

Exploring the Moderating Effect of AI Learning Behaviour on AI
Awareness and AI Anxiety: A Case of Teacher Candidates in Open
Distance Learning Environment

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Abstract

This study aimed to explore the moderating effect of AI learning behaviour on AI awareness and AI anxiety of teacher candidates in open distance learning environment. Correlation cross-sectional descriptive design was employed in this paper to investigate the status of AI-learning behaviour in moderating AI awareness and AI anxiety. Students enrolled in the faculty of education were considered as the population for the study. AI Anxiety scale (AIA), AI awareness scale (AIA), and AI Learning Behaviour questionnaire were used to collect the data from the teacher candidates. The result indicated that AI learning behaviour is found to be moderating the relationship between AI Anxiety and AI Awareness in the Pakistani context. The study recommends that the sooner education institutions shift towards artificial intelligence the sooner it will help them improve the learning outcomes of their students.

Keywords: ODL, AI awareness, AI anxiety and Learning behavior

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Introduction

Recently, all social systems, including education, health, politics, and the economy, have been affected by rapid development and innovations in Artificial Intelligence (AI) tools and applications (Kaya et al., 2022; Luan et al., 2020; Stephanidis et al., 2019). In a report of 2017, McKinsey Global Institute (MGI) predicted that depending on the speed of AI adoption, 75 million to 375 million workers (from 3–14% of the global workforce) may be required to change occupations and/or upgrade their skills by 2030 (Sander et al., 2021). AI- technologies are predicted to drive innovation and economic growth, thus creating 133 million new jobs globally by 2022 (Dwivedi et al., 2021). Reinhart (2018) stated that 85% of the population around the globe is using at least one AI-based technology. However, people are often not aware of the AI applications that they use in daily life (Tai, 2020). Zhang and Dafoe (2019) explained that AI technology is widely useful in advancements in many sectors, including education, labor market, farming, health, and national security. Darko et al. (2020) further emphasized that AI is the technology of the Fourth Industrial Revolution (Industry 4.0) and has many beneficial applications, such as improving the educational experience of students, diagnosing diseases, preserving environmental resources, predicting natural disasters, financial gains, preventing violent acts, improving the quality of life and psychological well- being of individuals (Cohen & Jones, 2020). Likewise, in some sectors, i.e., health, researchers at Stanford were able to diagnose 14 types of medical conditions exceeding the human diagnostic accuracy within one month of AI-based system development (Rajpurkar et al., 2017). Similarly, in education, AI is helping to track the student's progress, suppressing human capabilities in the job market (Ilkka, 2018. P.5). These AI events impact individuals' psychology, and they are expressing their anxiety regarding its use and widespread (Li, & Huang, 2020).

AI Adaption in Teacher Education

As Artificial Intelligence (AI) continues to transform education, teachers play a pivotal role in integrating AI technologies into the classroom effectively. Kaya et al. (2022) emphasized that many factors contribute to willingness and tendency to use AI technology in specific fields. According to Seo et al. (2021), AI-based teaching-learning processes are currently offering effective support to design personalized instructions, activities, and assessments for students and teachers alike. On a similar notion, Hwang et al. (2020)

explained that AI provides students with tailored learning content and feedback based on students' learning styles and preferences. It further helped the teachers to organize their work and save ample time to engage in meaningful activities to improve their practices (Goel & Polepeddi, 2016). In fact, AI provides real-time data to teachers about students learning patterns and strategies to reshape their experiences (Fong et al., 2019). No doubt, the opportunities of AI are very promising and revolutionary in the educational context; however, its true potential for students is still vague and requires more empirical evidence. Zawacki-Richter et al. (2019) conducted a systematic review on AI in education (AIED) using data from 2007 to 2018, and they found there is a lack of critical reflection on the ethical impact of AI-based systems on students and the learner-instructor interactions.

Syed (2023) stated that AI is anticipated to play a significant part in education and the skilled workforce; therefore, it's useful to have relevant skills in AI and machine learning (ML). He further gave the example of the healthcare field, which, due to a lack of awareness about how to choose the right AI tools and incorporate them for patient care, may result in worse patient outcomes. On a similar notion, it is crucial to train teachers with the latest AI tools and mentor students for meaningful and engaging teaching-learning experiences using AI.

Ayanwale et al. (2022) described that teachers are being trained to use AI-based instructions through professional development programs at university and class levels. For this, many researchers have prepared instructional resources like AI-based tools, curricula, and approaches for teachers that support the teaching-learning process using AI concepts (Chiu, 2021). Tang et al. (2021) highlighted that academia is concerned about the absence of educational theories and models for AI-enabled e-learning for students. Similarly, it is important to know the student-teacher perceptions regarding their AI learning behavior and how AI learning behavior would affect AI awareness and AI anxiety in an online environment. This understanding would help researchers and teachers plan and implement AI-based instructional pedagogy efficiently.

Theoretical framework

The current study is grounded in the cultural-historical theory of activity, as proposed by Leont'ev, 1978. According to this theory, human learning behavior in its context is not a single entity; rather, it's based on the three hierarchically linked levels, explained by the cultural-historical theory. Vygotsky and Luria (1992) highlighted the importance of social and cultural factors that shape learning behaviors. However, critical pedagogies, i.e., Freire (1972) and Engestrom (1987), emphasized the role of learning behavior in the creation of new educational practices. Learning behavior with respect to AI of individuals is explained by a model proposed by Iilkka (2018). Here, behavior is considered a socially meaningful activity directed by social, cultural, and cognitive motives. It can further be explained as activity, properly understood, requires social and inter-generational learning (p.8). This theory focuses on the why, what, and how questions related to learning behavior. In the AI context, learning AI is an activity that requires socially, culturally, and historically meaningful questions of why to learn and, at a more operational level, how, which sets the activity in concrete settings.

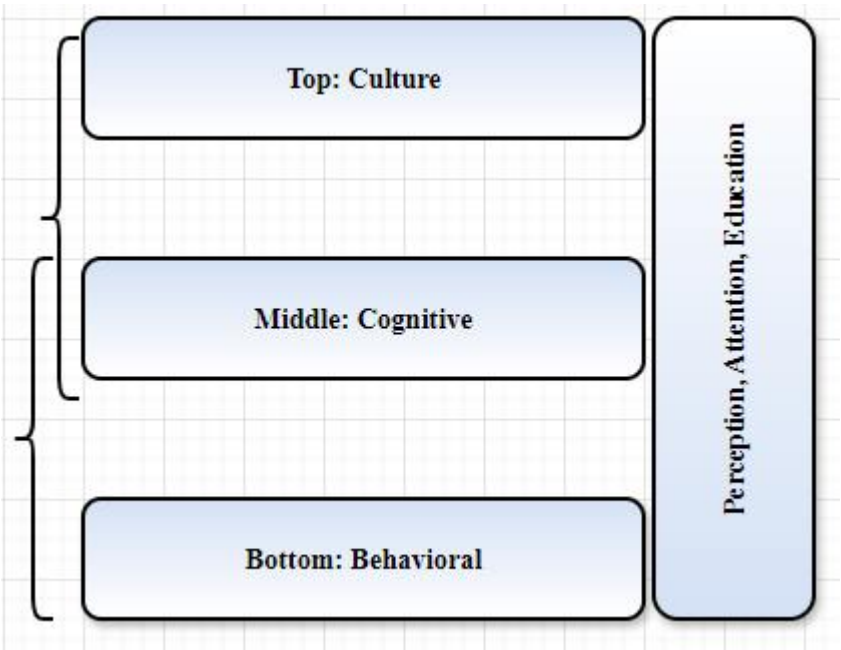


Fig. 1 Three-level model of learning behavior (Iilkka, 2018)

The three-level model provides a very useful framework for understanding artificial intelligence and its potential influence on human activities. It becomes, however, clear that different types of artificial intelligence, its awareness, and learning behavior with respect to

machine learning systems operate on different layers in this hierarchy levels (Iikka, 2018. p.10), which provides the base for the motivation to learn.

AI- Learning Behavior in relation to AI- Awareness

Learning behavior in this study is defined in terms of motivation to learn AI (Wang et al., 2022), and it is further explained by the individual engagement in a particular direction to sustain this learning. In addition, motivation theorists indicated that behavior is also related to intention, and that is determined by both intrinsic and extrinsic motivation (Teo et al.,1999). In the context of AI, learning behavior involves awareness and understanding of many specialized and complex algorithms, which causes learning anxiety for many students. The process of learning behavior has a close connection with motivation (Vallerand et al.,1992), which is the most important predictor of students' educational performance (Donnermann et al.,2021; Law et al., 2019). In a study reported by Almaiah et al. (2022), students' behavior intention to learn and use e-learning was found to be negatively correlated with computer phobia. According to Wang et al. (2022), when people have this fear that AI will replace their jobs and work, it will motivate them to learn and to gain more awareness regarding the potential applications of AI in their field. AI awareness encompasses individuals' knowledge and comprehension of AI concepts, capabilities, limitations, and potential societal impacts. It includes both general awareness and domain-specific knowledge related to AI applications. Factors affecting AI awareness include media exposure, educational resources, personal interest, and cultural context.

Law et al. (2019) emphasized that learning intention is the ability to achieve a specific task with the goal of improving or developing an ability in a specific subject area. Similarly, for current students, AI is expected to replace their jobs. Thus, it is indispensable for them to use resources and tools to increase their learning related to AI skills and knowledge to improve their competitiveness in the job market. Based on the theory mentioned above and the support of the studies, the researchers designed the first hypothesis.

H₁: AI Learning behavior moderates the AI Awareness of prospective teachers in ODL environment

AI- Awareness and its role in AI Anxiety

Almaiah et al. (2022) stated that AI is different from computers as it provides human-based features and personalized learning characteristics (Li et al., 2020). Syed et al. (2023) reported that there are several studies conducted internationally that show the positive impact of AI on their profession and their workflow (Reznick et al., 2020). Anyhow, Teng (2022) said that students' AI attitudes, awareness, and anxiety differed by discipline and field of specialization. Even students who were initially unperceptive towards AI have now recognized the importance of incorporating a basic understanding of AI tools into their curricula and learning practices. Neudert et al. (2020) further emphasized that there has been an extensive discussion regarding the potential ethical, emotional, social, political, and economic risks posed by AI. Green (2020) emphasized that AI technology has brought numerous challenges to life. These include but are not limited to job losses, privacy concerns, transparency, algorithmic-based biases, socio-economic inequalities, and unethical actions by using technology.

AI anxiety (AIA) is often compared with the term Technophobia (or computer phobia). However, these two terms are different in their context and usage (Ha et al., 2011). AIA is believed to evaluate learner's perceptions regarding the use of AI technology for various purposes. Any undesirable feelings related to AI technology and its application have a negative impact on the successful development of AI tools and resources (Wang et al., 2022). Therefore, it is important to identify the perceived AI anxiety and minimize it to expand the use of AI for future users. Artificial intelligence anxiety (AIA) is being rigorously investigated in recent literature due to its widespread application across the globe. As per Kaya et al. (2022), the phrase "Artificial Intelligence Anxiety" refers to feelings of fear about out-of-control AI (Johnson & Verdicchio, 2017). Based on prior anxiety studies conducted in the AI field, AIA may be defined as an overall affective response of anxiety or fear that inhibits an individual from interacting with AI. It is further explained by the individuals' lack of confidence in learning a difficult subject (Wang et al., 2022, p.3). The increased number of emerging AI tools makes it difficult for students to grasp all technologies, thus creating a gap between individual knowledge and skills, hence generating AI anxiety (Khasawneh, 2018). Another comprehensive study involving 154,192 participants from 142 countries, as reported by Neudert et al. (2020), found that many



individuals are anxious about the potential risks of using AI, thus providing the base for the second hypothesis.

H₂: AI Awareness helps in decreasing/minimizing the AI anxiety of prospective teachers in an ODL environment

AI Adaption in Pakistan

The use of AI in teaching-learning, particularly in Pakistan, is in its infancy. The education system of Pakistan is criticized for using traditional pedagogy, teacher-centered approaches, and paper-based assessment techniques. However, the infusion of technology with pedagogy has created many innovative approaches for teachers and students to create interactive learning experiences. The widespread use of ChatGPT tools (Amjad et al., 2024) and its affiliated applications has created a buzz in the education community, particularly for students and teachers. In their study on Pakistani university students, they investigated the mediating role of ChatGPT on M-learning and students’ performance and found positive responses. Kalhoro (February 15, 2024) said that in May 2023, the Ministry of Information Technology and Telecommunication published the first draft of a national Artificial Intelligence (AI) policy document for Pakistan. Under the banner of Digitalize Pakistan, the draft national Artificial Intelligence policy aims to raise awareness among the public on AI, work on developing the existing workforce, invest in R&D, and develop a regulation framework and ethical practices across all disciplines. However, this study aimed to provide insights into how prospective teachers' learning behaviors regarding artificial intelligence moderate AI awareness and AI anxiety in the Pakistani context, which is the most researched area so far.

Conceptual Framework

This theoretical framework aims to explore how teachers' AI learning behavior moderates the relationship between AI awareness and

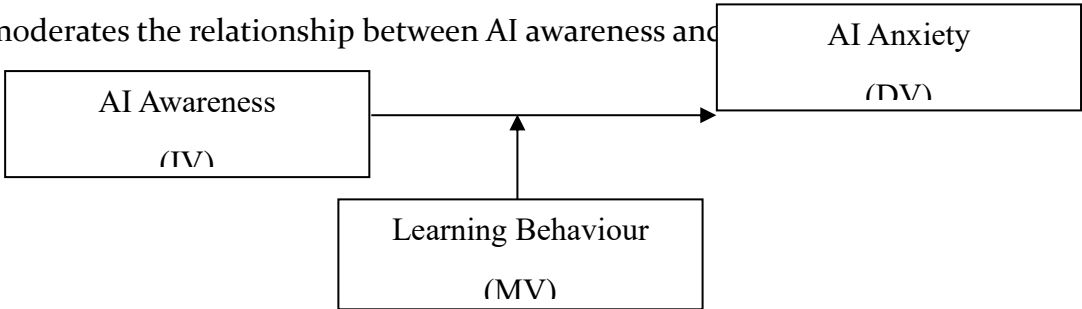


Figure 2. Conceptual framework of variables

Methodology

A cross-sectional study using the correlational method was conducted to investigate the moderating effect of AI Learning behavior on AI awareness and anxiety. Spector (2019) stated that a cross-sectional design is the best design for measuring status.

Study Participants

All the students enrolled in Spring 2023 from the first semester to the final year in the Faculty of Education were invited to participate in the study. A total of n=1019 students participated in this study. Demographic information of participants is provided below in Table 1.

Table 1. Distribution of sample (1019)

Variables	Category	(f)	%
Gender	Male	200	19.6
	Female	819	80.4
Education	Bachelor	443	43.5
	Masters	502	49.3
	Mphil	65	6.4
	PhD	9	0.9
Total	-	1019	100

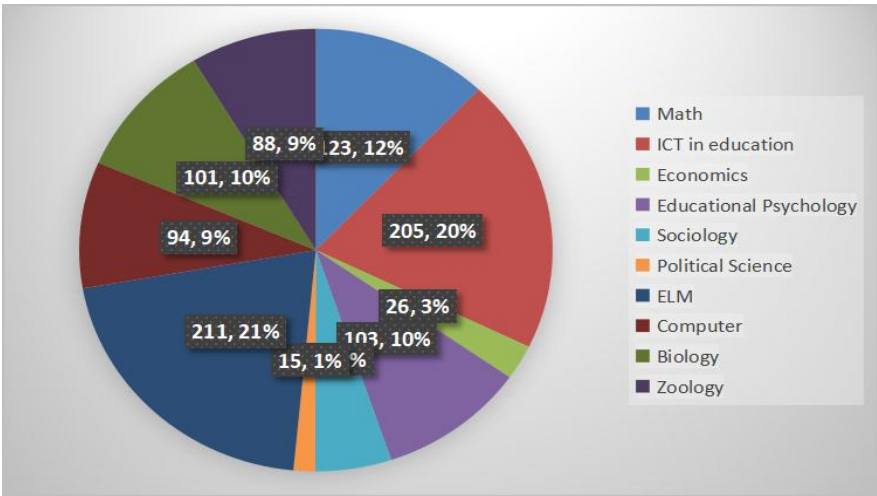


Fig 3. Area of Specialization of prospective teachers (n=1019)

Fig 4. Distribution of male and female with respect to Area of Specialization of prospective teachers (n=1019)

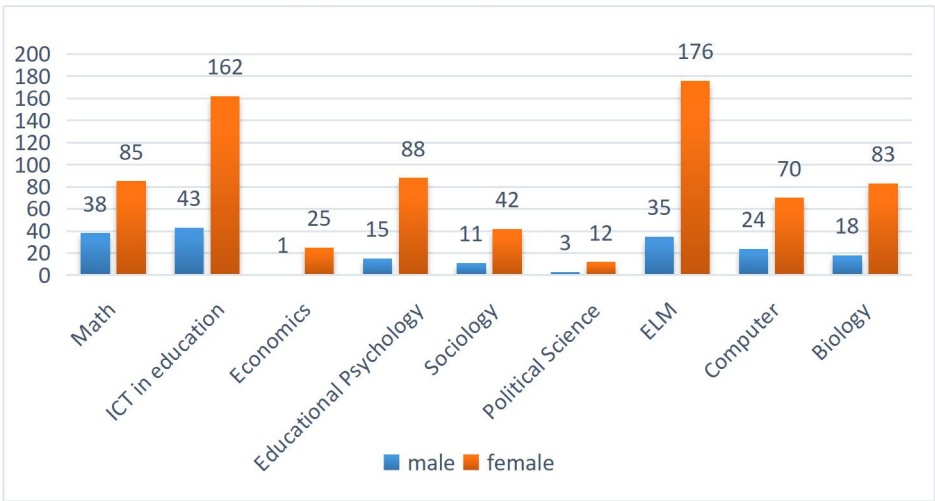


Table 2 (i-vi) reports prospective teachers' perceptions regarding their AI awareness. The majority (89%) of the respondents are aware of the AI term and consider it will replace their work/job (67%). Half of the respondents use the AI application (49.6%) or product, and most of the participants did not receive any formal qualification regarding AI (51. %).

Table 2. AI Awareness of prospective teachers (n=1019)

Do you know the term Artificial Intelligence (AI)	Frequency	Percent
YES	905	88.8
NO	111	10.9
Any comments	3	0.3
Do you think that AI may replace work content	Frequency	Percent
yes	690	67.7



No	329	28.9
Have you previously used an AI application or product?	Frequency	Percent
yes	505	49.6
No	514	50.3
Have you previously developed AI products or applications?	Frequency	Percent
yes	188	18.4
No	831	81.5
Have you previously interacted with Robots/ AI products?	Frequency	Percent
yes	406	39.8
No	610	59.9
Any comments	3	0.3
Have you received any formal education about AI?	Frequency	Percent
yes	255	25
No	526	51.6
Through seminars and presentations	71	7
Received training through the internet	167	16.4
Total	1019	100

Instrumentation

To collect the data, standardized questionnaires were used in this research. The questionnaire has four sections. The first section

was about the socio-demographic characteristics of the respondents. The second section was regarding the AI awareness of prospective teachers. For this purpose, Syed's (2023) Al-



Awareness questionnaire was adapted and modified as per the objectives and requirements of the study. For the current study, 16 items related to AI-awareness were used. Nine items were based on a five-point Likert scale (Strongly disagree to agree), while six items were dichotomous (Yes, No). However, 1 item related to training has four options. The third section of the questionnaire was adopted by (Wang and Wang, 2019; Trezi, 2020) to measure individuals’ anxiety about AI. The scale consists of 21 items and has four sub-factors: AI Learning Anxiety (8 items), Job Replacement Anxiety (6 items), Sociotechnical Blindness (4 items), and AI Configuration Anxiety (3 items). The fourth section of the questionnaire measured AI Learning Behavior. It is adapted from Wang et al. (2022) and consists of two sub-factors as AI-Learning Intension (3 items) and AI- Learning Behavior (14 items).

Reliability and validity of Instrument

After finalizing the questionnaire, it was sent to three experts (PhD in AI) and subjected to content and face validity. The feedback on a few items was taken into consideration, and the items were revised. Initially, it was a 50-item scale, which was reduced to 47. For reliability, a questionnaire was pilot-tested, and the coefficient of Cronbach alpha for internal consistency of items was measured (Martin, 2020), which is acceptable in quantitative studies and presented in Table 3.

Table 3. Reliability of the Scale

Variables	Reliability value	Number of Items
Artificial Intelligence Awareness (AIAwareness)	0.823	9
Artificial Intelligence Anxiety (AIAnxiety)	0.939	21
Artificial Intelligence Learning Behaviour (LB)	0.964	17
Scale	0.931	47

Data Collection



An online link to the questionnaire was generated and used to collect the data. The questionnaire was circulated from July to September 2023, and multiple reminders were sent to students to get the maximum participation. Ethical concerns regarding consent and anonymity were considered, and students were assured to keep using their information for research purposes only.

Data Analysis

The dataset was screened for missing data and outliers and examined for normal distribution and collinearity (Field, 2013). The data was found to be normal, and no missing items were found. After viewing the graphs resulting from normality tests, the data were analyzed further.

Descriptive analysis

The data were analyzed descriptively, and the mean scores, standard deviations, and frequencies were calculated. The mean score on each item was above 3.0, which meant that the responses agreed with the variables. The mean and standard deviation of each variable are presented in Table 4.

Table 4. Mean and Standard deviation of variables

Variables	Mean	SD
Artificial Intelligence Awareness (AI awareness)	3.83	0.58
Artificial Intelligence Anxiety (AI Anxiety)	3.23	0.72
Factor-I- Learning	3.12	0.82
Factor-II-Job Replacement	3.56	0.90
Factor-III- socio-technical blindness	3.53	0.90
Factor-IV- AI configuration	3.24	0.93

Learning Behaviour (LB)		
Factor 1-Learning Intention	3.64	.87
Factor 1-Learning Behaviour	3.34	.72

Hypotheses testing

The coefficient of moderation was applied to find out the role of moderating variable (AI Learning Behaviour) on the AI awareness and AI anxiety

Table 5. Model Summary

R	R-sq	MSE	F	df1	df2	p
0.4046	0.1637	0.4940	66.2343	3.0000	1015.0000	.0000

The model was applied through regression in SPSS version 23.0. The results displayed in Table 5 indicate that the model is successful to 16.37% (R sq. = .1637), meaning thereby, the role of Artificial Intelligence Learning Behavior moderates the correlation between artificial intelligence awareness (AIA) and artificial intelligence anxiety (AIA). This moderation is significant ($p < 0.001$).

Table 6. Coefficient of moderation

Model	coeff	se	t	p	LLCI	ULCI
constant	5.9563	.5623	10.5925	.0000	4.8528	7.0597
S_Fit04	-1.1091	.1726	-6.4268	.0000	-1.4478	-.7705
S_AIA	-.7462	.1336	-5.5834	.0000	-1.0085	-.4839
Int_1	.3348	.0411	8.1393	.0000	.2541	.4155

SE= Standard Error, LCL = Lower Confidence Limit, UCL = Upper Confidence Limit

Table 6 reflects that the moderator variable, artificial Intelligence Learning behavior, significantly moderates the correlation between Artificial intelligence awareness and anxiety. The table also shows that as the moderator increases, the moderating effect also increases.

The coefficient value increases from -1.1091 to -.7462 and then to a positive .3348 value. The t values also change from -1.4478 to -1.0085 and then to a positive .2541, respectively. All these values are significant at $p < 0.001$.

Discussion

Artificial Intelligence (AI) has become an integral part of modern society, influencing various aspects of human life. As AI technologies continue to evolve, it is crucial to understand the relationship between AI learning behavior, AI awareness, and AI anxiety. To the best of our knowledge, this is the first kind of study in Pakistan that aimed to explore the awareness, anxiety, and role of AI learning behavior in moderating their relationship. As there is no evidence of similar studies in the education sector, the findings are compared with the other domains to consolidate the findings.

The findings of this study reported that artificial intelligence would reduce the

AI reduces the workforce (67%), as reported by Jha et al. (2022) and (Syed & Al-Rawi, 2023). Furthermore, it is interesting to note that prospective teachers have high self-perceived AI awareness (mean 3.83), which is subsequently required to show reduced AI anxiety. However, for this study, a slightly higher anxiety level (mean=3.23) was also reported by the prospective teachers, which shows there is a need to investigate these constructs with different populations. The highest mean was found for AI anxiety factors -ii and iii (job replacement and sociotechnical blindness with mean=3.56, 3.53), which shows prospective teachers' concerns regarding their job replacement and unethical use of AI malfunction.

On a more systemic level, AI will have a profound impact on education systems. This is not because of any specific characteristics of AI; Instead, AI is one expression of an ongoing broader transformation that results from digitalization, global real-time networking of communication and production, and automation of productive processes (IHKKA, 2018). The study results indicate that learning behavior in an artificial intelligence environment plays a significant moderator effect in the correlation of artificial intelligence

awareness and artificial intelligence anxiety, and guided application of AI is required at all levels. There is a need to further elaborate on the data. The data collection for this research was limited to a particular online university. This remains a limitation of this study. Further studies with larger sets of data widespread across different regions of Pakistan may indicate different results. Cross-tabulation with different faculties might produce different results.

The use of technology and the penetration of information technology (IT) in a country also paves the way for the acceptability and readiness of new concepts in the field of Ed-tech. Hence, it is only a matter of time before concepts such as artificial intelligence will surface in the education sector of Pakistan and all developing countries.

Limitation

Although this study is ordinal in terms of showing the moderating role of AI learning behavior in the relationship between AI awareness and AI anxiety, the research has a few limitations. Firstly, it is a cross-sectional study and depends on the self-perceived awareness and anxiety level of prospective teachers only in ODL. In addition, studies could be carried out by conducting qualitative research techniques and including other stakeholders. Lastly, the generalizability of the study is possible for Pakistan; this study may be repeated with student-teachers from other countries and even with different variables.

Conclusion and recommendations

The study reveals that learning behaviour significantly moderates the correlation between artificial intelligence and artificial awareness. The more the trend of online education increases, the more learning behaviors of the learners will develop. Once the learning behavior is developed, the artificial intelligence anxiety will start decreasing gradually. The scope of this study was totally quantitative; it is recommended to add semi-structured interviews of a few learners to identify the learning behaviors and patterns. The more awareness is spread, the more anxiety levels will be reduced. The researchers recommend a longitudinal study to examine the real effect of learning behaviors on awareness and anxiety related to artificial intelligence. The sooner education institutions shift towards artificial intelligence the sooner it will help them improve the learning outcomes of their students.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper. They have not reported any financial or personal relationships with individuals or organizations that could influence the research.

Data availability statement

The data supporting the findings of this study are available upon reasonable request to the corresponding author.

References

- Almaiah, M. A., Alfaisal, R., Salloum, S. A., Hajje, F., Thabit, S., El-Qirem, F. A., & Al-Maroo, R. S. (2022). Examining the impact of artificial intelligence and social and computer anxiety in e-learning settings: Students' perceptions at the university level. *Electronics*, 11(22), 3662.
- Amjad, A. I., Aslam, S., & Tabassum, U. (2024). Tech-infused classrooms: A comprehensive study on the interplay of mobile learning, ChatGPT and social media in academic attainment. *European Journal of Education*, 00, e12625. <https://doi.org/10.1111/ejed.12625>
- Ayanwale, M. A., Sanusi, I. T., Adelana, O. P., Aruleba, K. D., & Oyelere, S. S. (2022). Teachers' readiness and intention to teach artificial intelligence in schools. *Computers and Education: Artificial Intelligence*, 3, 100099.
- Brooks, C. (2019). Introductory econometrics for finance. Cambridge university press.
- Chiu, T. K. (2021). A holistic approach to the design of artificial intelligence (AI) education for K-12 schools. *Tech Trends*, 1–12.
- Cohen, T., & Jones, P. (2020). Technological advances relevant to transport understanding what drives them. *Transportation Research Part A: Policy and Practice*, 135, 80–95.
- Darko, A., Chan, A. P., Adabre, M. A., Edwards, D. J., Hosseini, M. R., & Ameyaw, E. E. (2020). Artificial intelligence in the AEC industry: Scientometric analysis and visualization of research activities. *Automation in Construction*, 112, 103081.
- Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., ... & Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, 57, 101994.

- Donnermann, M., Lein, M., Messingschlager, T., Riedmann, A., Schaper, P., Steinhäusser, S., & Lugin, B. (2021). Social robots and gamification for technology supported learning: An empirical study on engagement and motivation. *Computers in Human Behavior*, 121, 106792.
- Engeström, Y. (1987). *Learning by Expanding: An Activity Theoretical Approach to Developmental Work Research*. Orienta Konsultit.
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. sage.
- Fong, M., Dodson, S., Harandi, N. M., Seo, K., Yoon, D., Roll, I., & Fels, S. (2019). Instructors desire student activity, literacy, and video quality analytics to improve video-based blended courses. In *Proceedings of the Sixth (2019) ACM Conference on Learning@ Scale* (pp. 1–10).
- Freire, P. (1972). Education: domestication or liberation?. *Prospects*, 2(2), 173–181.
- Gansser, O. A., & Reich, C. S. (2021). A new acceptance model for artificial intelligence with extensions to UTAUT2: An empirical study in three segments of application. *Technology in Society*, 65 (101535)
- Goel, A. K., & Polepeddi, L. (2016). *Jill Watson: A virtual teaching assistant for online education*. Georgia Institute of Technology.
- Green, B. P. (2020, August 18). Artificial intelligence and ethics: Sixteen challenges and opportunities. Markkula Center for Applied Ethics at Santa Clara University. <https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/>
- Ha, J. G., Page, T., & Thorsteinsson, G. (2011). A study on technophobia and mobile device design. *International Journal of Contents*, 7(2), 17–25.
- Ilkka, T. (2018). *The impact of artificial intelligence on learning, teaching, and education*. European Union.
- Hwang, G. J., Xie, H., Wah, B. W., & Gašević, D. (2020). Vision, challenges, roles and research issues of Artificial Intelligence in Education. *Computers and Education: Artificial Intelligence*, 1, 100001.
- Jackson, R. (2019). Pros and cons of robots in the workplace. <https://adviserplus.com/insights/pros-and-cons-of-robots-in-the-workplace/>

- Jha, P., Deshmukh, Y., Tumbe, C., Suraweera, W., Bhowmick, A., Sharma, S., ... & Brown, P. (2022). COVID mortality in India: National survey data and health facility deaths. *Science*, 375(6581), 667-671.
- Johnson, D. G., & Verdicchio, M. (2017). AI anxiety. *Journal of the Association for Information Science and Technology*, 68(9), 2267-2270.
- Kalhor, N.A. (February 15, 2024) Artificial Intelligence and National Security: A Way Forward for Pakistan (<https://www.paradigmshift.com.pk>)
- Kaya, F., Aydin, F., Schepman, A., Rodway, P., Yetişensoy, O., & Demir Kaya, M. (2022). The Roles of Personality Traits, AI Anxiety, and Demographic Factors in Attitudes toward Artificial Intelligence. *International Journal of Human Computer Interaction*, 1-18.
- Khasawneh, O. Y. (2018). Technophobia: Examining its hidden factors and defining it. *Technology in Society*, 54, 93-100.
- Kwak, Y., Ahn, J. W., & Seo, Y. H. (2022). Influence of AI ethics awareness, attitude, anxiety, and self-efficacy on nursing students' behavioral intentions. *BMC nursing*, 21(1), 1-8.
- Law, K. M. Y., Geng, S., & Li, T. (2019). Student enrollment, motivation and learning performance in a blended learning environment: The mediating effects of social, teaching, and cognitive presence. *Computers & Education*, 136, 1-12.
- Li, J., & Huang, J. S. (2020). Dimensions of artificial intelligence anxiety based on the integrated fear acquisition theory. *Technology in Society*, 63, (101410).
- Luan, H., Geczy, P., Lai, H., Gobert, J., Yang, S. J. H., Ogata, H., Baltes, J., Guerra, R., Li, P., & Tsai, C.-C. (2020). Challenges and future directions of big data and artificial intelligence in education. *Frontiers in Psychology*, 11, 580820).
- Leont'ev, A.N. 1978. Activity, Consciousness, and Personality. Prentice-Hal.
- Luria, A.R., and L. Vygotsky. 1992. Ape, Primitive Man, and Child: Essays in the History of Behavior. Harvester Wheatsheaf
- Manyika, J., Lund, S., Chui, M., Bughin, J., Woetzel, J., Batra, P., Ko, R., & Sanghvi, S. (2017). Jobs lost, jobs gained: Workforce transitions in a time of automation. McKinsey Global Institute. Luria
- Neudert, L. M., Knuutila, A., Howard, P. N. (2020, October 7). Global attitudes towards AI, machine learning & automated decision making: Implications for involving artificial intelligence in public service and good governance. Oxford Internet Institute.

- Park, J. E., Park, S. Y., Kim, H. J., & Kim, H. S. (2019). Reproducibility and generalizability in radiomics modeling: Possible strategies in radiologic and statistical perspectives. *Korean Journal of Radiology*, 20(7), 1124–1137. <https://doi.org/10.3348/KJR.2018.0070>
- Rajpurkar, P., Irvin, J., Zhu, K., Yang, B., Mehta, H., Duan, T., ... & Ng, A. Y. (2017). Chexnet: Radiologist-level pneumonia detection on chest x-rays with deep learning. *arXiv preprint arXiv:1711.05225*.
- Reznick, R. K., Harris, K., Horsley, T., & Hassani, M. S. (2020). Task force report on artificial intelligence and emerging digital technologies. *R Coll Physicians Surg Canada*, 2020, 1–52.
- Reinhart, R. J. (2018, March 6). Most Americans already using artificial intelligence products. Gallup
- Sander, G., & Keller, N. J. (2021). McKinsey Gender Parity Report. In *Handbook on Diversity and Inclusion Indices* (pp. 164–175). Edward Elgar Publishing.
- Seo, Kyoungwon, Joice Tang, Ido Roll, Sidney Fels, and Dongwook Yoon. (2021) "The impact of artificial intelligence on learner-instructor interaction in online learning." *International journal of educational technology in higher education* 18 (1), 1–23.
- Seo, K., Tang, J., Roll, I. et al. (2021). The impact of artificial intelligence on learner-instructor interaction in online learning. *International Journal of Educational Technology in Higher Education*, 18, 54 <https://doi.org/10.1186/s41239-021-00292-9>
- Spector, P. E. (2019). Do not cross me: Optimizing the use of cross-sectional designs. *Journal of Business and Psychology*, 34(2), 125–137. <https://doi.org/10.1007/S10869-018-09613-8/METRICS>
- Stephanidis, C., Salvendy, G., Antona, M., Chen, J. Y. C., Dong, J., Duffy, V. G., Fang, X., Fidopiastis, C., Fragomeni, G., Fu, L.P., Guo, Y., Harris, D., Ioannou, A., Jeong, K-a. (., Konomi, S., Krömker, H., Kurosu, M., Lewis, J. R., Marcus, A., ... Zhou, J. (2019). Seven HCI grand challenges. *International Journal of Human-Computer Interaction*, 35(14), 1229–1269.
- Syed, W., & Basil A. Al-Rawi, M. (2023). Assessment of Awareness, Perceptions, and Opinions towards Artificial Intelligence among Healthcare Students in Riyadh, Saudi Arabia. *Medicina*, 59(5), 828.

- Tai, M. C. T. (2020). The impact of artificial intelligence on human society and bioethics. *Tzu Chi Medical Journal*, 32(4), 339–343. https://doi.org/10.4103/tcmj.tcmj_71_20
- Teo, T. S., Lim, V. K., & Lai, R. Y. (1999). Intrinsic and extrinsic motivation in Internet usage. *Omega*, 27(1), 25–37.
- Teng, M., Singla, R., Yau, O., Lamoureux, D., Gupta, A., Hu, Z., & Field, T. S. (2022). Health care students' perspectives on artificial intelligence: countrywide survey in Canada. *JMIR medical education*, 8(1), e33390.
- Terzi, R. (2020). An adaptation of artificial intelligence anxiety scale into Turkish: Reliability and validity study. *International Online Journal of Education and Teaching (IOJET)*, 7(4). 1501-1515
- Vallerand, R. J., Pelletier, L. G., Blais, M. R., Briere, N. M., Senecal, C., & Vallieres, E. F. (1992). The academic motivation scale: A measure of intrinsic, extrinsic, and amotivation in education. *Educational and Psychological Measurement*, 52(4), 1003–1017
- Wang, Y. Y., & Wang, Y. S. (2022). Development and validation of an artificial intelligence anxiety scale: An initial application in predicting motivated learning behavior. *Interactive Learning Environments*, 30(4), 619–634.]
- Wang, Y. M., Wei, C. L., Lin, H. H., Wang, S. C., & Wang, Y. S. (2022). What drives students' AI learning behavior: A perspective of AI anxiety. *Interactive Learning Environments*, 1–17.
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1),
- Zhang, B., & Dafoe, A. (2019, January 9). Artificial intelligence: American attitudes and trends. SSRN. <https://doi.org/10.2139/ssrn.3312874> [Google Scholar]
- Zhang, K., & Aslan, A. B. (2021). AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence*, 2, 100025.

