ORIGINAL ARTICLE

Using Generative AI to create clinical scenarios to improve diagnostic capabilities in specialized consultation for medical students

Morteza Malmir[1,*]
[1]Department of Psychology, Faculty of Literature and Humanities, University of Malayer, Malayer, Iran
[*]University of Malayer, Kilometer 4, Malayer–Arak Road Malayer, 6574184621 Iran
Tel: +989371521925
Email: morteza.malmir@ut.ac.ir

Background: Given the growing importance of artificial intelligence (AI) in various fields and the necessity of its integration into education, this study was designed with the aim of using Generative AI to create clinical scenarios to improve diagnostic competency in clinical counseling for medical students.

Method: This study was a quasi-experimental design. Forty students from Tehran University of Medical Sciences and Iran university of Medical Sciences were conveniently selected and randomly assigned to either an experimental or a control group. The experimental group used AI-based counseling scenarios for 24 days, while the control group received traditional training. The students' diagnostic abilities were measured in terms of accuracy, speed, and differentiation before and after the intervention using a validated and reliable smart tool. All analyses were performed with SPSS 24 software.

Results: Based on the study's findings, using Generative AI to create clinical scenarios significantly improved the diagnostic competency of medical students. This novel educational approach was more effective than the traditional method across all dimensions examined, including correct diagnosis ($F_{1,38}=8.81, P<0.001$), diagnostic speed ($F_{1,38}=5.49, P<0.001$), differentiation ability ($F_{1,38}=6.22, P<0.001$), and overall diagnostic competency ($F_{1,38}=13.44, P<0.001$).

Conclusion: The use of Generative AI is an effective strategy for improving diagnostic competency in clinical counseling for medical students.

Key Words: Artificial Intelligence, Clinical Competence, Diagnosis, Reaction Time, Education, Medical

استخدام الذكاء الاصطناعي التوليدي لإنشاء سيناريوهات سريرية لتحسين القدرات التشخيصية في الاستشارات المتخصصة لطلاب الطب

الخلفية: نظرًا للأهمية المتزايدة للذكاء الاصطناعي في مختلف المجالات وضرورة دمجه في التعليم، تم تصميم هذه الدراسة بهدف استخدام الذكاء الاصطناعي التوليدي لإنشاء سيناريوهات سريرية لتحسين الكفاءة التشخيصية في الاستشارة السريرية لطلاب الطب.

الطريقة: اعتمدت هذه الدراسة تصميمًا شبه تجريبي. اختير أربعون طالبًا من جامعة طهران للعلوم الطبية وجامعة إيران للعلوم الطبية، ووُزّعوا عشوائيًا على مجموعتين: تجريبية وضابطة. استخدمت المجموعة التجريبية سيناريوهات إرشادية قائمة على الذكاء الاصطناعي لمدة ٢٤ يومًا، بينما تلقت المجموعة الضابطة تدريبًا تقليديًا. قُيست قدرات الطلاب التشخيصية من حيث الدقة والسرعة والتمييز قبل وبعد التدخل باستخدام أداة ذكية مُعتمدة وموثوقة. أُجريت جميع التحليلات باستخدام برنامج SPSS 24.

النتائج: بناءً على نتائج الدراسة، أدى استخدام الذكاء الاصطناعي التوليدي لإنشاء سيناريوهات سريرية إلى تحسين كفاءة التشخيص لدى طلاب الطب بشكل ملحوظ. كان هذا النهج التعليمي المبتكر أكثر فعالية من الطريقة التقليدية في جميع الأبعاد المدروسة، بما في ذلك التشخيص الصحيح ($F_{1,38}=8.81, P<0.001$)، وسرعة التشخيص ($F_{1,38}=5.49, P<0.001$)، والقدرة على التمييز ($F_{1,38}=6.22, P<0.001$)، والكفاءة التشخيصية الكلية ($F_{1,38}=13.44, P<0.001$).

الخلاصة: يُعد استخدام الذكاء الاصطناعي التوليدي استراتيجية فعّالة لتحسين الكفاءة التشخيصية في الإرشاد السريري لطلاب الطب.

الكلمات المفتاحية: الذكاء الاصطناعي، الكفاءة السريرية، التشخيص، زمن الاستجابة، التعليم، الطب

استفاده از هوش مصنوعی مولد (Generative AI) برای ایجاد سناریوهای بالینی در جهت بهبود توانمندی تشخیصی در زمینه مشاوره تخصصی در دانشجویان علوم پزشکی

زمینه و هدف: با توجه به اهمیت روز افزون هوش مصنوعی در زمینه¬های مختلف و ضرورت بکارگیری آن در آموزش این پژوهش با هدف استفاده از هوش مصنوعی مولد (Generative AI) برای ایجاد سناریوهای بالینی در جهت بهبود توانمندی تشخیصی در زمینه مشاوره تخصصی در دانشجویان علوم پزشکی شکل گرفت.

روش: این پژوهش از انواع مطالعات نیمه‌آزمایشی بود. در این مطالعه، ۴۰ دانشجو از دانشگاه¬ علوم پزشکی تهران و دانشگاه علوم پزشکی ایران در سال ۱۴۰۴ به صورت در دسترس انتخاب و بصورت تصادفی در دو گروه آزمایش و کنترل قرار گرفتند. گروه آزمایش به مدت ۲۴ روز از سناریوهای مشاوره مبتنی بر هوش مصنوعی بهره برد، در حالی که گروه کنترل آموزش‌های سنتی را دریافت کرد. توانایی تشخیصی دانشجویان در ابعاد دقت، سرعت و تفکیک قبل و بعد از مداخله با ابزار هوشمند که روائی و پایایی آن تایید شده بود، سنجیده شد. کلیه تحلیل¬ها با نرم افزار SPSS24 انجام شد.

یافته‌ها: بر اساس یافته‌های پژوهش، استفاده از هوش مصنوعی مولد برای ایجاد سناریوهای بالینی به طور معناداری باعث بهبود توانمندی تشخیصی دانشجویان علوم پزشکی می‌شود. این رویکرد نوین آموزشی در مقایسه با روش سنتی، در تمام ابعاد مورد بررسی شامل تشخیص صحیح ($F_{1,38}=8.81, P<0.001$)، سرعت تشخیص ($F_{1,38}=5.49, P<0.001$)، توانایی تفکیک ($F_{1,38}=6.22, P<0.001$)، و توانایی تشخیصی کلی ($F_{1,38}=13.44, P<0.001$) اثربخش بوده است.

نتیجه گیری: استفاده از هوش مصنوعی مولد راهکاری کارآمد در جهت بهبود توانمندی تشخیصی در زمینه مشاوره تخصصی در دانشجویان علوم پزشکی است.

واژه های کلیدی: هوش مصنوعی، توانمندی تشخیصی، سرعت تشخیص، آموزش پزشکی

طبی طلباء کے لیے خصوصی مشاورت میں تشخیصی صلاحیتوں کو بہتر بنانے کے لیے طبی منظرنامے بنانے کے لیے جنریٹو AI کا استعمال

پس منظر: مختلف شعبوں میں مصنوعی ذہانت (AI) کی بڑھتی ہوئی اہمیت اور تعلیم میں اس کے انضمام کی ضرورت کو دیکھتے ہوئے، یہ مطالعہ جنریٹیو AI کا استعمال کرتے ہوئے طبی طلباء کے لیے طبی مشاورت میں تشخیصی قابلیت کو بہتر بنانے کے لیے طبی منظرنامے بنانے کے لیے ڈیزائن کیا گیا تھا۔

طریقہ: یہ مطالعہ ایک نیم تجرباتی ڈیزائن تھا۔ تہران یونیورسٹی آف میڈیکل سائنسز اور ایران یونیورسٹی آف میڈیکل سائنسز کے چالیس طلباء کو آسانی کے ساتھ منتخب کیا گیا اور تصادفی طور پر یا تو تجرباتی یا کنٹرول گروپ کو تفویض کیا گیا۔ تجرباتی گروپ نے ۲۳ دنوں تک AI پر مبنی مشاورت کے منظرنامے استعمال کیے، جبکہ کنٹرول گروپ نے روایتی تربیت حاصل کی۔ طلباء کی تشخیصی صلاحیتوں کو درستگی، رفتار، اور مداخلت سے پہلے اور بعد میں ایک توثیق شدہ اور قابل اعتماد سمارٹ ٹول کا استعمال کرتے ہوئے ناپا گیا۔ تمام تجزیے SPSS 24 سافٹ ویئر کے ساتھ کیے گئے تھے۔

نتائج: مطالعہ کے نتائج کی بنیاد پر، طبی منظرنامے بنانے کے لیے جنریٹو اے آئی کے استعمال سے طبی طلباء کی تشخیصی قابلیت میں نمایاں بہتری آئی۔ یہ نیا تعلیمی نقطہ نظر جانچے گئے تمام جہتوں میں روایتی طریقہ سے زیادہ موثر تھا، بشمول درست تشخیص ($F_{1,38}=8.81, P<0.001$)، تشخیصی رفتار ($F_{1,38}=5.49, P<0.001$)، تفریق کی اہلیت ($F_{1,38}=6.22, P<0.0001$)، مجموعی طور پر ($F_{1,38}=13.44, P<0.001$)۔

نتیجہ: جنریٹو اے آئی کا استعمال طبی طلباء کے لیے طبی مشاورت میں تشخیصی قابلیت کو بہتر بنانے کے لیے ایک موثر حکمت عملی ہے۔

کلیدی الفاظ: مصنوعی ذہانت، طبی قابلیت، تشخیص، رد عمل کا وقت، تعلیم، طبی

INTRODUCTION

Artificial intelligence (AI) is increasingly applied across diverse domains, including healthcare, where it holds the potential to reshape clinical decision-making and optimize operational efficiency (1). While AI is commonly defined as "a set of technologies that mimic human intelligence functions and expressions, particularly cognition, reasoning, learning, adaptation, and creativity" (2), this definition alone overlooks critical nuances in how these technologies interact with complex clinical environments. Among AI paradigms, Generative AI has recently gained prominence for its capacity to produce novel outputs—including text, images, and structured data—derived from patterns learned in extensive datasets (3). Unlike conventional AI models that primarily classify or predict based on existing data, Generative AI introduces the capability to simulate hypothetical clinical scenarios, thereby offering potential pedagogical advantages for training purposes. This distinction is crucial, as it situates Generative AI not merely as an analytical tool but as an active facilitator of experiential learning, bridging gaps between theoretical knowledge and practical clinical reasoning (1).

Generative AI's potential to analyze extensive datasets and provide predictive or synthetic insights positions it as a transformative technology in healthcare, yet its integration raises several critical considerations (4, 5). For instance, while models can generate realistic clinical scenarios, their outputs are inherently dependent on the scope and quality of training data, which introduces the risk of bias, overfitting to specific population characteristics, or misrepresentation of rare conditions (6, 7). Moreover, although Generative AI can enhance efficiency and diagnostic accuracy, its effectiveness in cultivating higher-order cognitive skills such as differential diagnosis, contextual reasoning, and ethical decision-making remains under-explored (8). These limitations underscore that the adoption of Generative AI in medical education should not be perceived as a replacement for conventional mentorship or clinical experience but as a complementary scaffold that requires careful validation and contextual integration (9, 10).

Within psychology and psychiatry, clinical decision-making involves a complex interplay of biomedical knowledge, experiential insight, and context-sensitive judgment, all of which develop through sustained practice, reflection, and supervision (11–15). Conventional instructional methods, such as textbook-based learning or static case studies, may inadequately simulate the variability and dynamism of real clinical encounters. Generative AI, by contrast, offers the ability to dynamically generate diverse and interactive scenarios, potentially enhancing students' exposure to rare or complex cases that they might not encounter during standard clinical rotations. However, the efficacy of such simulations in truly improving diagnostic reasoning, speed, and accuracy has yet to be empirically validated, creating a clear research gap. This study seeks to critically examine this gap by leveraging Generative AI to create specialized clinical scenarios for medical students in psychology and psychiatry. By focusing on operational competencies and diagnostic decision-making under realistic and interactive conditions, the study aims to move beyond descriptive assessments of AI capabilities and provide empirical evidence regarding the pedagogical impact of Generative AI. Ultimately, this research interrogates not only the potential benefits of AI-driven simulation but also the conditions under which such tools can be reliably integrated into medical education, highlighting both their transformative promise and their current limitations (9, 10).

METHODS

This interventional study adopted a quasi-experimental design involving graduate students of clinical psychology from medical universities who voluntarily participated in a virtually delivered curriculum developed using Generative Artificial Intelligence (AI). Forty eligible students (aged 22–32 years) from Tehran University of Medical Sciences and Iran University of Medical Sciences in 2025, who had no acute physical or mental disorders, no prior independent professional experience as psychologists, and expressed willingness to participate, were recruited through convenience sampling. Following initial homogenization based on variables such as university affiliation, grade point average (GPA), and other controllable factors, participants were randomly assigned to either the experimental or control group. In quasi-experimental research utilizing analysis of covariance (ANCOVA), an adequate sample size is essential to maintain statistical power. Methodological guidelines recommend a minimum of 15–20 participants per group to achieve a power of 0.80 at an alpha level of 0.05 with a medium effect size ($\eta^2 = 0.25$) (16,17). In line with these recommendations and consistent with prior studies in educational and clinical psychology (18,19), the inclusion of 20 participants per group in the present study ensured sufficient statistical power while addressing the practical constraints inherent to virtual learning environments.

The study was conducted in strict accordance with the ethical principles outlined in the Declaration of Helsinki, ensuring that all participants provided informed consent and that their rights, privacy, and

well-being were fully protected throughout the research process (20). Diagnostic ability was evaluated using a smart assessment tool specifically designed to measure three distinct dimensions of clinical reasoning: diagnostic accuracy, diagnostic speed, and diagnostic discrimination ability. Each dimension included five items rated on a 10-point Likert scale, allowing for granular assessment of individual performance across multiple facets of diagnostic competence. The tool was administered both prior to and following the intervention to capture pre- and post-intervention performance and enable a precise measurement of changes in diagnostic ability attributable to the educational program.

The validity of the assessment instrument was established through a rigorous multi-step process. Content validity was ensured by a panel of ten domain experts who systematically reviewed each item for relevance, clarity, and representativeness of the underlying constructs. Experts evaluated whether the items adequately reflected key components of clinical diagnostic reasoning, including rapid information processing, accuracy of clinical judgments, and the ability to discriminate between similar clinical presentations. Criterion validity was additionally confirmed by correlating tool scores with established benchmarks in clinical performance, providing evidence that higher scores corresponded to objectively better diagnostic outcomes (21). The instrument's internal consistency was assessed using Cronbach's alpha, yielding coefficients of 0.881 for the total scale and 0.794, 0.838, and 0.807 for the subscales of diagnostic speed, accuracy, and discrimination, respectively. These coefficients indicate strong reliability, suggesting that the tool consistently measures the intended constructs across participants and time points, thereby supporting both the precision and robustness of the diagnostic assessments in the context of this study

The intervention lasted for 24 consecutive days. The experimental group engaged daily with five AI-generated clinical counseling scenarios, while the control group received traditional instruction, including theoretical orientation to diagnostic processes, textbook-based learning, and familiarization with diagnostic criteria for mental disorders. Upon completion, both groups were reassessed using the same standardized instrument to evaluate post-intervention changes in diagnostic competency

RESULTS

The normality of the data distribution was first examined (table 1).

Given that the significance level (P) is greater than 0.05, the null hypothesis is rejected, the sample distribution is considered normal, and parametric testing is permissible. For the assumptions of covariance analysis, the first step involved checking the M-Box test results. The M-Box statistic was 11.86, with a P-value of 0.811 and a significance level of 0.643. Since the significance level (0.643) is greater than 0.001, the assumption of homogeneity of covariance matrices holds, and an analysis of covariance (ANCOVA) can be used.

To satisfy the condition of homogeneity of variances, the significance value for each component must be greater than 0.05. According to Table 2, this condition was met for all sub-categories. Additionally, the interaction between the experimental and control groups was not significant at the 0.05 level, as the significance level in each case was greater than 0.05. Therefore, the assumption of homogeneity of regression slopes was met, allowing for the use of ANCOVA.

The results in Table 3 indicate a significant difference between the pre-test and post-test scores of the experimental and control groups in terms of correct diagnosis, diagnostic speed, and differentiation ability at the $P<0.001$ level. This suggests that there was a significant difference between the two groups on at least one of the dependent variables.

The results of the Analysis of Covariance (ANCOVA) demonstrate that using Generative AI to create clinical scenarios significantly improves the diagnostic competency of medical students compared to traditional training (table 4). This effectiveness was observed across all examined dimensions: correct diagnosis ($F=8.81, P<0.001$), diagnostic speed ($F=5.49, P<0.001$), differentiation ability ($F=6.22, P<0.001$), and overall diagnostic competency ($F=13.44, P<0.001$). The high F-statistics and significance levels ($P<0.001$) in all cases indicate a statistically significant difference between the group trained with AI and the control group.

Furthermore, the R2 values show that this educational method makes a significant contribution to improving students' diagnostic skills. The greatest impact was observed on overall diagnostic competency, with an R2 of 0.56, meaning that 56% of the variance in overall diagnostic competency can be attributed to the training with Generative AI. The R2 values for correct diagnosis, differentiation ability, and diagnostic speed were 0.48, 0.37, and 0.34, respectively. These findings clearly indicate that training with clinical scenarios generated by Generative AI is a highly effective and efficient method for developing key skills in medical students and can be adopted as a novel educational approach.

DISCUSSION

Emerging electronic technologies have significantly transformed traditional teaching methods, introducing innovative approaches to

Table 1. Shapiro-Wilk Test

Component		Group	Statistic	Significance
Correct Diagnosis	Post-test	Experimental	0.811	0.186
		Control	0.933	0.569
Diagnostic Speed	Post-test	Experimental	0.824	0.199
		Control	0.835	0.216
Differentiation Ability	Post-test	Experimental	0.956	0.608
		Control	0.892	0.411
Overall Diagnostic Competency	Post-test	Experimental	0.978	0.794
		Control	0.945	0.561

Table 2. Levene's and Tests of Between-Subjects Effects

	Levene's Test		Tests of Between-Subjects Effects	
Components	Statistic	Sig.	Statistic	Sig.
Correct Diagnosis	1.121	0.102	1.15	0.082
Diagnostic Speed	0.908	0.554	1.04	0.142
Differentiation Ability	1.046	0.239	1.09	0.106

Table 3. Results of Multivariate Analysis of Covariance on Post-test Mean Scores for Correct Diagnosis, Diagnostic Speed, and Differentiation Ability in Experimental and Control Groups, with Pre-test as a Covariate.

Test Name	Value	F	P-value
Pillai's Trace	0.576	13.87	0.001
Wilks' Lambda	0.701	13.87	0.001
Hotelling's Trace	1.08	13.87	0.001
Roy's Largest Root	1.08	13.87	0.001

enhance educational effectiveness (22). Among these advancements, artificial intelligence (AI) stands out as a powerful tool capable of driving substantial improvements in diagnostic and clinical systems (23). AI continues to evolve rapidly, with Generative AI representing a particularly notable progression (24). This technology has emerged as a transformative force, offering a unique capacity to generate new data—from visual content to complex molecular structures—thus extending both the creative potential of AI and its ability to tackle intricate challenges previously considered insurmountable (25-27). AI has already facilitated groundbreaking developments in critical areas such as drug discovery, patient diagnosis, and the personalization of treatment strategies, paving the way for a new era of individualized medicine (28-30). Successfully integrating Generative AI into clinical research represents a major advancement that redefines conventional processes (24). Accordingly, the present study aimed to explore its application specifically within the fields of psychology and psychiatry.

Table 4. ANCOVA of the Effectiveness of Using Generative AI to Create Clinical Scenarios for Improving Diagnostic Competency in Clinical Counseling for Medical Students

	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level	Explained R2
Correct Diagnosis	881.37	1	881.37	8.81	0.001	0.48
Diagnostic Speed	443.42	1	443.42	5.49	0.001	0.34
Differentiation Ability	569.87	1	569.87	6.22	0.001	0.37
Overall Diagnostic Competency	1215.41	1	1215.41	13.44	0.001	0.56

The findings of this study demonstrate the significant impact of Generative AI on enhancing the diagnostic competency of medical students. ANCOVA analysis revealed statistically meaningful differences across all assessed dimensions—correct diagnosis, diagnostic speed, differentiation ability, and overall diagnostic competency—between the experimental group, which utilized Generative AI, and the control group, which followed traditional training. Notably, overall diagnostic competency exhibited the greatest improvement in the experimental group ($R^2 = 0.56$), indicating that more than half of the positive change in students' diagnostic performance can be attributed to this technology. These results highlight the superiority of this innovative educational approach compared to conventional methods.

Moreover, the study's outcomes align with a broad spectrum of recent research on AI's potential in medical education and the enhancement of clinical processes. For instance, Preiksaitis et al. (2023) emphasized Generative AI's role in transforming learning, while Reddy (2024) identified it as a powerful means to improve accuracy and efficiency in clinical workflows. These findings suggest that Generative AI has progressed from a supplementary tool to a core educational methodology. This study further substantiates these conclusions by focusing on specialized counseling and psychology, addressing a research gap in applying AI to develop dynamic, realistic clinical scenarios.

The effectiveness observed in this research can be attributed to the distinctive characteristics and capabilities of Generative AI. Unlike traditional training, which relies on static and limited resources such as textbooks, the AI-based system can generate a virtually limitless array of complex and varied clinical scenarios. This diversity exposes students to a wide spectrum of real-world conditions that are otherwise inaccessible in conventional educational settings, thereby directly enhancing clinical reasoning and critical thinking skills. Additionally, AI's ability to deliver immediate, personalized feedback enables students to promptly recognize and correct errors, reinforcing learning in an interactive and engaging manner. Such an approach is particularly effective in improving diagnostic speed and differentiation ability. By providing a dynamic and realistic learning environment, Generative AI extends beyond traditional methods, equipping students to navigate complex clinical challenges with greater competence.

LIMITATIONS

This study has some limitations that should be considered. The small sample size and convenience sampling restrict the generalizability of the findings. In addition, the short 24-day intervention reflects only short-term outcomes, and the persistence of effects over time is unknown. The diagnostic assessment tool, while useful, has not been fully validated across broader samples, which may affect accuracy. Finally, the virtual nature of the intervention does not fully capture the complexities of real clinical settings. Future studies with larger samples, longer follow-ups, and more comprehensive evaluation methods are recommended.

CONCLUSION

The present study indicates that using Generative AI to create clinical scenarios is effective for improving diagnostic competency in clinical counseling for medical students, and it can be used in academic training.

Ethical Considerations

Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors.

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