOT matrix

Evaluation of internal and external factors	Strengths (S) List of aviation industry strengths	Weaknesses (W) List of weaknesses of the aviation industry
Opportunities (O) List of aviation industry opportunities	SO Strategies Take advantage of opportunities by leveraging strengths	WO strategies eliminate weaknesses by taking advantage of opportunities.
threats (T) List of threats to the aviation industry	ST Strategies Use strengths to avoid threats.	WT Strategies Minimize weaknesses and avoid threats.

This research includes the analysis of strengths, weaknesses, opportunities and environmental threats. The collection tool in this research is a questionnaire, which was used to set up the questionnaire and compile the research literature, considering that the techniques used are SWOT and IE (internal factors) from library methods, documents, documents, interviews, internet, etc. In this research, sampling was not done for the domestic and foreign expert community, a census was taken and the sample is the same community.

To review and analyze the strengths and weaknesses, opportunities and threats, the opinions of 25 managers, professors, experts and experts in the field of artificial intelligence have been used. Selected people in this field include people who have books, articles, authorships, translations in the field of aviation and artificial intelligence, and also have work experience as university professors, managers and consultants in terms of education and positions. - Postgraduate education in this field should be a field. First, a questionnaire designed during coordination was sent to the mentioned people in an open form via email, and after collecting the sent questionnaires, the contents were summarized based on the closest opinions. To reach a consensus, the questionnaire was sent and collected again, and this work continued until the desired result was obtained. According to the conditions of the research, in-depth interviews were also conducted with the expert community. After the finalization of the aforementioned dimensions and indicators, the knowledge, expertise and experiences of the expert community have been used in order to assign importance coefficients and weight them.

SO strategies:

In the form of these strategies, companies try to take advantage of external opportunities by using their internal strengths and maximize the opportunities by taking advantage of their strengths. Organizations usually use WO, ST and WT strategies to reach such a situation, so that they can use SO strategies.

WO strategies:

The purpose of these strategies is that the company tries to improve the internal weaknesses by taking advantage of the opportunities in the internal environment. In this case, the company cannot take advantage of these opportunities due to its internal weakness. Therefore, it is necessary to use strategies such as the use of new technologies, etc. in order to use the opportunities properly by eliminating the weak points.

ST strategies:

By implementing these strategies, companies try to reduce or eliminate the effects of existing threats by using their strengths.

WT strategies:

Organizations that use this strategy become defensive, and the purpose of this strategy is to reduce internal weaknesses and avoid threats from the external environment. In fact, in order to maintain its survival, such an organization tries to reduce its activities (downsizing or divestment strategies), merge with other companies, declare bankruptcy, or finally dissolve.

3. findings

At this stage, the internal factors of investigation and the weak and strong points related to artificial intelligence in the field of electronic medical education have been extracted (Table 2). In this research, each strength and weakness has been given a weight from 0 to 1, so that at the end, the sum of the coefficients of the internal factors is equal to 1, and a number has been given to each of the strengths and weaknesses. According to the importance of each one, according to experts, it is placed between 1 and 4.

4.1. Matrix of external factors of artificial intelligence in the aviation industry

To prepare the evaluation matrix of external factors (EEE), we first list the opportunities and threats and assign a weight coefficient between zero (unimportant) and one (very important) to each factor. In this case, the sum of assigned weight coefficients must be equal to one; This weight is calculated using the Shannon entropy technique. We give a score of 1 to 4 to each of these factors. A score of 1 indicates a serious threat, a score of 2 indicates a low threat, a score of 3 indicates an opportunity, and a score of 4 indicates an excellent opportunity. The ranking is based on coefficients and from 1 to 4; These numbers represent the capabilities of artificial intelligence in the aviation industry. These ranks are determined by the effectiveness of the capabilities.

Table 2. Matrix of external factors of artificial intelligence in the aviation industry

Row	Opportunity	Coefficient	rank	score
O1	Production of personalized educational content	0.08	4	0.094
O2	Monitor learning	0.06	4	0.113
O3	Provide immediate feedback	0.08	3	0.092
O4	Medical simulations	0.07	3	0.105
O5	Diagnosis	0.03	2	0.088
O6	Medical research	0.03	3	0.109
O7	Medical imaging analysis	0.05	4	0.092
O8	Reducing human error and providing timely diagnosis training	0.04	3	0.083

O9	Surgical training and robotic assistant without error	0.03	2	0.092
O10	Comprehension and production of pseudo-human text during training	0.04	3	0.113
O11	Assist in patient triage and symptom assessment	0.05	4	0.097
O12	Epilepsy diagnosis training and seizure monitor	0.04	4	0.103
O13	Teaching pulmonary function tests	0.03	3	0.098
O14	Education and assistance in predicting the risk of cardiovascular diseases	0.02	2	0.112
O15	Teaching diagnostic imaging in digestive problems	0.02	3	0.099
O16	Reducing education costs	0.08	2	0.107
O17	Increasing student-teacher interaction	0.06	2	0.083
O18	Providing medical, nutritional and sports advice	0.08	1	0.084
Row	**Threats**	**Coefficient**	**rank**	**score**
T1	Risk of data errors and defects	0.03	3	0.043
T2	Risks to data privacy	0.02	3	0.072
T3	Resistance to the adoption of artificial intelligence	0.03	2	0.062
T4	Destructive social and psychological effects on the Professors and doctors	0.02	2	0.051
T5	Legal and regulatory challenges	0.02	2	0.065
T6	Hard access to artificial intelligence	0.01	2	0.044
T7	Changing the role of teachers and reducing their need	0.03	1	0.031
T8	AI can be affected by human biases	0.02	1	0.083
T9	AI is still a developing technology and may not always be accurate	0.02	1	0.042
T10	The role of ethics in the application of artificial intelligence in medical education is not yet clearly defined	0.03	1	0.072
T11	The limitation of artificial intelligence operational field and the necessity of its integration	0.01	1	0.035
T12	Unfair access to artificial intelligence	0.03	1	0.063
T13	Artificial intelligence can make traditional methods of medical education ineffective	0.02		0.042
	total	**1**		**2.469**

Matrix of internal factors of artificial intelligence in the aviation industry

Internal or internal environmental factors are factors that are inside the organization and can be controlled by the organization. Strategists try to capitalize on internal strengths (strengthen them) and eliminate weaknesses. After examining the internal factors, the known and important factors were listed according to the discretion of the experts, and the weight coefficients were determined by their consensus, which have a total of one. These coefficients range from zero (unimportant) to 1 (very important), which indicates the relative importance of a factor in terms of the success of the relevant organization in that factor. The ranking is based on coefficients and from 1 to 4.

Table 3. Matrix of internal factors of artificial intelligence in the aviation industry

Row	Strengths	Coefficient	rank	score
S1	AI can be used to automate training	0.07	4	0.099
S2	AI can be used to provide medical training in remote or sparsely populated areas.	0.06	4	0.102
S3	Optimization of electronic medical education	0.04	3	0.113
S4	Adding new features in medical education	0.04	3	0.107
S5	identifying fraudulent activities and malicious behaviors	0.03	2	0.113
S6	Training doctors to identify measures to reduce the risk of disease.	0.03		0.093
S7	Training and providing new solutions to provide services to disabled people virtually	0.05	3	0.109
S8	The use of new technologies in the field of pharmaceuticals	0.04	4	0.113
S9	Patient education and empowerment	0.04	3	0.097
S10	It can be used to communicate with and teach people who speak another language	0.03	2	0.103
S11	Simplify clinical documentation and note-taking	0.05	3	0.117
S12	Remote health monitoring and care	0.04	4	0.103
S13	Training and use of surgeon and robotic assistant	0.03	4	0.098
S14	Reducing errors and increasing speed in training	0.05	3	0.122
S15	Artificial intelligence can reduce costs throughout the medical and healthcare industry	0.04	2	0.099
Row	**Weakness**	**Coefficient**	**rank**	**score**
W1	Need for expensive infrastructure	0.04	3	0.072
W2	Poorly designed systems can lead to medical misdiagnosis.	0.03	3	0.062
W3	Software that operates on datasets laced with cultural biases multiplies these flaws.	0.03	2	0.051
W4	Once they start interacting with unpredictable humans, they can create unintended consequences	0.03	3	0.065
W5	Only able to perform planned and one-dimensional tasks	0.02	2	0.044
W6	The possibility of hacking and cyber attacks on the program	0.02	3	0.031
W7	The need for teaching and learning by humans	0.03	2	0.083
W8	Substitute jobs and increase unemployment (in few cases)	0.02	2	0.042
W9	Unknown bias in the data on which the system is trained	0.02	1	0.072
W10	Decision making based on "black box" algorithms.	0.03	1	0.035
W11	The use of artificial intelligence raises ethical concerns	0.01	2	0.023
W12	it is a technology based on pre-loaded facts and experience.	0.03	1	0.052
W13	works based on algorithms that cannot be understood	0.02	2	0.049
W14	Educational data can have human biases	0.03	1	0.047
	total	1		2.316

The factor evaluation matrix was used to determine the strategy that was chosen. This matrix considers the strengths, weaknesses, opportunities, and threats (SWOT) of artificial intelligence (AI). The final score for each factor is calculated based on its rank and score coefficient. The SWOT matrix allows for the creation of four different strategic options: defensive, adaptive, contingent, and offensive. These strategies are based on a combination of the internal and external factors affecting AI. In practice, different strategies may overlap or be implemented together. Given the current state of AI capabilities, four categories of strategies can be identified, each with a different level of activity.

Strategic analysis is a very important step in the strategic planning process. At this stage, the position of the organization is evaluated according to the strengths and weaknesses it has in its internal environment and the opportunities and threats it faces in the external environment. There are three basic steps in analyzing these factors:

1-Evaluation of the key factors influencing the mission and realization of the organization's vision that can be identified within the system. (weaknesses - strengths)

2-Evaluation of the key and influencing factors on the realization of the organization's mission and vision that exists in its external environment. (opportunities - threats)

3- Situation evaluation and strategic action.

4.2. Internal and external matrix

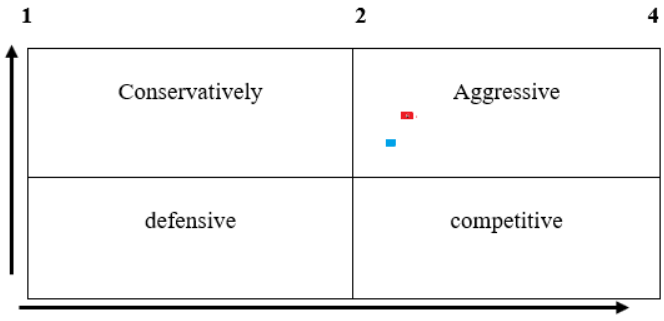
For the simultaneous analysis of internal and external factors, the internal and external matrix is used so that the scores obtained from internal and external factors are used. The grades obtained from the evaluation of internal factors (IFE) are written in the horizontal dimension and the grades obtained from the evaluation of external factors (EFE) are written in the vertical dimension.

In the square matrix, these scores are classified in a two-part spectrum, strong (2.5 to 4) and weak (1 to 5.2). growth and development), if it is in the second house, a conservative strategy (maintenance and external support) and if it is in the third house, a defensive strategy, and finally, if it is in the fourth house, a competitive strategy is recommended.

By using the IE matrix and placing the scores of the evaluation matrices of internal and external factors on it, the strategic position in the first region was determined as follows, and the competitive strategies (SO) will be selected accordingly.

Evaluation of internal factors (IFE): 2.469

Evaluation of external factors (EFE): 2.316



Since the area marked with red and blue colors is the aggressive strategy area, we will continue to present aggressive strategies in the internal and external environment.

- Production of personalized educational content

AI can be used to create personalized learning content for each student. This is done by analyzing data about each student's performance, preferences, and needs. For example, AI can be used to identify students who are struggling with a particular subject and then provide additional learning content or practice exercises to help them.

- Monitor learning

AI can be used to monitor student learning in real time. This is done by analyzing data related to students' learning activities, such as time spent studying, questions asked, and test results. For example, AI can be used to identify students who are at risk of failing and then provide intervention measures to help them.

- Provide immediate feedback

AI can be used to provide students with instant feedback on their performance. This is done by analyzing data from students' responses to questions, assignments, or projects. For example, AI can be used to provide detailed explanations of students' incorrect answers.

- Medical simulations

AI can be used to create interactive medical simulations. These simulations can help students practice their skills in a safe and controlled environment. For example, AI can be used to create surgical simulations that allow students to practice surgical procedures without risk to the patient.

- Diagnosis

AI is already being used to diagnose disease in medical images, such as X-rays, CT scans, and MRIs. This technology can help doctors make more accurate diagnoses faster and at a lower cost.

- Medical research

AI is being used to accelerate medical research. This technology can be used to analyze big data, such as genomic data and clinical data. This can help researchers identify patterns and relationships that were previously undetectable.

Applications of artificial intelligence in medical e-learning are developing. As technology advances, AI can play an increasing role in medical education.

- Inaccessibility

AI can be an expensive technology, so it may not be available to all medical students. This can lead to inequality in medical education.

- inaccuracy

AI is still a developing technology and may not always be accurate. This can lead to misdiagnoses or inappropriate treatments.

- unfairness

AI can be affected by human biases. This can lead to discrimination against some medical students.

- Change in the role of teachers

AI can automate some of the tasks of teachers. This can lead to a change in the role of teachers and reduce the need for them.

4. Conclusion

Integrating medical AI into clinicians' workflows can provide valuable context as providers make decisions about care. A trained machine learning algorithm can help reduce research time by providing clinicians with valuable search results with evidence-based insights into treatments and procedures while the patient is still in the room with them [6]. There is evidence that AI can help improve patient safety. A recent systematic review of 53 reviewed studies examining the impact of AI on patient safety found that AI-based decision support tools can help improve diagnosis and medication management [11].

There are many potential ways that AI can reduce costs across the healthcare industry. Some of the most promising opportunities include: Reduce medication errors, virtual health aids and support more efficient clinical and administrative workflow.

Many doctors and patients think of questions outside of normal business hours. AI can help provide round-the-clock support through chatbots that can answer basic questions and provide resources to patients when their doctor's office isn't open. AI can also potentially be used to triage (clinical prioritization) questions and flag information for further investigation, which can alert health providers to health changes that require further attention. One of the main advantages of deep learning is that AI algorithms can use the patient's prior context to distinguish between different types of information. For example, if a clinical note includes a list of a patient's current medications along with a new medication their doctor recommends, a trained AI algorithm can use natural language processing to identify which medications belong in the patient's medical history. In the future, doctors will need many skills to properly use artificial intelligence in their work; In addition to understanding medical principles, sufficient knowledge in mathematical concepts, principles of artificial intelligence, data science, and related ethical and legal issues will be required. These skills will help doctors take advantage of data from different sources, monitor AI-based tools, and identify cases where algorithms may not be accurate enough. In addition, communication skills, leadership and emotional intelligence will be of double importance.

AI can be used to create personalized learning content for each student. This is done by analyzing data about each student's performance, preferences, and needs. For example, AI can be used to identify students who are struggling with a particular subject and then provide additional learning content or practice exercises to help them.

AI can be used to monitor student learning in real time. This is done by analyzing data related to students' learning activities, such as time spent studying, questions asked, and test results. For example, AI can be used to identify students who are at risk of failure and then provide intervention measures to help them. AI can be used to provide students with immediate feedback on their performance. This is done by analyzing data from students' responses to questions, assignments, or projects. For example, AI can be used to provide detailed explanations of students' incorrect answers.

AI can be used to create interactive medical simulations. These simulations can help students practice their skills in a safe and controlled environment. For example, AI can be used to create surgical simulations that allow students to practice surgical procedures without risk to the patient. AI is already being used to diagnose disease in medical images, such as X-rays, CT scans, and MRIs. This technology can help doctors make more accurate diagnoses faster and at a lower cost. AI is being used to accelerate medical research. This technology can be used to analyze big data, such as genomic data and clinical data. This can help researchers identify patterns and relationships that were previously undetectable.

Harvard University is using artificial intelligence to create an e-learning program that helps medical students develop their communication skills [3]. Stanford University is using artificial intelligence to create an e-learning program that helps medical students learn about skin disease diagnosis [9]. The University of Maryland Medical Center is using artificial intelligence to create an e-learning program that helps medical students learn about open heart surgery [13]. Considering the potential benefits of artificial intelligence in medical education, it is expected that this technology will play an increasing role in this field in the coming years.

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