Artificial Intelligence in Educational Technology: Transforming Learning Culture in the Digital Age

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HOW TO CITE:

Yuk Fong Chin*, Desmond Cherng En Lee, Karthik Kaushik, Atal Bihari Tripathy, Rishi Raj Balwaria, Ruttuja Karkhanis More (2026). Artificial Intelligence in Educational Technology: Transforming Learning Culture in the Digital Age. International Journal of Special Education, 41(17s), 883-892

ABSTRACT:

Artificial intelligence (AI) is becoming a big part of educational technology, impacting various facets of student access to information, academic work, and digital learning. This study examined AI-related performance expectations, perceived challenges, attitudes, perceptions, and motivation among higher education students and identified the factors predicting motivation and intention to use AI for learning. A quantitative cross-sectional design was applied to secondary survey data from 535 higher education students in Indonesia. Five constructs were measured using 39 four-point Likert-scale items. Descriptive statistics, Cronbach's alpha, Pearson correlation, and multiple linear regression with HC3 robust standard errors were employed for analysis. Performance Expectations recorded the highest mean score ($M = 3.055$, $SD = 0.576$), whereas Challenges of AI Use had the lowest ($M = 2.459$, $SD = 0.661$). All constructs were positively correlated. Motivation and Intention showed the strongest associations with Attitudes Toward AI ($r = 0.663$) and AI Use Perceptions ($r = 0.619$). The regression model explained 55.3% of the variance in motivation and intention. Attitudes Toward AI ($\beta = 0.370$), AI Use Perceptions ($\beta = 0.304$), and Performance Expectations ($\beta = 0.211$) significantly predicted motivation, whereas AI Use Challenges did not. The results emphasize the need for a positive attitude, positive perception, and perceived educational benefits as factors in creating an AI learning culture.

Keywords: artificial intelligence, educational technology, higher education, learning culture, student motivation

1. Introduction

AI has become one of the most powerful and transformative tech innovations in today's education. Educational technologies have evolved from traditional digital products to adaptive learning platforms that enable personalised learning, automated evaluations and data-driven decision-making processes, all driven by the rapid progress in machine learning, natural language processing and intelligent automation. The use of AI in education has grown significantly, driven by the overall process of digitalization that aims at enhancing the quality of education, access to education, and educational outcomes in various spaces of learning (Chen et al., 2020). AI-based education systems can use their modelling of learner behavior to make personalized suggestions, and can even help learners in real-time learning (Zhai et al., 2021), transforming education technology from content dissemination to smart learning environments that support and respond to learners' learning needs and learning preferences. In the field of education, AI is becoming a major driver of change by supporting learning through intelligent tutoring systems and adaptive learning platforms, and through automated feedback and generative AI applications, which are all being used to augment teaching methods and learning analytics (Harry & Sayudin, 2023). The surge in educational technology has ushered in pedagogical strategies that actively involve AI in the learning process instead of using it merely as a tool. In order to achieve learning while innovating, human-centred AI, learner-AI collaboration, and intelligent educational ecosystems have become more and more the focus of attention of institutions (Ouyang & Jiao, 2021). The growing trend of online and blended learning has driven increased institutional investment in AI-driven technologies, resulting in a pivotal role for educational technology in digital transformation efforts to enhance student learning and student-centred learning (Limna et al., 2022). Concurrently, transparency, fairness, privacy, and responsible use concerns have shed light on the need for trustworthy AI, where trustworthiness of the technology is key to students' willingness to use it, and is a pre-condition of its educational value (Vincent-Lancrin & Van der Vlies, 2020).

The existing studies have shown how AI has been integrated into education and its impact. The previous studies have proved that AI has been firmly embedded in education technology, shaping teaching methods, digital learning settings, and educational advancement. With interactive learning, resource management and tailored learning experiences, intelligent features are now a strategic part of digital education (Selwyn et al., 2020). In the realm of higher education, AI-powered tools have enabled libraries, learning management platforms, and institutional digital environments to each reach beyond their current capacities, fostering greater accessibility to knowledge and enriching students' learning journey (Kumar et al., 2024). Further, entrepreneurial innovations in educational technology have initiated adaptive learning platforms and scalable AI-powered learning services that have increased the engagement of students and enhanced the quality of instruction (Ip, 2024).

One of the most researched results of the use of AI is student engagement. The current literature confirms that the use of intelligent education systems can help to motivate students to learn, encourage collaborative learning and facilitate participation as a result of providing personalized guidance and timely feedback, but the effectiveness of such systems is dependent on the students' perception and

attitude towards the AI-supported learning environment (Nguyen et al., 2024). Recent analyses support the continuing advancement of the application of AI in higher education and the interest in the potential impact of intelligent technologies on learning behaviour and educational outcomes (Chen et al., 2025). AI's use in education, spanning from teaching to assessment and institutional decision-making, has been documented as significant, with a need for effective pedagogical integration along with technological development to achieve meaningful transformation in education (Zawacki-Richter et al., 2019). More recent reviews also identify the rise of generative AI, adaptive learning systems, and intelligent education assistants to support personalized learning and the need to focus on

students' behavioural responses towards AI implementation (Crompton, 2023). Furthermore, the use of intelligent assistants that offer personalized recommendations and adaptive support illustrates the positive effects of positive expectations, favourable attitudes, and strong motivation on the effectiveness of learning (Sajja et al., 2024).

While studies have already confirmed the educational value of AI in either technological innovation, pedagogical use, or student engagement, the majority have focused on one aspect of AI at a time. Comparatively less research has been conducted on the relationship among performance expectation, perceived challenge, attitude, perception, and motivation within a single empirical framework to explain students' motives toward learning in HEIs' implementation of AI in higher education. Furthermore, very few studies have explored how these behavioural factors are involved in the process of cultivation of learning culture through educational technology. Filling these gaps can contribute to a more holistic view of how AI is being used in today's higher education landscape.

The purpose of the present study is to explore students' expectations for performance, perceived challenges, attitudes, perceptions and motivation for the introduction of artificial intelligence in higher education. It also aims to explore the interactions between these constructs and identify the ones that can significantly predict students' motivation and intention to employ AI in learning.

2. Methodology

2.1 Research Design

The present study used a quantitative cross-sectional research design to investigate factors that influenced the adoption of artificial intelligence (AI) in higher education and the connections of these factors with students' motivation and intention to use AI tools for learning. The design was suitable because it allowed for the measurement of several constructs related to AI through a structured questionnaire administered at a single time point. The analytical framework was designed to assess students' learning outcomes expectations, perceived challenges, attitudes, perceptions, and motivation in relation to understanding the contribution of these to the learning culture in the digital age.

2.2 Data Source

The dataset used in the study was a public dataset developed by Prasetiyo (2025) that includes responses to questionnaires from students who are studying in higher education institutions in Indonesia. The dataset was specially created to gauge the adoption of AI by capturing the expectations, attitudes, perceptions, challenges with using AI, and motivations of students through standardized items using the Likert scale. After screening and cleaning of data, 535 valid responses were retained for statistical analysis. Information from the data set and documentation was adequate to enable quantitative analysis and construction-based modeling in a reproducible way.

2.3 Variables and Measurement

The five latent constructs were investigated in this study. The Performance Expectations were measured with 20 items in the questionnaire, Challenges of AI Use were measured with 4 items, Attitudes Toward AI were measured with 5 items, AI Use Perceptions were measured with 5 items, and Motivation and Intention to Use AI were measured with 5 items. The items on the questionnaires were all on a four-point Likert scale ranging from lower to higher levels of agreement. Data were

cleaned, and the scores for constructs were obtained by taking the average of the items, with higher scores reflecting greater agreement with the construct.

2.4 Data Preparation

The data were systematically checked for quality before analysis. Participants who did not respond were removed to ensure only valid participant responses remained. Observations that were duplicated were omitted, and the answers that were not in the range of the questions were considered missing. Minimal but acceptable numbers of responses were missing from the scale after cleaning, so only construct scores were calculated when the minimum number of valid responses was available for each construct. Data

were then cleaned and used in all statistical analyses.

2.5 Statistical Analysis

Means, standard deviations, medians, and response distributions were computed to summarize participants' responses. Cronbach's alpha was used to evaluate the internal consistency for each construct. Pearson correlation analysis was used to explore the relationships between the study constructs. Multiple linear regression analysis using HC3 heteroskedasticity-consistent standard errors was then conducted to determine the factors predicting students' motivation and intention to use AI. The level of multicollinearity was checked by variance inflation factors (VIF) and tolerance statistics, and model adequacy was checked by coefficient of determination (R2), adjusted R2, F-statistic and residual diagnostics. A $p < 0.05$ was used as the criterion for statistical significance.

3. Results

3.1 Descriptive Statistics and Reliability of the Study Constructs

Descriptive analysis was performed on the responses of 535 students and sample sizes for the constructs ranged from 532 to 534 because of very few missing responses. The results showed that the Cronbach's alpha in all the constructs ranged from 0.672 to 0.957, which is acceptable to excellent reliability. The students generally showed that they believed that artificial intelligence (AI) helped enhance their learning experience, as indicated by the highest mean score for the category of performance expectations ($M = 3.055$, $SD = 0.576$). In contrast, the lowest mean score was found for Challenges of AI Use ($M = 2.459$, $SD = 0.661$), reflecting relatively low levels of agreement regarding barriers related to AI use. The mean scores for all three subscales of this questionnaire (Attitudes Toward AI, Motivation and Intention, and AI Use Perceptions) were moderate-to-high. Overall, the reliability coefficients validated the reliability of measurement of each construct for the questionnaire.

Table 1. Descriptive Statistics and Reliability of the Study Constructs

Construct	N	Items	Mean	SD	Median	Minimum	Maximum	Cronbach's α
Performance Expectations	534	20	3.055	0.576	3.0	1.0	4.0	0.957
Challenges of AI Use	533	4	2.459	0.661	2.5	1.0	4.0	0.713
Attitudes Toward AI	532	5	2.870	0.616	3.0	1.0	4.0	0.833
AI Use Perceptions	534	5	2.667	0.572	2.6	1.0	4.0	0.672
Motivation and Intention	534	5	2.754	0.649	2.8	1.0	4.0	0.859

The highest average score was for the construct Performance Expectations, while the lowest mean was for the construct Challenges of AI Use (Figure 1A). The responses were clustered around the moderately high level for each construct as shown in Figure 1B, where Performance Expectations had the highest percentage of highly positive responses.

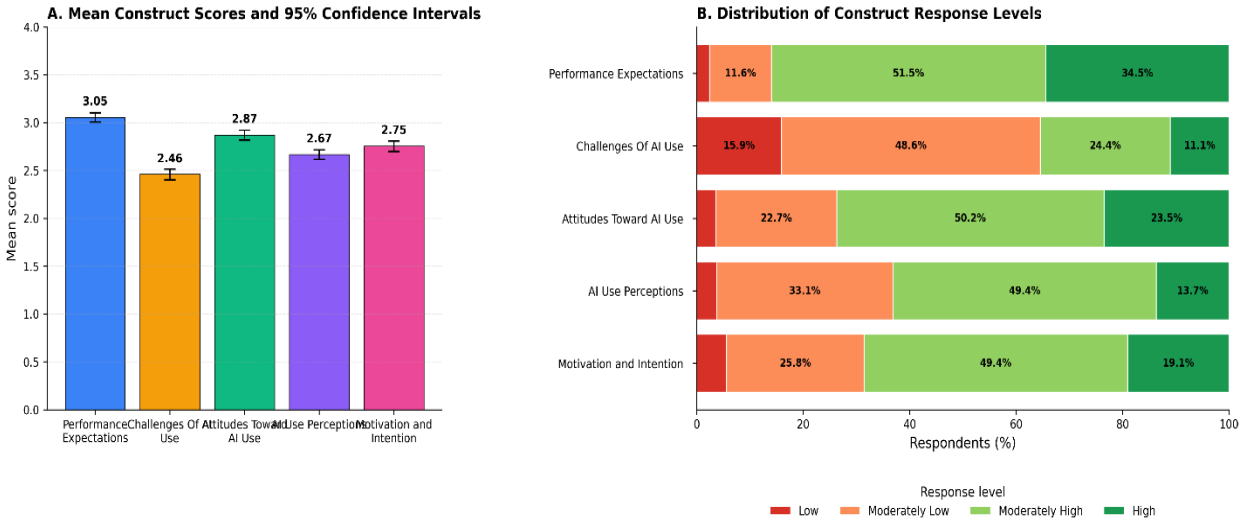

Figure 1. Student Responses Across Artificial Intelligence Learning Constructs (A) Mean Construct Scores and 95% Confidence Intervals (B) Distribution of Construct Response Levels

3.2 Correlation Analysis Among the Study Constructs

The statistically significant positive relationships between all the study constructs as revealed by Pearson correlation were statistically significant ($p < 0.001$). The correlations among the different scales showed the highest correlation between Attitudes Toward AI and Motivation and Intention ($r = 0.66$), meaning that the more positive attitudes towards AI were linked to greater intent to continue using AI technologies for learning. The positive relationships for the items of AI Use Perceptions were also fairly strong, with Motivation and Intention ($r = 0.62$) and Performance Expectations ($r = 0.56$) following. Challenges of AI Use, however, had relatively low but still positive correlations with all of the other constructs ($r = 0.23 – 0.46$). In general, the results reveal that students with positive perceptions of AI and those who believed that it would bring more educational advantages were more inclined to show a higher level of motivation for making use of AI in their learning. The correlation matrix is also reflected in Figure 2, which visually confirms the correlations between the main constructs, including moderate to strong positive relationships between Attitudes Toward AI, AI Use Perceptions, Motivation and Intention.

Table 2. Pearson Correlations Among the Study Constructs

Construct	1	2	3	4	5
1. Performance Expectations	1.00				
2. AI Use Challenges	0.23***	1.00			
3. Attitudes Toward AI	0.56***	0.31***	1.00		
4. AI Use Perceptions	0.48***	0.46***	0.58***	1.00	
5. Motivation and Intention	0.56***	0.30***	0.66***	0.62***	1.00

Note: **$p < 0.001$

Figure 2. Relationships Among Artificial Intelligence Learning Constructs

3.3 Predictors of Motivation and Intention to Use Artificial Intelligence

A multiple linear regression analysis was conducted with HC3 to determine predictors of students' motivation and intention to use AI. The regression model was statistically significant, with an $F = 163.141$, $p < 0.001$ and $R^2 = 0.553$, adjusted $R^2 = 0.550$, indicating that the model accounted for 55.3% of the variance in the dependent variable, motivation and intention. Multicollinearity diagnostics determined no evidence of problematic collinearity, as variance inflation factor values were between 1.269 and 1.802. Attitudes Toward AI was the best predictor of motivation and intention ($B = 0.389$, $\beta = 0.370$, $p < 0.001$) among the four predictors. AI Use Perceptions also exerted a significant positive influence ($B = 0.347$, $\beta = 0.304$, $p < 0.001$), followed by Performance Expectations ($B = 0.238$, $\beta = 0.211$, $p < 0.001$). However, the perception of challenges of AI use did not independently predict motivation and intention ($B = 0.002$, $p = 0.954$), indicating that perceived challenges of AI use did not independently predict students' motivation and intention after accounting for the other predictors.

Table 3. HC3 Robust Multiple Regression Predicting Motivation and Intention to Use Artificial Intelligence

Predictor	B	HC3 SE	Standardized β	t	p	95% CI Lower	95% CI Upper	VIF	Tolerance
Performance Expectations	0.238	0.051	0.211	4.688	<0.001	0.138	0.338	1.530	0.654
AI Use Challenges	0.002	0.035	0.002	0.057	0.954	−0.066	0.070	1.269	0.788
Attitudes Toward AI	0.389	0.053	0.370	7.401	<0.001	0.286	0.493	1.775	0.563
AI Use Perceptions	0.347	0.053	0.304	6.487	<0.001	0.242	0.452	1.802	0.555

Note: HC3 SE = heteroskedasticity-consistent standard error.

Furthermore, Figure 3 presents the standardized effects of the regression model, showing that

Attitudes Toward AI, AI Use Perceptions, and Performance Expectations were significant positive predictors while Challenges of AI Use had a negligible and not statistically significant influence on students' motivation and intention to use AI.

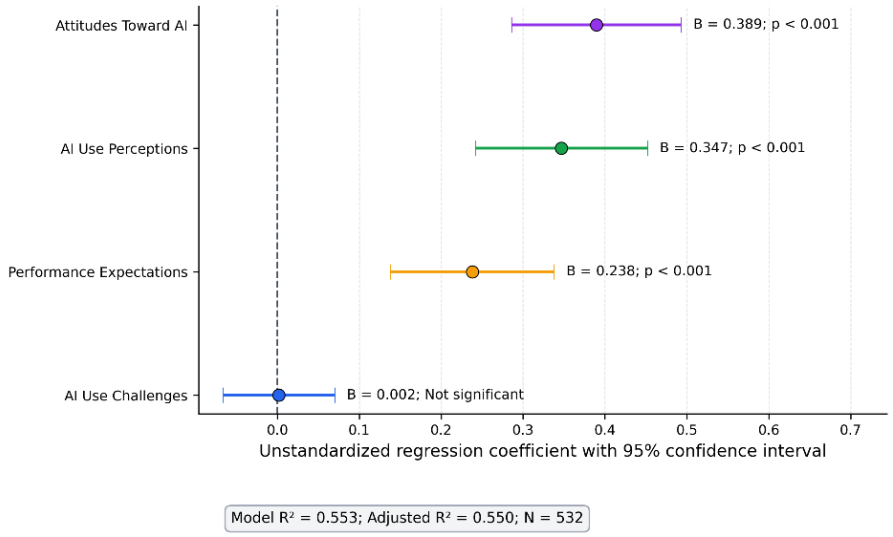

Figure 3. Predictors of Motivation and Intention to Use Artificial Intelligence

4. Discussion

The results showed that, in general, students had a positive perception of the use of AI as an educational technology that is useful in the learning process today. The highest mean score was for the Performance Expectations dimension, indicating that the respondents linked AI with better learning efficiency, access to information, educational productivity and assistance with academic tasks. The scores for the Attitudes Toward AI and Motivation and Intention were also moderately high, indicating that students were not only aware of learning opportunities with AI, but they were also interested in continuing to use AI in learning. AI Use Perceptions were moderate, indicating that students had a good awareness of the educational value of AI, but lacked some degree of concern about its overall impact in learning. The lower mean for Challenges of AI Use indicates that the challenges existed, but were not prominent in students' overall perception of the use of AI in education. The correlation analysis indicates that all the constructs were positively correlated. Attitudes Toward AI and Motivation and Intention showed the strongest association, while AI Use Perceptions and Motivation and Intention showed the next strongest association. These associations indicate that students who have a positive attitude towards AI and view it as a positive force will be more inclined to use AI for learning. Performance Expectations also showed a significant positive correlation with motivation, suggesting that the motivation to continue using the app comes from the anticipated academic benefits. The correlation between AI Use Challenges and motivation is weaker when there is clear educational value, indicating that it is not only the challenges holding students back, as they are motivated when they see the value of learning. The regression model accounted for 55.3% of the variance in Motivation and Intention, which is considered to be a well-explained behavioural study. Attitudes Toward AI were found to be the strongest predictor, followed by AI Use Perceptions and Performance Expectations. The results highlight that the most influential factors influencing preparedness for AI adoption include positive appraisal, education relevance, and potential gains. After further statistical analyses of the other predictors simultaneously, the challenges of AI Use were not significant. While technical or instructional obstacles are not inconsequential, they do not seem to have a major impact when students already have positive attitudes and believe that AI can be useful. The consistent results that have been yielded from the strong standard errors

and sensitivity analysis further enhance confidence in the relationships identified.

The findings indicate that the use of Performance Expectations plays a vital role in the overall change in teaching and learning as a result of the use of AI, which provides adaptive support, speedy feedback

and personalized educational assistance. Jackson (2024) also highlighted the role of AI in the revolution of digital-age learning, highlighting its ability to change the way students acquire and engage with knowledge. Another positive correlation exists between educational expectations and motivation, which is also the result of the convergence of pedagogy and technology. Alam and Mohanty (2023) contended that good educational technology is the combination of interactive tools, mobility, AI and pedagogical design, not the isolation of these components. What is revealed in the present findings is that students' expectations of educational benefit are directly related to their intention to use AI. The relevance of attitudes towards AI is similar to the findings that attitudes and evaluations of students with intelligent technologies are well correlated with student behaviour. Alzahrani (2023) found that students' attitudes towards the use of AI in the academic setting were highly linked to their behaviour in relation to AI. Additionally, cross-national findings indicate that student attitudes towards AI are shaped by their educational context, technological exposure, and cultural background, highlighting the importance of considering these factors when understanding students' AI acceptance (Skalka et al., 2025).

The strong predictive power of attitudes is in line with the multinational study carried out on university students' use of generative AI. Abdaljaleel et al. (2024) reported that the perception and attitude of the students were the main issues in the use of ChatGPT in various national contexts. The current findings corroborate this trend, but also show that attitudes are not only important when looking at expectations and challenges alone, but also when looking at broader perceptions. The acceptable reliability of the attitude construct is in line with that found in previous attitude measurement research. Suh and Ahn (2022) showed that student attitudes towards AI could be measured by multidimensional instruments covering the aspects of acceptance, perceived value and emotional response. The present findings also suggest that attitudes are a coherent and meaningful aspect of AI adoption. The moderate AIP and their substantial predictive role are also consistent with resistance being a factor that limits the acceptance of AI. Sánchez-Reina et al. (2023) noted that while some students were interested in ChatGPT, others were wary, indicating that students' attitudes towards AI acceptance will vary depending on how they view AI as a supportive tool. Similar trends have been observed among nursing students, with some positive attitudes towards AI but with mixed levels of confidence, as students may not be sure of the reliability, relevance, or appropriateness of its use (Asio et al., 2025). Previous studies with medical students also revealed interest in AI, along with a sense of lack of preparation and future professional implications. Pinto dos Santos et al. (2019) found that the students generally find AI to be important and are not sure about training and integration. The present findings were in a similar balance: students' expectations and motivation were favourable, but their perceptions were more moderate than expectations of their performance.

The findings have implications for universities, teachers and educational technology developers. HEIs need to build student confidence in AI by providing guidance, learning activities, and policies. Because attitudes were most strongly related to motivation, institutional policies and practices need to shift from access to AI tools to models of meaningful learning outcomes that are supported by the use of AI tools. Using AI to support real academic tasks, like formative feedback, idea development, information synthesis, and personalized practice, can enhance the adoption of AI in education. The responsible use of information, as well as information source evaluation, privacy, and academic integrity should also be covered. To gain sustained engagement, EdTech designers need to focus on the usability, transparency and learner control of the product, since positive perceptions are likely to boost engagement over time. In theory, the results

suggest a multidimensional perspective of attitudes and perceptions toward the use of AI, where attitudes and perceptions, and expected benefits, are more important in influencing behavioral intention than perceived barriers are.

Some caveats about this should be noted. The cross-sectional study design limits causal interpretation and the self-reported measures may have response bias. The findings are not necessarily generalizable to other national higher education contexts. Longitudinal studies to investigate levels of AI adoption

change over time, and the inclusion of students from other countries and academic fields in future studies are all suggested for further research. Moving forward, it would be valuable to also include the perspectives of teachers, digital competence, and institutional support, as well as the actual practices of using AI, to provide an overall picture of the impact of AI on the learning culture.

5. Conclusion

AI is quickly becoming part and parcel of educational technology and impacting the way students interact with learning in digital environments. The results indicate that positive attitudes, perceptions, and educational benefits are the primary factors influencing students' motivation and intention towards using AI. The expectations for performance were high, and the perceived challenges had no independent contribution when combined with the others. Overall, the regression model accounted for a significant amount of the variance in students' behaviors and demonstrated that barriers are not the sole influence on their acceptance of AI, but rather perceived value and confidence also play a significant role. According to these findings, universities should not restrict leveraging AI to providing tools. Adoption success needs to have pedagogical purpose, guidance, policy, and pedagogically valuable learning activities in practice. Teachers also need to promote responsible use by discussing source evaluation, privacy, academic integrity, and the responsible use of AI-generated assistance. In this context, the evidence places AI as a valuable tool in the learning culture transformation as long as it is put into practice in a learner-centred, ethically considered, and educationally beneficial way.

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