

How Professional Identity Drives AI Readiness in TCM Students: The Mediating Mechanism of Learning Engagement*

Xinyi Li¹, Shuangqing Zhai¹, Nan Jiao¹, Na Yuan¹ and Yu Liu^{1,*}

¹ Beijing University of Chinese Medicine, 11 North Third Ring Road East, 100029 Beijing, China

Abstract

As artificial intelligence (AI) continues to reshape healthcare systems, AI readiness has emerged as a critical developmental competency for future professionals in Traditional Chinese Medicine (TCM). Grounded in Self-Determination Theory (SDT), this study developed a mediation model to examine the mechanism through which professional identity influences AI readiness among TCM students, with learning engagement as a potential mediator. A cross-sectional survey was conducted among 4,313 students from 16 TCM universities in China. Statistical analyses were performed using IBM SPSS Statistics (Version 27.0), and mediation analyses were conducted with the PROCESS macro (Model 4) based on 5,000 bootstrap samples. The results indicated that professional identity was positively correlated with both AI readiness and learning engagement, and learning engagement was also positively associated with AI readiness. Mediation analysis showed that professional identity significantly predicted AI readiness, both directly and indirectly through learning engagement. The indirect effect accounted for 24.78% of the total effect, indicating partial mediation. These findings suggest that professional identity serves as an important psychological predictor of AI readiness among TCM students, while learning engagement represents a key behavioral pathway through which professional identity translates into a higher level of subjective preparedness for AI integration. Strengthening professional identity and enhancing learning engagement may therefore contribute to improving students' technological integration readiness in the context of "digital and smart TCM".

Keywords

professional identity; AI readiness; learning engagement; Traditional Chinese Medicine students ¹

1. Introduction

The field of Traditional Chinese Medicine (TCM) has become an important context for AI application. AI is not merely a technological tool, but a critical pathway for the modernization of TCM, and deep integration between AI and TCM has already been achieved in several key domains [1]. Although the importance of AI has been widely recognized within TCM education, whether TCM students are adequately prepared to integrate AI into their future clinical practice remains an open question requiring empirical investigation.

The cultivation of TCM professionals has its own distinctive characteristics. TCM education emphasizes experiential inheritance and classical theoretical systems, which may create adaptation challenges when students encounter highly logical and data-driven AI technologies. AI readiness, defined as an individual's capacity at the technical, psychological, and ethical levels to accept and apply AI technologies, has increasingly been regarded as an essential competency for contemporary TCM practitioners [2].

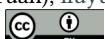
Among the psychological factors influencing medical students' development, professional identity is widely considered a core driver of career progression. It reflects students' sense of belonging to the TCM profession and the internalization of their future professional role. Concurrently, learning engagement serves as a bridge between cognition and behavior,

*Joint Proceedings of LAK 2026 Workshops, co-located with the 16th International Conference on Learning Analytics and Knowledge (LAK 2026), Bergen, Norway, April 27 – May 1, 2026

^{1*} Corresponding author.

[†] These authors contributed equally.

✉ li_xinyi13@163.com (X. Li); zsq2098@163.com (S. Zhai); flynnny@163.com (N. Jiao); yuanna89284128@163.com (N. Yuan); liuyu80213@126.com (Y. Liu)



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representing the dedication that students invest in their academic activities. Although prior studies have examined AI literacy among medical students, relatively few have explored, within the specific cultural and educational context of TCM, how professional identity may be translated into AI readiness through concrete behavioral processes.

1.1. Professional identity and AI readiness

Professional identity constitutes a foundational element in individuals' vocational psychological development. Students with a robust professional identity tend to hold positive expectations regarding the future of the TCM profession. Such students are more likely to perceive AI as a tool that facilitates the modernization and transformation of TCM, rather than a threat to its traditional essence. This positive psychological orientation may directly translate into greater acceptance of emerging technologies and a stronger willingness to learn and adopt them. Jussupow et al. (2022) found that the increasing presence of AI in healthcare can evoke feelings of "identity threat" among medical students, potentially leading to defensive or resistant responses [3]. However, this study proposes that a high level of professional identity may itself buffer against the perceived technological threat posed by AI. This proposition is supported by the findings of Ta'an et al. (2025), who reported a significant positive association between professional identity and AI readiness [4]. For TCM students, a well-established professional identity implies a strong conviction in the core values of TCM, such as holistic thinking and syndrome differentiation-based treatment. This confidence may reinforce students' belief in their irreplaceable role in complex clinical decision-making, thereby psychologically alleviating concerns about professional substitution by AI technologies.

1.2. The mediating role of learning engagement

Learning engagement refers to the energy and emotional investment that individuals devote to the learning process. Prior research has demonstrated that students with a strong sense of professional identity are more likely to invest substantial time and effort in their field of study [5]. In addition, evidence suggests that medical students who have received AI-related training report greater confidence in using AI technologies in future practice compared to those without such training [6]. The development of AI readiness requires the accumulation of interdisciplinary knowledge and competencies, which relies heavily on in-depth engagement in daily academic activities. Therefore, learning engagement may function as a key behavioral mediator linking professional identity to AI readiness.

1.3. Theoretical framework and research hypotheses

The present study employs Self-Determination Theory (SDT) as an explanatory framework. Originally proposed by Deci and Ryan [7], SDT posits that the quality of individuals' behavior depends on the degree to which their motivation is internalized. When basic psychological needs—autonomy, competence, and relatedness—are satisfied, individuals are more likely to exhibit high-quality behavioral engagement [8].

In this study, professional identity is conceptualized as a highly internalized cognitive structure of vocational identity, reflecting students' alignment with the values of the TCM profession and their emotional attachment to their future professional role. According to the internalization process in SDT, a stronger professional identity allows individuals to perceive learning activities as self-determined choices rather than externally imposed obligations. This internalization, in turn, is expected to foster higher levels of learning engagement [9]. Learning engagement represents students' behavioral, cognitive, and emotional involvement in the learning process, serving as a key mechanism through which motivation is transformed into competence development. Orsini (2016) demonstrated that autonomous motivation is positively associated with deep learning strategies [10]. Sustained, high-quality engagement in learning activities may therefore enhance

individuals' subjective competence and preparedness in emerging technological domains such as AI. Based on this theoretical reasoning, we propose the following hypotheses:

H1: Professional identity significantly and positively predicts AI readiness among TCM students.

H2: Learning engagement mediates the relationship between professional identity and AI readiness.

2. Methods

2.1. Participants and procedure

A cross-sectional survey design was adopted in this study. An online questionnaire was administered to 4,313 undergraduate students from 16 TCM universities in China.

2.2. Ethical considerations

The study was approved by the relevant academic ethics committee. Participation was voluntary and anonymous, and all data were used solely for academic research purposes.

2.3. Measures

All original items were rated on a 4-point Likert scale. All variables were linearly transformed to a standardized 0–100 scale to facilitate comparison. Higher scores indicated higher levels of professional identity, learning engagement, and AI readiness.

Professional identity was measured using the scale developed by Qin (2009) [11]. The scale assesses the extent to which TCM students are able to form objective and accurate cognitions about the TCM profession and demonstrate emotional recognition and acceptance of their chosen field (Cronbach's $\alpha = 0.925$).

Learning engagement was measured using the revised scale developed by Fang (2008) [12]. This instrument assesses students' sustained, positive, and fulfilling emotional and cognitive states in relation to learning, research, and career development activities (Cronbach's $\alpha = 0.934$).

AI readiness was measured using the scale developed by Karaca et al. (2021) [2], with minor adaptations to fit the context of TCM education. The scale evaluates students' preparedness to utilize AI technologies to optimize clinical decision-making and promote their professional development (Cronbach's $\alpha = 0.934$).

2.4. Data analysis

Descriptive statistics and correlation analyses were conducted using IBM SPSS Statistics (Version 27.0). Mediation analysis was performed using the PROCESS macro (Model 4), with 5,000 bootstrap resamples to estimate indirect effects.

3. Results

3.1. Preliminary analysis

Table 1 presents the scores and difference testing results for professional identity, learning engagement, and AI readiness across various demographic characteristics ($N = 4,313$). Regarding gender, no statistically significant difference was observed between male and female students in professional identity ($p > 0.05$). However, significant gender differences were found in both learning engagement ($p = 0.021$) and AI readiness ($p = 0.002$). Specifically, male students reported significantly higher scores in learning engagement (54.29 ± 20.58) and AI readiness (63.30 ± 22.20) compared to their female counterparts (52.81 ± 19.70 and 61.09 ± 22.46 , respectively). Analysis of

variance indicated that scores for professional identity and learning engagement (both $p < 0.001$), as well as AI readiness ($p = 0.003$), differed significantly across grade levels. Professional identity scores exhibited a gradual downward trend as grade levels increased, with Year 1 students recording the highest score (80.74 ± 17.87) and Year 5 students the lowest (76.36 ± 17.78). In contrast, learning engagement generally followed an upward trajectory, rising from its lowest point in Year 1 (50.53 ± 20.02) to a peak in Year 4 (55.20 ± 21.04). Similarly to professional identity, AI readiness scores were highest among Year 1 students (63.44 ± 23.20) and lowest among Year 5 students (59.90 ± 22.93), demonstrating an overall decline as students advanced through their education.

Table 1

Scores of study variables by demographic characteristics (N = 4,313)

Variable	N(%)	Professional identity		Learning engagement		AI readiness	
		Mean $\pm$ SD	p	Mean $\pm$ SD	p	Mean $\pm$ SD	p
Gender			0.118		0.021		0.002
Male	1540 (35.7)	77.65 $\pm$ 17.88		54.29 $\pm$ 20.58		63.30 $\pm$ 22.20	
Female	2773 (64.3)	78.52 $\pm$ 17.49		52.81 $\pm$ 19.70		61.09 $\pm$ 22.46	
Grade			< 0.001		< 0.001		0.003
Year 1	1091 (25.3)	80.74 $\pm$ 17.87		50.53 $\pm$ 20.02		63.44 $\pm$ 23.20	
Year 2	1015 (23.5)	78.29 $\pm$ 17.56		53.59 $\pm$ 19.33		61.81 $\pm$ 22.03	
Year 3	875 (20.3)	77.60 $\pm$ 17.70		54.31 $\pm$ 19.40		62.79 $\pm$ 21.52	
Year 4	661 (15.3)	76.58 $\pm$ 16.63		55.20 $\pm$ 21.04		60.18 $\pm$ 21.92	
Year 5	671 (15.6)	76.36 $\pm$ 17.78		54.44 $\pm$ 20.45		59.90 $\pm$ 22.93	

The Pearson correlation results among the three primary variables are presented in Table 2. All variables were significantly and positively correlated with one another ($p < 0.01$). Specifically, professional identity was positively associated with learning engagement ($r = 0.316$) and AI readiness ($r = 0.517$), while learning engagement also showed a significant positive correlation with AI readiness ($r = 0.528$). The overall mean scores for the total sample were 78.21 ± 17.63 for professional identity, 53.34 ± 20.03 for learning engagement, and 61.88 ± 22.39 for AI readiness.

Table 2

Pearson correlations among study variables (N = 4,313)

	Professional identity	Learning engagement	AI readiness
Professional identity	1	0.316**	0.517**
Learning engagement	0.316**	1	0.528**
AI readiness	0.517**	0.528**	1

Mean ± SD	78.21±17.63	53.34±20.03	61.88±22.39
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Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.2. Mediation analysis

The results of the mediation analysis, conducted using the PROCESS macro, are presented in Table 3 and 4. In the initial model excluding the mediator, professional identity was found to be a significant positive predictor of AI readiness among TCM students ($B = 0.656$, $p < 0.001$; 95%CI = [0.624, 0.689]). When learning engagement was incorporated into the model as a mediator, the positive predictive effect of professional identity on learning engagement was significant ($B = 0.359$, $p < 0.001$; 95%CI = [0.327, 0.391]). Similarly, learning engagement significantly and positively predicted AI readiness ($B = 0.453$, $p < 0.001$; 95%CI = [0.426, 0.479]). Even with learning engagement in the model, the direct effect of professional identity on AI readiness remained statistically significant ($B = 0.494$, $p < 0.001$; 95%CI = [0.463, 0.524]).

To further verify the mediation effect, a bias-corrected percentile Bootstrap test (5,000 resamples) was performed (see Table 4). The results revealed a significant indirect effect of learning engagement on the relationship between professional identity and AI readiness (indirect effect = 0.163, SE = 0.011, 95%CI = [0.142, 0.184]). Since the 95% confidence interval did not include zero, the mediation effect was confirmed. The indirect effect accounted for 24.78% of the total effect, indicating that learning engagement plays a partial mediating role in the relationship between professional identity and AI readiness (see Figure 1).

Table 3

Regression analysis of the mediating effect of professional identity on AI readiness

Predictor	Learning engagement			AI readiness		
	<i>B</i>	SE	95%CI	<i>B</i>	SE	95%CI
Constant	25.241***	1.316	[22.661, 27.820]	-0.873	1.236	[-3.296, 1.550]
Professional identity	0.359***	0.016	[0.327, 0.391]	0.494***	0.016	[0.463, 0.524]
Learning engagement				0.453***	0.014	[0.426, 0.479]
R ²	0.100			0.415		
F	479.096***			1526.219***		

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. SE = standard error; CI = confidence interval.

Table 4

Total, direct, and indirect effects in the mediation model

Effect type	Effect	SE	95%CI	Standardized effect
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Total effect	0.656	0.017	[0.624, 0.689]	0.517
Direct effect	0.494	0.016	[0.463, 0.524]	0.389
Indirect effect	0.163	0.011	[0.142, 0.184]	0.128

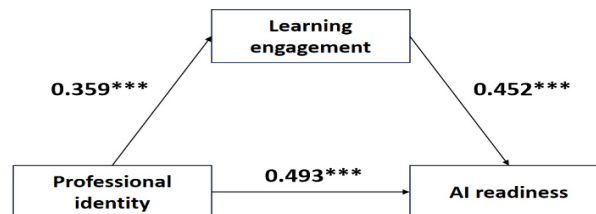


Figure 1: The mediating role of learning engagement in the model

4. Discussion

This study constructed a mediation model grounded in Self-Determination Theory (SDT) to examine the predictive role of professional identity in AI readiness among Traditional Chinese Medicine (TCM) students, as well as the mediating mechanism of learning engagement. The findings indicate that professional identity significantly and positively predicts AI readiness, and that this relationship is partially mediated by learning engagement.

The results suggest that professional identity serves as a key psychological predictor of AI readiness. In the context of rapid technological transformation, individuals' affirmation of their professional role and values may shape their attitudes toward emerging technologies and their willingness to integrate them into practice. Previous research has suggested that the introduction of artificial intelligence may trigger professional identity anxiety among healthcare practitioners [13]. However, the present findings demonstrate that, among TCM students, a higher level of professional identity is significantly associated with greater AI readiness. This may imply that when students have developed a stable identification with the core values of TCM, they are more likely to perceive AI as a supportive tool rather than a threat to their professional role.

The mediation analysis further revealed that learning engagement partially mediates the relationship between professional identity and AI readiness, with the indirect effect accounting for 24.78% of the total effect. This indicates that professional identity is not only directly associated with AI readiness but also indirectly related to it through enhanced engagement in learning activities. From the perspective of SDT, the internalization of professional identity may strengthen autonomous learning tendencies, thereby fostering higher levels of behavioral participation. Nevertheless, professional identity explained 10% of the variance in learning engagement in this study, suggesting that engagement is also influenced by other factors, such as the teaching environment, curriculum design, and access to digital resources. These findings underscore that a positive professional identity alone is insufficient to ensure technological readiness; sustained and high-quality learning engagement represents a critical pathway.

The study also found that professional identity and AI readiness showed a declining trend across academic years, whereas learning engagement demonstrated an increasing trend. This pattern may be related to the growing clinical practice pressures experienced by senior students. However, as internship workload and course satisfaction were not measured in the present study, further in-depth investigation is needed to clarify these explanations. In addition, male students

reported slightly higher levels of AI readiness than female students. This difference may reflect varying emphases in attitudes toward technology application. Stogiannos et al. (2025) reported that males tend to focus more on technological development and logic, whereas females are more concerned with how technology serves patient-centered care [14]. These findings suggest that TCM institutions should consider gender-sensitive approaches when designing AI education initiatives. Future research may further explore the relationship between gender role cognition and attitudes toward technology.

Based on the above discussion, several educational implications are proposed. First, institutions should emphasize the role of AI as an assistive tool in training programs to reduce potential psychological anxiety associated with technological advancement. Second, in line with Wood (2021) [15], AI education should be closely integrated with clinical practice. Interdisciplinary mentorship teams involving both TCM and AI experts should be established to demonstrate the effectiveness of AI-assisted treatment through authentic clinical cases. Third, institutions should strengthen ethics and data security education. As highlighted by Bootchuy (2025), ethical awareness and data protection are crucial components of AI readiness [16]. TCM students should therefore develop sensitivity to legal boundaries and moral responsibilities when learning to apply AI technologies. Finally, institutions should cultivate learning environments that support autonomous learning in order to promote sustained and high-quality engagement.

5. Limitations and Future Directions

Despite the robust evidence provided by the large sample ($N = 4,313$), several limitations should be acknowledged. First, this study primarily focused on subjective AI readiness. Future research could incorporate qualitative interviews to explore in greater depth the specific barriers students encounter in applying AI, such as the digital divide and hardware limitations. Second, given the cross-sectional design, the conclusions are based on statistical associations among variables, and causal relationships cannot be established. Longitudinal or intervention-based studies are needed to further verify causal pathways. Future research may also integrate behavioral assessments and actual performance in technology use to develop a more comprehensive evaluation framework for AI readiness, while further examining the multidimensional factors that influence students' technological integration capacity.

6. Conclusion

Grounded in Self-Determination Theory, this study provides empirical evidence that professional identity serves as a fundamental psychological antecedent of AI readiness among TCM students, with learning engagement acting as a key behavioral mechanism. The findings demonstrate how internalized professional values translate into technological preparedness within the context of traditional medical education. The partial mediation effect (24.78%) underscores that while professional identity is crucial, its translation into AI readiness is significantly facilitated by sustained behavioral engagement. This highlights the need for educational strategies that simultaneously strengthen professional identity and create engaging learning environments. As AI continues to reshape healthcare, fostering stable professional identity and deep learning engagement in TCM students will be essential for preparing a workforce capable of integrating intelligent technologies with traditional wisdom to build “digital and smart TCM”.

Acknowledgements

The authors would like to express their sincere gratitude to the participating universities and students for their valuable contributions to this study. We also thank colleagues and research assistants who provided support in data collection and organization.

Declaration on Generative AI

During the preparation of this work, the author(s) used ChatGPT (OpenAI, GPT-4) for grammar refinement. After using this tool, the author(s) carefully reviewed and revised the content as necessary and take full responsibility for the integrity and accuracy of the publication.

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