Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Frequency and purpose of artificial intelligence tool use and their associations with academic motivation and self-efficacy among medical students: a cross-sectional study

Mohammad Saeid Moeinfar
Mashhad University of Medical Sciences
Hossein Karimi Moonaghi
KarimiH@mums.ac.ir
Mashhad University of Medical Sciences
Nazila Zarghi
Mashhad University of Medical Sciences
Saeed Akhlaghi
Mashhad University of Medical Sciences

Research Article

Keywords: Artificial Intelligence, Medical Students, Motivation, Self-Efficacy, Cross-Sectional Studies, Medical Education

Posted Date: November 10th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11242207/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Frequency and purpose of artificial intelligence tool use and their associations with academic motivation and self-efficacy among medical students: a cross-sectional study

Mohammad Saeid Moeinfar[1,2], Hossein Karimi Moonaghi[3*], Nazila Zarghi[1,4], Saeed Akhlaghi[5,6]

[1] Department of Medical Education, Mashhad University of Medical Sciences, Mashhad, Iran

[2] Student Research Committee, School of Medicine, Kashan University of Medical Sciences, Kashan, Iran

[3] Medical Sciences Education Research Center, and Nursing and Midwifery Care Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

[4] Medical Sciences Education Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

[5] Department of Biostatistics, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran

[6] Social Determinants of Health Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

***Corresponding author:** Hossein Karimi Moonaghi, KarimiH@mums.ac.ir

Abstract

Background: Artificial intelligence (AI) tools are increasingly used by medical students for academic purposes, yet how patterns of such use relate to academic motivation and self-efficacy remain insufficiently characterized, particularly in the Iranian medical education context. This study examined the frequency and purpose of AI tool use among medical students and their associations with academic motivation and academic self-efficacy.

Methods: A descriptive-analytical cross-sectional study was conducted among medical students at Kashan University of Medical Sciences, Iran, in 2026. Using proportionate stratified sampling across four educational stages, 111 students completed a questionnaire package comprising a researcher-developed AI-use instrument (separate frequency and purpose scores), the Persian Academic Motivation Scale, and the Persian College Academic Self-Efficacy Scale. Associations between the two AI-use scores and five outcomes (self-efficacy, intrinsic motivation, extrinsic motivation, amotivation, and composite positive motivation) were examined using Spearman correlation with Bonferroni correction, followed by five multiple linear regression models adjusting for age, sex, educational stage, and GPA.

Results: Conversational AI tools, most notably ChatGPT, were used by nearly all participants. Both AI-use frequency and purpose were positively correlated with academic self-efficacy, intrinsic motivation, extrinsic motivation, and positive motivation, and negatively correlated with amotivation (Spearman $\rho = 0.46–0.77$; all $p < 0.001$, surviving Bonferroni correction). In adjusted models, AI-use purpose remained independently associated with all five outcomes (standardized $\beta = 0.32–0.69$), whereas AI-use frequency remained independently associated only with self-efficacy ($\beta = 0.55$, $p < 0.001$). GPA was independently associated with intrinsic motivation, extrinsic motivation, and positive motivation, but not self-efficacy or amotivation. No significant

differences by sex or educational stage were observed. The five models explained 40% to 61% of outcome variance.

Conclusions: The purpose for which medical students use AI tools showed more consistent independent associations with academic motivation and self-efficacy than frequency of use alone, suggesting that how AI is used may be more relevant to these outcomes than how often it is used. As an observational, cross-sectional study, these findings describe association rather than causal sequence, and contribute context-specific evidence on AI use and its psychological correlates among medical students in Iran.

Keywords: Artificial Intelligence; Medical Students; Motivation; Self-Efficacy; Cross-Sectional Studies; Medical Education

Background

Artificial intelligence (AI) tools, and conversational large language models in particular, have rapidly become common study aids for medical students. Survey evidence from North American and European medical schools indicates that a majority of respondents have used ChatGPT or a comparable tool for academic purposes at least once, most commonly to clarify course content, prepare for examinations, or support research-related writing [1-4]. This uptake has occurred against a curriculum that requires the absorption of a large volume of material and its integration with clinical reasoning, achieved largely through self-directed study outside formal contact hours [5, 6]. AI tools plausibly meet this demand by supplying explanation and feedback without depending on an instructor's availability [1, 2].

Most existing research on this topic has examined prevalence, attitudes, readiness, or perceived usefulness of AI tools among health-profession students, generally using single-occasion perception or readiness instruments [2, 5, 7, 8]. A recent scoping review of AI chatbots in higher education reported that students often describe these tools as useful and motivating for completing academic tasks, but also noted that the underlying evidence remains uneven in method and setting [8]. Fewer studies have investigated associations between patterns of use of AI and established, validated measures of academically-relevant psychological constructs than have focused on attitudes towards the technology itself.

Academic motivation and academic self-efficacy are two academically relevant constructs with well-established theoretical and empirical foundations. Self-determination theory conceptualizes motivation as a spectrum ranging from intrinsic interest for the sheer value of an activity to several forms of extrinsic regulation and finally to amotivation, in which a student feels little reason to engage at all to engage in an activity; motivation of this kind is linked to persistence and depth of

engagement in curricula, such as medical training, that depend heavily on self-managed study [9, 10]. Academic self-efficacy, grounded in Bandura's theory of self-efficacy, refers to a student's belief in their own capacity to organize and execute the actions required to succeed at a specific academic task, and is understood to shape whether a student initiates a demanding task, how much effort they invest, and how long they persist [11]. Both constructs are measurable with established instruments and are plausible correlates of a technology that changes how quickly a question receives an answer and how much friction accompanies a difficult task.

How AI use relates to these two constructs, however, remains less clearly characterized than AI use itself. Evidence connecting AI tool use specifically to academic motivation and self-efficacy is comparatively sparse for medical student populations, and sparser still in the Iranian medical education context, where a small number of recent studies have begun to examine medical students' engagement with tools such as ChatGPT and their readiness for AI more broadly [12, 13]. Most available instruments also collapse AI use into a single exposure metric, which cannot distinguish a student who uses AI tools often from one who uses them deliberately for a defined set of academic purposes; these two dimensions are conceptually distinct and may relate differently to motivational and self-efficacy outcomes.

This study examined AI-use frequency and AI-use purpose separately among medical students at a single Iranian medical university and evaluated their associations with academic self-efficacy and three theoretically distinct dimensions of academic motivation (intrinsic motivation, extrinsic motivation, and amotivation), together with a composite positive-motivation score. The study further examined whether these associations remained after adjustment for age, sex, educational stage, and grade point average.

Methods

Study design and setting

This was a descriptive-analytical cross-sectional study, reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement for cross-sectional studies [14], conducted among medical students at Kashan University of Medical Sciences, Iran, between June and August 2026.

Participants and sampling

The target population comprised all medical students enrolled across the four educational stages of the Iranian medical curriculum (Basic Sciences, Pathophysiology, Clerkship, and Internship), totaling approximately 1,345 students. A required sample size was calculated from the standard deviation of a validated AI-readiness scale reported in a comparable Iranian medical student sample [13], with a 95% confidence level ($Z\alpha/2 = 1.96$) and a margin of error of 5 scale points, yielding a minimum requirement that was then adjusted upward for the anticipated design effect of stratification and for expected non-response, giving a target of 110 participants. Participants were recruited by proportionate, stratified random sampling to represent the four educational stages as per their proportion in the target population; rounding of calculated stratified sample sizes led to the final analysis set of 111 completed questionnaires without missing values.

Instruments

A demographic questionnaire recorded age, sex, educational stage, and self-reported grade point average (GPA). AI tool use was evaluated using researcher-developed questionnaire comprising two separately scored components: a 10-item frequency component asking participants to rate, on a 6-point scale, how often they had used each of ten named AI tools (ChatGPT, Gemini, DeepSeek,

Grok, Claude, Qwen, Elicit, Research Rabbit, Copilot, and an open "other" option) for academic purposes over the preceding six months (summed range 10–60), and a 6-item purpose component rating the extent of use for specific academic purposes on a 7-point scale (summed range 6–42). This instrument was developed for the present study due to the absence of a validated Persian-language measure of AI-use frequency and purpose; content validity was established using a panel of subject-matter experts (scale-level content validity index, S-CVI/Ave = 0.93), and internal consistency and test–retest reliability (intraclass correlation coefficient, ICC = 0.90, 95% CI 0.81–0.95) were established in a pilot sample prior to the main study. The English version of the questionnaire is provided as Supplementary File 4. Internal consistency in the present analytic sample was good for both the frequency (Cronbach's $\alpha = 0.87$) and purpose ($\alpha = 0.88$) components.

Academic motivation was measured using the Persian version of the Academic Motivation Scale (AMS) [10, 15], a 28-item, 7-point Likert instrument yielding three subscales used in the present study: intrinsic motivation and extrinsic motivation (12 items each) and amotivation (4 items), together with a composite positive-motivation score calculated as the sum of the intrinsic and extrinsic motivation subscales combined with a reverse-coded amotivation score. Academic self-efficacy was measured with the Persian version of the College Academic Self-Efficacy Scale (CASES) [16, 17], a 32-item, 5-point instrument yielding a single total score. Internal consistency for all seven scores in the present sample ranged from acceptable to excellent (Cronbach's α = 0.85–0.97).

Procedure

The combined questionnaire package was administered as a single online form (Porsline platform) with a printed paper alternative offered to students without convenient online access. The paper and online versions contained identical items, and responses from the paper questionnaires were

manually entered and checked before analysis. Participation was voluntary; the study information and consent statement preceded the questionnaire items, and students could decline or withdraw at any stage without consequence.

Statistical analysis

All analyses were performed in SPSS version 22 at a two-tailed significance level of 0.05 unless otherwise specified. The distribution of the nine main quantitative variables (age, GPA, AI-use frequency, AI-use purpose, academic self-efficacy, and the four motivation scores) was assessed using the Shapiro–Wilk test; all nine showed a statistically significant deviation from a normal distribution, and non-parametric methods were used accordingly throughout. Associations between the two AI-use scores and the five outcome variables (ten pre-specified comparisons directly addressing the two study hypotheses) were examined using Spearman's rho, with a Bonferroni-corrected significance threshold ($\alpha = 0.05/10 = 0.005$) applied in addition to the conventional threshold of 0.05. Exploratory associations of age and GPA with the same five outcomes were examined at the conventional 0.05 threshold. Group differences by sex and by educational stage were examined using the Mann–Whitney U test and Kruskal–Wallis test, respectively, consistent with the non-normal distribution of the study variables.

The independent contribution of AI-use frequency and AI-use purpose to each of the five outcomes, adjusting for age, sex, educational stage, and GPA, was examined using five multiple linear regression models (simultaneous entry method), one per outcome. Sex was coded with male as the reference category and educational stage was dummy-coded with Basic Sciences as the reference category. The absence of problematic multicollinearity was confirmed using the variance inflation factor (VIF); model assumptions were assessed via residual normality, the Breusch–Pagan test for heteroscedasticity, the Durbin–Watson statistic, and Cook's distance for influential

observations, with heteroscedasticity-consistent (HC3) standard errors calculated as a sensitivity analysis for models in which heteroscedasticity was detected.

Ethical considerations

The study protocol was approved by the Research Ethics Committee of Mashhad University of Medical Sciences (approval code IR.MUMS.MEDICAL.REC.1405.062). All participants provided informed consent prior to completing the questionnaire, and confidentiality of responses was maintained throughout data collection and analysis.

Results

Participant characteristics

Of 111 questionnaires distributed according to the stratified sampling plan, all 111 were returned complete, with no missing values on any variable (completion rate 100%). Mean age was 22.27 ± 2.28 years (range 18–28); 60 participants (54.1%) were male and 51 (45.9%) were female. Participant characteristics and descriptive statistics for the study's main variables are summarized in Table 1.

Table 1 Participant characteristics and descriptive statistics of the study variables (N = 111)

Characteristic	n (%) or Mean ± SD
Age, years (Mean ± SD)	22.27 ± 2.28
Sex – Male	60 (54.1)
Sex – Female	51 (45.9)
Educational stage – Basic Sciences	47 (42.3)
Educational stage – Pathophysiology	18 (16.2)
Educational stage – Clerkship	27 (24.3)
Educational stage – Internship	19 (17.1)
GPA (range 0-20)	16.14 ± 1.45

Characteristic	n (%) or Mean ± SD
AI use – frequency score (range 10–60)	25.95 ± 9.97
AI use – purpose score (range 6–42)	30.38 ± 6.96
Academic self-efficacy, total (range 32–160)	114.23 ± 24.51
Intrinsic motivation (range 12–84)	60.51 ± 13.30
Extrinsic motivation (range 12–84)	62.50 ± 12.36
Amotivation (range 4–28)	11.91 ± 5.49
Positive motivation, composite (range 28–196)	143.11 ± 28.70

Abbreviations: SD, standard deviation; AI, artificial intelligence; GPA, grade point average.

Frequency and pattern of AI tool use

Conversational AI tools were used by nearly all participants: ChatGPT had been used by 100.0% of respondents, followed by DeepSeek (85.6%), Gemini (72.1%), Grok (68.5%), and Claude (47.7%); tools oriented toward literature search and discovery (Elicit, Research Rabbit) were the least commonly used, at 36.0% each (Fig. 1). Internal consistency reliability for all study instruments in the present sample was good to excellent (Cronbach's α range 0.85–0.97).

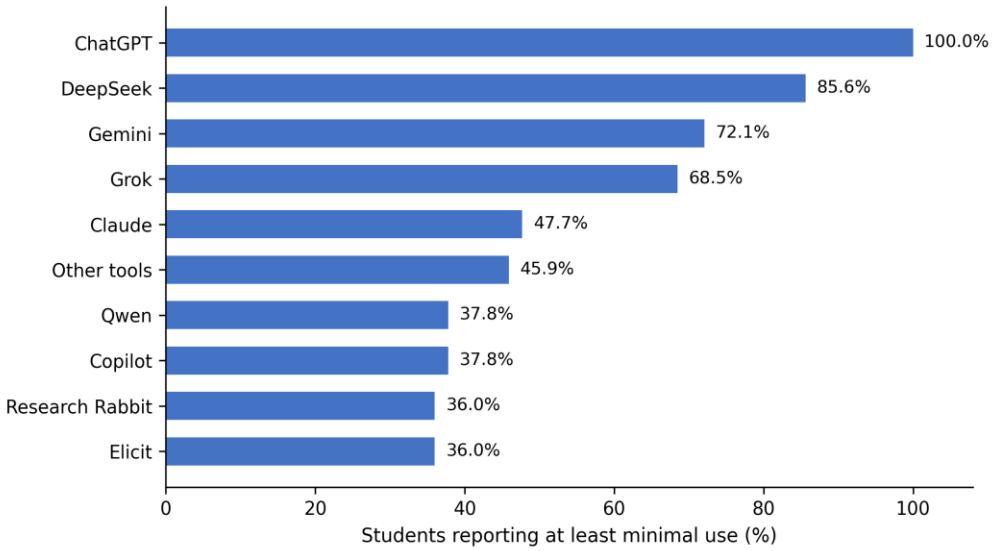


Fig. 1 Proportion of students reporting at least minimal use of each AI tool, ranked (N = 111)

Associations between AI use and study outcomes

Since Shapiro–Wilk testing revealed a statistically significant deviation from normality for all nine of the main quantitative variables, Spearman's rho was used for all correlational analyses. Both AI-use frequency and AI-use purpose were significantly positively correlated with academic self-efficacy, intrinsic motivation, extrinsic motivation, and positive motivation, and significantly negatively correlated with amotivation; all ten correlation coefficients remained statistically significant at the conservative Bonferroni-corrected threshold ($\alpha = 0.005$) (Table 2). Using Cohen's benchmarks, effect sizes ranged from moderate to large ($\rho = 0.46$ to 0.77). In exploratory analyses, age was not significantly associated with any of the outcomes (all $p > 0.05$), whereas GPA showed statistically significant, weak-to-moderate associations with all five outcomes ($\rho = 0.29$ to 0.35 in absolute value).

Table 2 Spearman correlation coefficients between AI-use scores and study outcomes (N = 111)

AI-use dimension	Outcome	Spearman ρ	95% CI	p
Frequency	Academic self-efficacy	0.771	0.683, 0.837	<0.001
Frequency	Intrinsic motivation	0.500	0.346, 0.628	<0.001
Frequency	Extrinsic motivation	0.461	0.301, 0.597	<0.001
Frequency	Amotivation	−0.558	−0.675, −0.415	<0.001
Frequency	Positive motivation	0.526	0.376, 0.649	<0.001
Purpose	Academic self-efficacy	0.696	0.586, 0.781	<0.001
Purpose	Intrinsic motivation	0.616	0.485, 0.720	<0.001
Purpose	Extrinsic motivation	0.608	0.475, 0.713	<0.001
Purpose	Amotivation	−0.539	−0.659, −0.392	<0.001
Purpose	Positive motivation	0.637	0.511, 0.736	<0.001

All p-values remain significant after Bonferroni correction for the 10 primary comparisons ($\alpha = 0.05/10 = 0.005$).

Group comparisons

No statistically significant difference by sex was observed for any of the seven principal study variables (Mann–Whitney U test, all $p > 0.05$). Across the four educational stages, no statistically significant differences was observed for six of the seven variables (Kruskal–Wallis test, all $p > 0.05$); the exception was AI-use frequency, for which the omnibus test approached but did not reach significance ($H = 7.09$, $p = 0.069$), and none of the pairwise post-hoc comparisons remained significant after Bonferroni correction.

Multiple regression analyses

Variance inflation factors for all predictors were well below the conventional threshold of 5 (range 1.09–2.89), indicating that multicollinearity, including the moderately high bivariate correlation between the two AI-use scores (Spearman $\rho = 0.707$), was not a concern for interpretation of the models. All five regression models were statistically significant overall (all $p < 0.001$), with adjusted R^2 ranging from 0.351 (amotivation) to 0.581 (academic self-efficacy) (Table 3). Residual diagnostics indicated approximately normal residuals for two of the five models and a statistically significant but slight deviation from normality for the remaining three (Shapiro–Wilk $W > 0.97$ throughout); the Breusch–Pagan test indicated statistically significant heteroscedasticity for the self-efficacy and extrinsic-motivation models, for which a heteroscedasticity-consistent (HC3) sensitivity analysis reproduced the same pattern of statistical significance as the conventional models. Cook's distance did not identify any observation exceeding the conventional threshold of 1.0 in any model.

Across the five adjusted models, a consistent pattern emerged (Table 3): AI-use purpose was an independent, statistically significant predictor in all five models (standardized $\beta = 0.32$ to 0.69), whereas AI-use frequency retained independent significance only in the academic self-efficacy

model (β = 0.55, p < 0.001), and was not a significant independent predictor of any of the four motivation-related outcomes once purpose of use was accounted for. GPA was an independent, significant predictor of intrinsic motivation, extrinsic motivation, and positive motivation, but not of self-efficacy or amotivation. Sex and educational stage were not significant independent predictors in any model, with the isolated exception of the Pathophysiology-stage coefficient in the self-efficacy model (B = 10.39, p = 0.026).

Table 3 Adjusted associations between AI-use scores and study outcomes across five multiple regression models (N = 111)

Predictor	Self-efficacy	Intrinsic mot.	Extrinsic mot.	Amotivation	Positive mot.
AI use – frequency	0.55**	0.12	−0.03	−0.21	0.08
AI use – purpose	0.32**	0.58**	0.69**	−0.43**	0.65**
Age	0.08	0.15	0.15	−0.09	0.15
GPA	0.04	0.16*	0.18*	−0.10	0.17*
Sex (female vs male)	0.09	0.07	0.01	0.02	0.03
Adjusted R^2	0.581	0.497	0.503	0.351	0.555
Model F (8, 102)	20.08**	14.58**	14.92**	8.43**	18.13**

*Values are standardized regression coefficients (β) unless otherwise indicated. Reference categories: sex = male; educational stage = Basic Sciences (stage coefficients omitted from this summary; full stage-level coefficients for all five models are provided in Additional file 1). * p < 0.05; ** p < 0.001. Mot., motivation; GPA, grade point average.*

Discussion

In this cross-sectional study of medical students at an Iranian medical university, both the frequency and the purpose of AI tool use were positively associated with academic self-efficacy and with a more favorable motivational profile, and negatively associated with amotivation; these associations were of moderate to large magnitude and robust to a conservative correction for multiple testing, supporting the study's two primary hypotheses. Considered jointly in adjusted regression models, however, a clear dissociation emerged: purpose of use remained an

independent, significant correlate of all five outcomes, while frequency of use retained independent significance only for academic self-efficacy. This pattern was not attributable to collinearity between the two AI-use scores, which was low by conventional criteria and confirmed by a robust-standard-error sensitivity analysis.

This dissociation is consistent with the theoretical basis for treating AI-use frequency and AI-use purpose as distinct constructs. Self-determination theory characterizes motivation in terms of the reasons underlying an action rather than its raw frequency [9, 10]; a purpose-of-use score, which asks what a student uses AI tools for, is conceptually closer to this "why" than a frequency score, which counts occurrences of use without reference to intent. This may explain why purpose, rather than frequency, showed the more consistent independent association with the three motivation subscales and the composite positive-motivation score. Academic self-efficacy followed a different pattern, in which frequency retained an independent association alongside purpose. This is compatible with Bandura's account of mastery experience, in which repeated successful engagement with a task, here, repeated successful use of a tool to resolve an academic problem, is itself a proposed source of self-efficacy independent of the reason for engaging [11]; prior studies of AI-chatbot use in health-profession students have similarly reported associations between chatbot engagement and self-efficacy or related self-directed learning outcomes [18, 19], consistent with a frequency-sensitive pathway specific to self-efficacy. On this account, sheer repetition of successful AI-assisted problem-solving could plausibly contribute to self-efficacy beliefs through a pathway less dependent on the student's stated purpose.

Several alternative, non-causal explanations for these associations warrant explicit consideration. Because the design is cross-sectional, reverse causation is fully consistent with the observed pattern: students with higher baseline self-efficacy and more self-determined motivation may be

more likely to identify specific, purposeful uses for AI tools, rather than purposeful AI use causing these psychological states. A reciprocal relationship, in which motivation and purposeful use reinforce one another over time, is equally consistent with a single cross-sectional snapshot. Shared method variance is a further concern, since all variables were obtained by self-report in the same questionnaire administration; the purpose items, which describe specific, sanctioned academic uses, may also be more susceptible to socially desirable responding than the frequency items, particularly in a context where AI use carries academic-integrity connotations, which could inflate the apparent independent contribution of purpose relative to frequency.

These findings extend a growing literature describing widespread AI tool use among medical and health-profession students internationally [1-3, 5, 7], in which ChatGPT use approaching near-universal levels, as observed in the present sample, has been reported in several other settings [1, 3, 4, 20]. A recent scoping review concluded that AI chatbots are often described by students as useful and motivating for academic tasks, while noting that the supporting evidence remains methodologically uneven [8]. The present study extends this literature by using validated, multidimensional instruments for both motivation and self-efficacy rather than single-item perception measures, and by empirically distinguishing frequency from purpose of use rather than treating AI use as a single exposure. Within the Iranian medical education context specifically, where evidence on AI readiness and use among health-profession students has begun to accumulate [12, 13], evidence associating patterns of AI use to validated motivational and self-efficacy outcomes has to date been limited; direct numerical comparison with these studies is not appropriate given differences in population, instruments, and outcome constructs, but the present findings are broadly consistent with a picture of substantial and largely favorably regarded AI engagement among Iranian medical students. Absence of significant sex or educational-stage

differences in the present sample should be interpreted as an absence of detected difference in this sample rather than as evidence of true equivalence, given the more limited statistical power available for these subgroup comparisons.

If replicated in longitudinal or experimental designs capable of establishing temporal or causal sequence, these findings would suggest that how medical students use AI tools may carry more information about their motivational engagement than how often they use them, with a possible implication that institutional guidance on AI use might reasonably emphasize cultivating purposeful, task-specific engagement rather than focusing primarily on limiting frequency of use. This possibility is offered as a hypothesis for future testing rather than as a recommendation supported by the present observational evidence.

Limitations

This study has several limitations. Firstly, the cross-sectional design permits only the description of associations and cannot establish temporal sequence; reverse causation and reciprocal relationships remain fully consistent with the observed patterns. Secondly, the study was conducted at a single institution during a specific academic period, so the findings should be generalized cautiously and primarily to comparable Iranian medical education settings. Thirdly, all variables were obtained by self-report; the six-month recall window for AI-use frequency may introduce imprecision, and socially desirable responding cannot be excluded in a context where AI use carries academic-integrity connotations. Fourthly, the sample size, although adequate for the primary analysis, subgroup estimates within smaller educational strata carry wider uncertainty, and null findings for sex and stage should be interpreted as an absence of detected difference rather than evidence of equivalence. Finally, the specific pattern of tool use reflects the technological

landscape of 2025–2026 and may not fully capture patterns associated with subsequent generations of generative AI tools.

Conclusions

Among medical students at this Iranian medical university, both frequency and purpose of AI tool use were positively associated with academic self-efficacy and a more favorable motivational profile. When examined jointly, purpose of use showed a more consistent independent association with academic motivation and self-efficacy than frequency of use, which retained an independent association only with self-efficacy. As these findings arise from an observational, cross-sectional design, they describe statistical association rather than causal or temporal sequence, and reverse-causal and reciprocal explanations remain equally consistent with the data. The principal contribution of this study is the empirical distinction between frequency and purpose as separable dimensions of AI utilization, examined against multiple, theoretically differentiated motivational outcomes and academic self-efficacy simultaneously, in an Iranian medical education context in which such evidence has so far been limited. Longitudinal and multi-institutional studies are needed to clarify the direction of these associations and their generalizability.

List of abbreviations

AI: Artificial intelligence

AMS: Academic Motivation Scale

CASES: College Academic Self-Efficacy Scale

CI: Confidence interval

GPA: Grade point average

HC3: Heteroscedasticity-consistent standard error estimator (type 3)

SD: Standard deviation

VIF: Variance inflation factor

Declarations

Ethics approval and consent to participate

The study protocol was approved by the Research Ethics Committee of Mashhad University of Medical Sciences (approval code IR.MUMS.MEDICAL.REC.1405.062). The study was conducted in accordance with the Declaration of Helsinki. All participants provided informed consent prior to completing the questionnaire.

Consent for publication

Not applicable.

Availability of data and materials

The dataset used in this study is available with the authors and can be made available upon request.

Competing interests

The authors declare that they have no competing interests.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors' contributions

MSM: data collection, formal analysis, and drafting of the original manuscript. HKM: conceptualization, study supervision, and critical review and editing of the manuscript. NZ and

SA: methodological guidance, and critical review and editing of the manuscript. All authors read and approved the final manuscript.

Acknowledgements

This is a part of approved master thesis (code no: 4040326) by the Vice Chancellor for Research (VCR) at Mashhad University of Medical Sciences who supported this study. We thank VCR and all of the students and colleagues who contributed to this research despite their lack of time.

References

1. Ganjavi C, Eppler M, O'Brien D, Ramacciotti LS, Ghauri MS, Anderson I, Choi J, Dwyer D, Stephens C, Shi V *et al*: **ChatGPT and large language models (LLMs) awareness and use. A prospective cross-sectional survey of U.S. medical students**. *PLOS digital health* 2024, **3**(9):e0000596.
2. Weidener L, Fischer M: **Artificial Intelligence in Medicine: Cross-Sectional Study Among Medical Students on Application, Education, and Ethical Aspects**. *JMIR medical education* 2024, **10**:e51247.
3. Wu F, Dang Y, Li M: **A Systematic Review of Responses, Attitudes, and Utilization Behaviors on Generative AI for Teaching and Learning in Higher Education**. *Behavioral sciences (Basel, Switzerland)* 2025, **15**(4).
4. Xu AY, Speakman S, Piranio VS, Medina R, Liu M, Lamprecht C, Abchee N, Brennan M: **Medical Student Experiences With ChatGPT: National Cross-Sectional Study**. *JMIR formative research* 2026, **10**:e76838.
5. Pham TD, Karunaratne N, Exintaris B, Liu D, Lay T, Yuriev E, Lim A: **The impact of generative AI on health professional education: A systematic review in the context of student learning**. *Medical education* 2025, **59**(12):1280-1289.
6. Barbosa J, Silva A, Ferreira MA, Severo M: **The impact of students and curriculum on self-study during clinical training in medical school: a multilevel approach**. *BMC medical education* 2017, **17**(1):9.
7. Alammari D, Alamari E, Alamri R, Alharbi R, Felimban J, Aljohani J: **Assessing medical students' attitudes, performance, and usage of ChatGPT in Jeddah, Saudi Arabia**. *Frontiers in artificial intelligence* 2025, **8**:1577911.

8. Schei OM, Møgelvang A, Ludvigsen K: **Perceptions and use of AI chatbots among students in higher education: A scoping review of empirical studies**. *Education Sciences* 2024, **14**(8):922.

9. Ryan RM, Deci EL: **Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being**. *The American psychologist* 2000, **55**(1):68-78.

10. Vallerand RJ, Pelletier LG, Blais MR, Briere NM, Senecal C, Vallieres EF: **The Academic Motivation Scale: A measure of intrinsic, extrinsic, and amotivation in education**. *Educational and psychological measurement* 1992, **52**(4):1003-1017.

11. Bandura A: **Self-efficacy: toward a unifying theory of behavioral change**. *Psychological review* 1977, **84**(2):191-215.

12. Paygozar R, Tahery N, Abnavy SD: **Artificial intelligence use as a key predictor of clinical performance in nursing students: a cross-sectional study from Iran**. *BMC medical education* 2025, **26**(1):98.

13. Ziapour A, Darabi F, Janjani P, Amani MA, Yıldırım M, Motevaseli S: **Factors affecting medical artificial intelligence (AI) readiness among medical students: taking stock and looking forward**. *BMC medical education* 2025, **25**(1):264.

14. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP: **The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies**. *Lancet (London, England)* 2007, **370**(9596):1453-1457.

15. sarhadi m, Mazloom S, Soltani nejad S, Arbozia M: **The Academic Motivation and Related Factors in Students of Zahedan School of Nursing and Midwifery**. *Horizon of Medical Education Development* 2022, **13**(4):84-71.
16. Jamali M, Noroozi A, Tahmasebi R: **Factors Affecting Academic Self-Efficacy and Its Association with Academic Achievment among Students of Bushehr University Medical Sciences 2012-13**. *Iranian Journal of Medical Education* 2013, **13**(8):629-641.
17. Owen SV, Froman RD: **Development of a College Academic Self-Efficacy Scale**. 1988.
18. Elzeky ME, Alanazi S, FM Shahine N: **Association Between ChatGPT Reliance, Self-Directed Learning, and Problem-Solving Competencies Among Nursing Students: The Mediating Role of Academic Self-Efficacy in an Analytical Cross-Sectional Design**. In: *Nursing Forum: 2026*: Wiley Online Library; 2026: 3301894.
19. Lee Y-F, Hwang G-J, Chen P-Y: **Impacts of an AI-based cha bot on college students' after-class review, academic performance, self-efficacy, learning attitude, and motivation**. *Educational technology research and development* 2022, **70**(5):1843-1865.
20. AlAlwan AQM, Lone A: **ChatGPT in medical education: a cross-sectional analysis of usage, attitudes, perceptions, and practices among Saudi medical students**. *Frontiers in artificial intelligence* 2026, **9**:1751367.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- supplementary1.docx
- supplementary3.docx
- supplementary4.docx